

Scope of Supply

I. Power Generation Equipment and Codes and Standards

A. Used TM2500

Used TM2500 Mobile Gas Turbine Generator

The TM2500 consists of four trailers described below. The trailers include the main trailer, auxiliary trailer, air filter trailer, and exhaust trailer. In addition to the trailers, Seller will have ship loose and tools as required. Below describes the scope of each trailer.

1.1 Main Trailer

The main trailer consists of the following components:

Main Trailer and Jeep

A six-axle, air ride suspension trailer (3+3) and a 3-axle jeep are used to transport the main trailer components. The trailer and jeep combination is approximately 108' (32.9m) long (less tractor) during transport and weighs approximately 210,000 pounds (95,254 kg) fully loaded. At the jobsite, the jeep and trailer gooseneck are removed as well as the 3 rear axles of the trailer. With these pieces removed, the main trailer is approximately 58' (17.7m) long during operation. Ten landing legs are provided to support and level the equipment at the jobsite. Appropriate site foundation is not part of the scope of supply.

Gas Turbine

The gas turbine is a General Electric Model LM2500 PE MDW that is ISO rated for continuous duty and configured for operation on either natural gas or liquid fuel. Altitude, humidity and inlet and exhaust losses will affect power output, heat rate and fuel efficiency. In addition to the inlet air filter, the engine is equipped with a stainless steel mesh screen in the inlet air stream for "last chance" protection against foreign object damage. The engine is shock mounted for shipping and shipped in position, with the exception of the coupling spacer, which is removed for shipment.

Generator

The generator is an air-cooled, open air, 2-pole, 50/60 Hz, 0.85-.99 PF (lagging) capable Brush generator. The generator includes a brushless excitation system with permanent magnet generator. Neutral cubicle, line side cubicle, and medium voltage switchgear are included. The generator is hard mounted to a base on the main trailer and includes generator air inlet filtering and air silencing.

Unit Enclosure

The equipment package is supplied with a weatherproof acoustic enclosure for the turbine. The enclosure is completely assembled and mounted over the equipment prior to testing and shipment. Provisions for turbine removal and personnel access are included. The turbine compartment is fully ventilated by 3 x 50% ventilation fans (provided on the air filter trailer).

Fuel System

The equipment package is dual fuel capable. The package is supplied with a natural gas fuel system using an electronically controlled fuel-metering valve. For full-load operation, the gaseous fuel must be supplied to the Auxiliary Trailer skid connection at: 250 MMBtu/hr Max; 250 °F [121 °C] Max; 375 psig +/- 20PSIG; and filtered to 3 Microns. The Buyer must provide gas fuel that is clean, filtered and compliant with General Electric specification MID-TD-0000-1.

The package is also equipped with a liquid fuel system. Typical liquid fuels include DF1, DF2, or JP4. For full-load operation, Buyer must supply liquid fuel to the connection at the Auxiliary Trailer Skid

at 40 GPM [151.4 L/m] 30 ± 10 PSIG [207 ± 69 kPaG], filtered to 10 Microns and at least 20°F (11°C) above the wax point temperature. The Buyer must provide liquid fuel that is clean, filtered and compliant with General Electric specification MID-TD-0000-2.

All necessary shutoff valves, flow meter, piping and instruments between the Auxiliary Trailer Skid connection and the engine are included. Buyer must provide supply piping with sampling ports, fuel system filtration and applicable shut-off valves and containment per local codes and standards.

Water Injection System

The equipment package is capable of water injection for NOx reduction. For full-load operation, the demineralized water must be supplied to the Auxiliary Trailer skid connection at 28 GPM [106 L/min], 15PSIG [103 kPaG] Minimum, 40 to 140 °F [4 to 60 °C), and filtered to 10 Microns. The Buyer must provide demineralized water that is clean, filtered and compliant with General Electric specification MID-TD-0000-3.

All necessary shutoff valves, flow meter, piping and instruments between the Auxiliary Trailer Skid connection and the engine are included. Buyer must provide supply piping with sampling ports, fuel system filtration and applicable shut-off valves and containment per local codes and standards.

Lube Oil Systems

The equipment package is supplied with two separate lube oil systems; one for the gas turbine and one for the generator. The oil reservoirs and piping are all stainless steel, and the lube oil system valves have stainless steel trim. Each lube oil system has a pump, simplex filters, necessary valving and instrumentation, and thermostatic-controlled electric heaters. A dual fan, single core fin fan cooler is provided to cool turbine, generator lube oil and hydraulic oil. The cooler is mounted on the auxiliary trailer and the rest of the lube oil systems are mounted on the main trailer. Buyer must provide any additional containment per local codes and standards.

Switchgear

The equipment package is supplied with a 3 section NEMA 3R switchgear enclosure. The switchgear includes a set of generator circuit breaker equipment, 2 sets of incoming line voltage monitoring equipment, a marshalling cabinet and a set of switchgear accessories. Permanent cable terminations from the neutral and line-side of the generator are also included.

1.2 Auxiliary Trailer

The auxiliary trailer is approximately 48' (14.6 m) long and 8'-6" (2.6 m) wide and weighs approximately 46,000 pounds (20,865 kg) fully loaded. The trailer is provided with a tandem air ride suspension and includes the equipment listed below. Four landing legs are provided to support and level the trailer at site.

Auxiliary Trailer Skid

The Auxiliary Trailer Skid includes the two fuel and water injection system components not mounted on the main trailer. The pumps, filters and necessary instrumentation are connected to the main trailer components at site with interconnect hoses. The Auxiliary Trailer Skid also includes the hydraulic start system and water wash system described below.

Electro-Hydraulic Start System

The equipment package is supplied with a hydraulic starting system, which includes an electric motor driven hydraulic pump assembly, filters, and a fin/fan heat exchanger, mounted on the auxiliary equipment module. A hydraulic motor is also mounted on the gas turbine accessory gearbox to turn gas generator shaft. All piping and fittings on the base plates, plus hydraulic connections between the auxiliary equipment module and the main base plate are also furnished.

“Off Line” Soak Wash System

The equipment package is supplied with an "off-line" cleaning system, with a water wash reservoir and all necessary filters and instrumentation supplied. Buyer is required to provide purified water to the standards listed in the water injection system.

Fire Protection System

The equipment package is supplied with an installed fire protection system complete with hydrocarbon sensing and thermal detectors, piping and nozzles in the engine compartment. The fire protection system includes cylinders containing CO₂ mounted on the auxiliary trailer. An included 24 VDC battery and charger powers the fire protection system (located in the control house.) All alarms and shutdowns are annunciated at the unit control panel. An alarm sounds at the turbine if the gas detectors detect high gas levels, or if the system is preparing to release the CO₂. When activated, the package shuts down, and the primary CO₂ cylinder is discharged into the turbine compartment via multiple nozzles, and the ventilation dampers automatically close. After a time delay and if required, the reserve supply of CO₂ is discharged.

Fin Fan Cooler

The equipment package is supplied with a 100% redundant dual fan, single core cooler with separate coils for the turbine, generator lube oil and hydraulic oil. The cooler is equipped with all interconnect piping and instrumentation necessary for the three circuits.

Turbine Ventilation Silencer

A turbine ventilation silencer is provided with the package and is mounted on a rail system to slide into position at the jobsite. The silencer is bolted to the side of the turbine enclosure opposite the exhaust collector and an expansion joint and fire damper are provided.

Control House

The basic equipment package is supplied with a lighted, insulated 20' (6.1 m) long by 8'-6" (2.6 m) wide control house. The control house is equipped with an access door, air conditioner/heater, and a hand held fire extinguisher. The control house is used to package the equipment listed below.

Digital Control System

The control system features an integrated electronic fuel management system with a PLC based programmable sequencer, vibration monitor, fire system monitor, digital meter, and a digital generator protective relay module. A desktop or laptop PC with separate workstation and chair is provided for HMI control. Alarm and shutdown events are displayed on the HMI automatically. A dedicated 24V DC battery system with power charger is included in the control house.

Generator Protective Relays

The equipment package is supplied with a microprocessor-based generator protective relay module, mounted in the turbine control panel. Protective relay system includes all functions necessary for protection of the generator.

Unit Motor Control Center

A freestanding lineup of motor controls for all TM2500 package motors is supplied. The motor control center is installed in the control house and also includes a 45 kVA lighting and distribution transformer.

Battery and Charger System

The equipment package is supplied with a 24 VDC control system battery system and charger, a 24 VDC fire system battery system and charger, and a 125 VDC switchgear and backup generator lube pump motor battery system and charger. The battery systems are fully wired and mounted in racks and are installed in the control house along with the wall-mounted chargers.

1.3 Air Filter Trailer

The air filter trailer is approximately 48' (14.6 m) long and 8'-6" (2.6 m) wide and weighs approximately 46,000 pounds (20,865 kg) fully loaded. The trailer is provided with a tandem air ride suspension and includes the equipment listed below. Four landing legs are provided to support and level the trailer at the jobsite.

The trailer is equipped with a two-stage filtration system for both ventilation and combustion air with panel type pre-filters housed in hinged doors and high efficiency bag barrier filters. Vane separators are installed in front of, and behind, the filtration system and include inlet silencers. A heating/cooling coil is provided with flanged Buyer connections for heating and chilling capability. An inlet plenum with access door is provided for access to the FOD screen and commissioning screen.

Ventilation fans for the turbine enclosure are installed on the air filter trailer. Three 50% fans are installed and are equipped with back draft dampers. All of the items listed are housed in the filter house that is complete with access doors and lighting for maintenance, separate air paths and turning vanes and the necessary instrumentation. For connection to the main trailer, a flex connection for the combustion inlet to the engine bellmouth and a trailer-to-trailer flex connection connects the air filter trailer to the main trailer.

1.4 Exhaust Trailer

The exhaust trailer is approximately 48' (14.6 m) long and 8'-6" (2.6 m) wide and weighs approximately 40,000 pounds (18,144 kg) fully loaded. The trailer is provided with a tandem air ride suspension and includes the equipment listed below. Four landing legs are provided to support and level the trailer at the jobsite.

The exhaust trailer is equipped with an expansion joint for trailer connection to the main trailer exhaust collector flange. An exhaust transition with access hatch, a horizontal exhaust silencer, a 90° exhaust elbow, and a vertical stack are also included. The stack is lifted into position at the jobsite. The exhaust trailer is 13'-6" (4.1 m) tall for road purposes and is 20' 11/16" (6.3m) tall with the stack in position at site.

1.5 Grounding

Each trailer is supplied with grounding pads for inter-connection between each trailer to a grounding grid. Completing the trailer-to-trailer ground inter-connection the connections to site grounding grid are not included. The grounding grid must be compliant with the General Electric "Specification for Grounding of Mobile Generation Unit."

1.6 Design Criteria

Ambient design limits	41F (5C) – 110F (43.3C)
Seismic Design Criteria (GTG Package)	Per UBC 1997, Zone 4, essential, 0.474g static acceleration
Maximum Wind Speed (Wind Load)	Per UBC 1997, 100mph, essential, Exposure C
Roof Live / Snow Load	20 psf at any exposed areas
Near Field Noise at 3 ft horizontal and 5 ft vertical	90 dB(A) arithmetic average

TM2500 Codes and Standards

Seller considers the applicable sections of the following US and ISO Codes and Standards to be the most relevant Codes and Standards for the Equipment. Our designs and procedures are generally compliant with applicable sections of the following:

ANSI/AFBMA	
Std 9	Loading Ratings and Fatigue Life for Ball Bearings.
Std 11	Load Ratings and Fatigue Life for Roller Bearings.
ANSI A58.1	Minimum Design Loads for Buildings and Other Structures (Used for Snow Loads)
ANSI B1.1	Unified Inch Screw Threads (Seller complies at the customer's connection)
ANSI B1.20.1	Pipe Threads
ANSI B16.5	Steel Pipe Flanges and Flanged Fittings
ANSI B16.9	Factory - Made Wrought Steel Butt Welding Fittings
ANSI B16.21	Non-metallic Flat Gaskets for Pipe Flanges. (Spiral-wound gaskets per API 601 may be used, particularly in turbine compartment piping.)
ANSI B31.1	Pressure Piping and gas turbine piping systems comply.
ANSI B133.2	Basic Gas Turbine. Seller complies, with the exception of paragraph: 8.5 Loose items such as jackscrews and eyebolts are not furnished. Provisions for use of such items are not included in the design.
ANSI B133.3	Gas Turbine Auxiliary Equipment. Seller complies fully with design portions only. Seller uses its own lube oil flushing procedure. Atomizing air receiver is not applicable.
ANSI B133.4	Gas Turbine Controls and Protection Systems
ANSI B133.5	Gas Turbine Electrical Equipment
ANSI B133.8	Gas Turbine Installation Sound Emissions
ANSI C37.90	Relays Associated with Electric Power Apparatus
ANSI C37.90.1	Guide for Surge Withstand Capability (SWS) Tests
ANSI C50.10	General Requirements for Synchronous Machines
ANSI C50.13	Requirements for Cylindrical Rotor Synchronous Generators
ANSI C50.14	Requirements for Combustion Gas Turbine Driven Cylindrical Rotor Synchronous Generators (Seller does not provide a peak reserve rating. Not all of the prototype tests indicated in Table 2 have necessarily been conducted.)
ANSI C57.94	American Standard, Guide for Installation and Maintenance of Dry Type Transformers
ANSI C83.16	Relays
ANSI S1.2	Method for the Physical Measurement of Sound
ANSI S1.4	Specification for Sound Level Meters
ANSI S1.13	Method for the Measurement of Sound Pressure Levels
ANSI/ASHRAE 52.1-1992	Gravimetric and Dust Spot Procedures for Testing Air-cleaning Devices Used in General Ventilation for Removing Particulate Matter
ANSI/IEEE C37.2	Electrical Power System Device Function Numbers (Seller complies with respect to device designations except that in a few cases device numbers had to be modified or added to fit Seller's needs.)
ANSI/IEEE 100	IEEE Standard Dictionary of Electrical and Electronics Terms
ANSI/NEMA MG1	Motors and Generators
ANSI/NEMA MG2	Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motor and Generators
ANSI/NFPA 12	Carbon Dioxide Extinguishing Systems

ANSI/NFPA 70	National Electrical Code (Electrical components are designed to meet the intent of this Code for Class 1, Group D, Div. 2, Hazardous area classification where appropriate.).
API 614	Special-Purpose Gear Units for Petroleum, Chemical, and Gas Industry Services
API 614	Lubrication, Shaft-Sealing, and Control - Oil Systems for Special - Purpose Applications
API 616	Gas Turbine for Refinery Services
API 650	Storage Tanks
API 670	Vibration Monitoring Systems
API 671	Special-Purpose Gear Units for Petroleum, Chemical, and Gas Industry Services
API 678	Accelerometer - Based Vibration Monitoring System
API RP11PGT	Packaged Combustion Gas Turbines
ASME PTC22	Gas Turbine Power Plants - Performance Test Codes
ASME Section VIII	ASME Boiler and Pressure Vessel Code
ASME Section IX	ASME Boiler and Pressure Vessel Code
AWS D1.1	American Welding Specification
EIA RS-232	Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Interchange
IEC 34.1	Rotating Electrical Machines - Rating and Performance
IEC 34.3	Rotating Electrical Machines - Turbine Type Synchronous Machines
IEEE Std. 421	IEEE Standard Criteria and Definitions for Excitation Systems for Synchronous Machines
JIC	Hydraulic Standards for Industrial Equipment
UBC	Uniform Building Code 1997 (Used for Wind Loads and Seismic Design)
Standard Specifications:	
• General Electric Specification MID-TD-0000-1 for Gaseous Fuels • General Electric Specification MID-TD-0000-2 for liquid fuels • General Electric Specification MID-TD-0000-3 for NOx Water • General Electric Specification MID-TD-0000-4 for Compressor Cleaning	

Ambient Site Conditions:

None.

Site Requirements:

None.

State and Local Laws:

None.