

Scope of Work and Equipment

1.1 Gas Turbine

GE LM2500 gas turbine, rated for continuous duty. Suitable for base load or peaking, designed for simple cycle, combined cycle or cogeneration service. Turbine is shock mounted and shipped in position, ready to run. Turbine is complete with "last chance" inlet screen and bellmouth seal for protection against foreign object damage.

1.2 Generator

Air-cooled generator with brushless excitation, suitable for Class 1, Group D, Division 2 areas, rated at 13,800 volts, 60 Hz / 11,500 volts, 50Hz. The generator can handle the full continuous power of the gas turbine at any ambient temperature throughout the operating range. Filtered air from the inlet air filter is used to cool the generator. A cooling water loop and its associated fans and pumps are not required. The generator is a utility grade, 2-pole, synchronous design and includes a brushless excitation system with permanent magnet generator. Neutral and lineside cubicles and voltage regulator are also included.

1.3 Coupling

The LM2500 gas turbine drives the generator with a dry, flexible-diaphragm coupling that bolts directly to the forged generator hub and the turbine output hub. No gearbox is required. The coupling transmits the full turbine load torque at all operation conditions. The coupling spacer is removed for shipment and is reinstalled at the jobsite.

1.4 Enclosure

Both gas turbine and generator are fully covered by a weatherproof acoustic enclosure. The enclosure is completely assembled and mounted over the equipment prior to testing and shipment. Both turbine and generator compartments are fully ventilated with redundant fans. Explosion-proof AC lighting and DC emergency lighting are provided in both compartments. A bridge crane in the turbine enclosure simplifies engine removal and maintenance.

1.5 Baseplate

The package is supplied with the support structures for the gas turbine generator set consisting of a two-piece skid assembly, which is sectioned between the gas turbine and the generator. The full depth, bolted section is designed to provide the full structural properties of the wide flange I-beams. Full depth cross members are utilized to provide for a rigid design that is suitable for installation in earthquake areas (IBC2000) as well as providing a convenient structure for transportation.

1.6 Inlet Air System

ProEnergy furnishes a modular, multi-stage filtration system consisting of weather hoods and inlet screens, a pre-filter and a final barrier filter. All air for ventilation systems is filtered to the same level as turbine combustion air. Optional anti-ice system, evaporative cooling system and combustion air heating or chilling system are available. Filtered air is silenced before entering the turbine plenum.

This compact arrangement eliminates the need for customer-supplied inlet ducting when the standard design is utilized. Internal lighting of the filter house is provided for inspection and service. Internal and external ladders and platforms for servicing the filter are included.

1.7 Exhaust System

The LM2500 package includes a thermally insulated exhaust collector to direct the turbine exhaust gases to an 80"h x 55"w rectangular flange in the side of the main enclosure.

1.8 Exhaust Stack

An exhaust stack is included as part of this offer. Details of a typical exhaust stack are in attachment B.

1.9 Piping System

Stainless Steel throughout. Lube Oil, Water and Fuel piping and fittings are Type 304 Stainless Steel. Steam piping and fittings are Type 321 Stainless Steel, and all piping is fabricated in accordance with ANSI B31.1 Power Piping Code requirements. Pipe spools are hydrostatically tested at 1.5 times maximum working pressure. Fuel, steam and high pressure hydraulic piping welds are 100% x-ray inspected. Lube oil piping welds are randomly x-rayed. Turbine and Generator Lube Oil Reservoirs are Type 304 Stainless Steel. The pressure vessels on the turbine baseplate (Water Wash Tanks, Generator Lube Oil Rundown Tanks) are also Type 304 Stainless Steel and are ASME Code stamped.

1.10 Gas Fuel System

The package is supplied with a natural gas fuel system that utilizes an electronically controlled fuel-metering valve. For full-load operation, the gaseous fuel must be supplied to the baseplate at 375 psig \pm 20 (4,654 \pm 138 kPag) at a flowrate of 4800 SCFM, 250°F maximum temperature filtered to 3 microns. Gas fuel must meet GE specification MID-TD-0000-1.

1.11 Liquid Fuel System

The package is supplied with a liquid fuel system that utilizes an electronically controlled fuel-metering valve. For full load operation, the liquid fuel must be supplied at 20-50 psig (138-345 kPa) and at least 20°F (11°C) above the "wax point" temperature (normally >35°F) (1.6°C). Maximum fuel temperature is 150°F (65°C). Customer supplied fuel must be clean, filtered and meet GE specification MID-TD-0000-1.

1.12 Lube Oil Systems

Two systems - mineral oil for the generator, synthetic oil for the gas turbine. Each lube oil system includes duplex full-flow filters, stainless steel piping and reservoirs and stainless steel trimmed valves. The oil from both systems is cooled by dual core fin-fan coolers mounted on the enclosure roof. All interconnecting piping is included. The coolers are 100% redundant and either can handle the cooling load. The full-flow oil filters can be serviced during operation. An optional water-cooled design is available utilizing duplex shell and tube coolers for customer installation on a separate foundation.

1.13 MCC- Unit Motor Control Center

Dependable motor control – Free-standing lineup of motor controls in ProEnergy equipment.* The MCC is suitable for indoor installation in an optional modular control room or other non-hazardous area. Customer typically supplies feeder breaker to energize the MCC and interconnecting wiring to motor terminal boxes on main enclosure.

**Balance-of-Plant equipment can be added to the MCC as a special option*

1.14 Water Injection Skids (out-board)

A self-standing skid is provided for NOx Water Injection equipped packages to support pressurizing of the incoming water feed to the GT package fuel system. An enclosure option is available to suit customer site requirements. Customer provides water in accordance with the following specifications:

The water injection system can be calibrated to flow any water-to-fuel weight ratios up to 1.25 for natural gas fuel, 1.4 for liquid fuel (approx 50-60 gpm). Pressure required at the skid flange customer's connection ranges from 10 to 20 psig at 26 GPM, and will be filtered to 20 micron absolute. A base connection is supplied to return by-pass fuel flow to customer demin water storage tank. An optional low pressure Demin Water Forwarding pump skid can also be installed to support delivery of Demin Water from Customer Demin Water tank to Water Injection Skid. Customer supplied water must be clean, filtered and meet GE specification MID-TD-0000-3.

1.15 Liquid Fuel Boost (in-board)

The Liquid (Diesel) Fuel pressurizing pump and motor is integrated into the Main GT package. Customer provides Diesel Fuel in accordance with the following specifications: Pressure required at the base flange customer's connection ranges from 10 to 50 psig at 39 GPM, and will be filtered to 20 micron absolute. A base connection is supplied to return by-pass fuel flow to customer diesel fuel storage tank. An optional off-base, low-pressure Fuel Forwarding pump skid can also be installed to support delivery of fuel from Customer Fuel tank to Main Package. Customer supplied fuel must be clean, filtered and meet GE specification MID-TD-0000-2.

1.16 Electro-Hydraulic Starting Module

Rotates turbine for starting and water washing. The starting system includes a 200 HP electric motor, hydraulic pump, filters, cooler and controls mounted on a separate baseplate. The pump powers a hydraulic starting motor mounted on the turbine auxiliary gearbox. Customer furnishes interconnecting hydraulic piping between hydraulic start module and rotating equipment module.

1.17 Control System

The ProEnergy control system provides operating, safety and sequencing controls for the gas turbine and generator. The unit panel is suitable for mounting indoors in a non-hazardous, air-conditioned control room. The panel contains a Allen Bradley programmable, microprocessor-based controller for fuel management and sequencing. Also included are a vibration monitor, a manual/auto voltage regulator, a color CRT, and meters and switches for starting, synchronizing, and loading. CRT annunciates alarms and shutdowns, status, analog valves (pressure, temp. etc.), with RS-232 interface to customer control system. Baseplate mounted equipment includes pressure, level, flow, speed and temperature sensors, plus valves and actuators. 24V DC Nickel-Cadmium batteries and dual battery chargers for control system power are included.

1.18 Balance of Plant Control System (BoP Controls)

The ProEnergy Balance of Plant control system provides operating, safety and sequencing controls for the plant supporting systems, including but not limited to Fuel/Water Forwarding, tank levels and operation parameters, Gas Fuel line operation parameters and function, Lube Oil Heat-Exchanger function, CEMS monitoring (if equipped).

The BoP unit panel is suitable for mounting indoors in a non-hazardous, air-conditioned control room. The panel contains a Allen Bradley programmable, microprocessor-based controller for fuel management and sequencing. Also included are a manual/auto voltage regulator, and a color CRT. CRT annunciates alarms and shutdowns, status, analog valves (pressure, temp. etc.), with RS-232 interface to customer Main Control System. 24V DC Nickel-Cadmium batteries and dual battery chargers for control system power are included.

1.19 Fire Protection System

The fire and gas detection and extinguishing system includes optical flame detection, hydrocarbon sensing and thermal detectors; complete with factory installed piping and nozzles in both generator and engine compartments. The fire protection system includes cylinders of CO2 extinguishant mounted on the side of the generator set enclosure. ProEnergy furnishes a dedicated 24V DC battery and charger to power the fire protection system. Fire system alarms and shutdowns are annunciated at the turbine control panel. An alarm sounds at the turbine enclosure and unit control panel if the gas detectors sense high gas levels, or if the system is preparing to release the extinguishant. When activated, the primary extinguishant cylinders discharge into both the turbine and generator compartments via multiple nozzles, and ventilation dampers close automatically. After a time delay, the reserve supply of extinguishant is discharged, if required.

1.20 "On Line" Cleaning and Soak Wash System

For baseload application, an "on-line" cleaning system is included which allow customers to clean the compressor section of the engine during full power operation. The same system reservoir and piping are utilized for off-line soak washing. Baseplate connections are provided for customer supplied purified water at 15-85 psig and air at 85-120 psig filtered to 20 microns.

1.21 Drawings, Documentation and Manuals

The basic equipment package is supplied with a customer drawing package, which includes general arrangement drawings, flow and instrument diagrams, electrical one-line drawings and a conduit interconnection plan. Additional electrical interconnect and logic drawings are provided for record. Maintenance manuals are provided printed in the English language, using Standard English engineering units. The manuals cover operating concepts for power generating equipment, guides to troubleshooting, and basic information on components and equipment within the turbine generator set.

1.22 Component Testing

The package is supplied with the testing documentation obtained with the unit. This documentation includes the generator test reports, electrical test reports, borescope inspections, package inspections and controls reports.