1. SCOPE OF SUPPLY

1.1 Equipment Scope Description

1.1.1 Gas Turbine

General Electric gas turbine model LM6000PD is a two-shaft/two-spool engine consisting of a five-stage low pressure compressor, a fourteen-stage high pressure compressor, a two-stage high pressure turbine, and a five-stage low pressure turbine. 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 and shipped in position, with the exception of the coupling spacer, which is removed and shipped in a separate container.

1.1.2 Generator

Air-cooled open air, Brush made 2-pole generator rated at min 63,500 KVA @ 0.8 pf, 15°C cooling air, 11,000 volts, 50 Hz, capable of handling the full continuous power of the gas turbine at any ambient temperature throughout the operating range. A cooling water loop and its associated fans and pumps are not required. The generator includes a brushless excitation system with permanent magnet generator. Neutral and line side cubicles are included. Neutral and line side cubicles are bolted onto the outside of the generator enclosure for the Customer's power connections.

GE Energy furnishes, located in the neutral cubicle, nine (9) current transformers and three (3) additional current transformers for Buyer's differential protection (4000:1), as follows:
<table>
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<tr>
<th>Qty</th>
<th>Service</th>
<th>European Class</th>
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<tbody>
<tr>
<td>3</td>
<td>Relaying &amp; Differentials</td>
<td>5P20</td>
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<td>3</td>
<td>Metering</td>
<td>5P20</td>
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<tr>
<td>3</td>
<td>Cross Current Compensation (AVR)</td>
<td>5P10</td>
</tr>
<tr>
<td>3</td>
<td>Differential Protection by Customer *</td>
<td>5P20</td>
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Note * 30 VA, 5P20, R_{ct}<30 Ohm

GE Energy also furnishes three lighting arrestors and three surge capacitors mounted in the line side cubicle.

Three (3) voltage transformers with secondary 110/√3 V and primary 11000/√3 V are included in the GE Energy scope of supply.

1.1.3 Main Load Gearbox

The equipment package is supplied with a single-stage, vertical offset, parallel shaft speed reducer with a gear rated HP of 70,000 (52,200 kW) from a gas turbine speed of 3627 RPM to a generator speed of 3000 RPM, with a 1.209:1 ratio. This unit is manufactured and tested in accordance with API 613 3rd Edition April 1988. The actual AGMA Service Factor is 1.35. The API service factor is 1.1. The unit design includes a fabricated steel housing, clockwise rotation with pinion on top, double helical precision carburized ground gear elements, split steel backed babbitt lined journal bearings on all shafts and a low speed quill shaft.

1.1.4 Unit Enclosure

The equipment package is supplied with weatherproof acoustic enclosures. The enclosures are completely assembled and mounted over the equipment prior to testing and shipment. The gas turbine compartment is fully ventilated with duplex belt driven fans. The generator compartment is fully ventilated with direct driven fans. Explosion-proof A.C. lighting is provided in both compartments. The enclosure provides guaranteed average noise emission of 85 dB(A) at 1m distance measured at 1.5m above grade in a free field condition, during full load operation. Noise emission could be greater than 85 dB(A) at 1m distance measured at 1.5m above grade in a free field condition, during equipment start-up and shut down.

1.1.5 Baseplate

The equipment 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/main load gearbox. 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 (U.S. Seismic Zone 4) as well as providing a convenient structure for transportation. The base-plate support system is enhanced by the installation of a heavy duty, welded superstructure which utilize structural tubing for wall columns and roof beams.
1.1.6 Air Inlet System

The equipment package is supplied with a modular, three-stage filtration system consisting of inlet screens, an EU4prefilter and an EU7 final barrier filter.

The filtration system removes more than 99.9 percent of all particles 5.0 micron and larger by utilizing a three-stage design, that is designed to meet the following downstream conditions:

~95% of the time, must not contain solid particles exceeding 0.004 grains/1000 cubic feet, and
~5% of the time, must not contain solid particles exceeding 0.04 grains/1000 cubic feet.

It will be possible to replace the pre-filter and high efficiency filter without stopping the GTG, however, replacement of the high efficiency filter with the GTG on line is very dangerous and not recommended by GE Energy.

Acoustical louvers for noise control are installed to the intake of the inlet filter, in lieu of the weather hoods. The acoustic louvers provided are 600 mm deep. The acoustical louvers provides guaranteed average noise emission of 82 dB(A) at 1m distance from the inlet filter intake, during full load operation. The estimated pressure loss added by the louvers is 20 mmH2O. A detailed description of the acoustical louvers provided for noise control and installed to the intake of the inlet filter is included in Section 7 of this proposal.

All air for ventilation systems is filtered to the same level as turbine combustion air. Filtered air is silenced before entering the turbine plenum. This design results in a compact arrangement and eliminates the need for customer supplied inlet ducting when the standard design is utilized. Internal lighting of the filter house is provided to facilitate inspection and service.

Package is also supplied with platforms and ladders to service the inlet filter (internal platforms and ladders only). These items are packaged separately for shipment.

1.1.7 Inlet Air Multi Purpose Coils

The equipment package is supplied with high performance multi purpose coils for combustion air heating and chilling as an integral part of the air inlet system. Customer shall provide adequate quantities of hot water and chilled water and interconnecting piping to GE Energy furnished chilling coils at filter house.

For the Anti-Ice System, that is required to allow safe operation of the equipment package during icing conditions, Customer shall furnish water at 27°C and 345 kPag, for circulation through the GE Energy supplied coils. The quantity of heat should be enough to heat the inlet air 5.6 deg C above ambient temperature when ambient temperatures are less than -1.1 deg C and to heat the inlet air to 4.4 deg C when ambient temperatures are between -1.1 and 4.4 deg C. No heating is required for ambient temperatures above 4.4 deg C.
For temperatures below -9.4 deg C there is no need for anti-icing operation, due to the very low moisture content of the air. The only expectation would be where there is fog, snow, or other visible precipitation.

Anti-ice protection is not required during start-up and warm up period (maximum 5 MW) for up to 1 hour maximum time period.

1.1.8 Turbine Exhaust

The equipment package is supplied with a circular, axial exhaust outlet with connection flange to facilitate in-line mounting of a WHRU.

1.1.9 Fuel System

The equipment package is supplied with a Dry Low Emission (DLE) natural gas fuel system using an electronically controlled fuel metering valve. All necessary shutoff valves, piping and instruments between the fuel module connection and the engine are included.

1.1.10 SPRINT® (Spray Inter-cooling) Power Boost System

The equipment package is supplied with the SPRINT® boosts system for engine performance augmentation. The SPRINT® boosts engine performance system uses a spray inter-cooling design that significantly increases the mass flow by cooling the air during the compression process. The system is based on an atomized water spray injected through spray nozzles placed at two locations, one between the high pressure and low pressure compressors, and the second at inlet bell-mouth.

Water is atomized using high pressure air taken off of the eighth stage bleed. The water flow rate is metered, using the appropriate engine control schedules and at the inlet bell-mouth.

Bell-mouth and inter-stage portions on SPRINT® alternate operation based on turbine inlet temperature.

If the SPRINT® boosts system is used, Customer must provide a supply of purified water per GE specification MID-TD-0000-3 (see Section 12) to a flange connection at the Sprint skid, at 200-450 kPag.

1.1.11 Lube Oil Systems

The equipment package is supplied with two separate lube oil systems: one for the gas turbine and one for the generator/gearbox. The oil reservoirs and piping are all stainless steel, and the lube oil system valves have stainless steel trim. Each lube oil system has duplex filters, duplex Shell and Tube water coolers, and thermostatic-controlled electric heaters. The oil reservoir, and filters for each system are mounted on an auxiliary equipment module located next to the gas turbine baseplate. The auxiliary equipment module provides simplified piping connections and reduces customer's installation time and costs. The gear box/ generator lube oil system is
located on the mineral lube oil module. The Shell and Tube water coolers are mounted on dedicated foundations and located near the gas turbine base-plate.

Each lube oil system has a lube oil vent separator able to reduce oil emission in the atmosphere as follows:

- Max mineral oil emissions: 20 mg/Nm³ and average 0.079167 kg/h over a 24-hour period
- Max synthetic oil emissions: 20 mg/Nm³ and average 0.0375 kg/h over a 24-hour period

1.1.12 Electro-Hydraulic Start System

The equipment package is supplied with an electric motor driven hydraulic pump assembly, filters, cooler and controls, mounted on the auxiliary equipment module. A hydraulic motor is also mounted on the gas turbine accessory gearbox. Hydraulic hoses are furnished to connect the auxiliary equipment module and the main baseplate.

1.1.13 Fire Protection System

The equipment package is supplied with a factory installed fire protection system complete with optical flame detection, hydrocarbon sensing and thermal detectors, piping and nozzles in both generator and engine compartments. The fire protection system includes cylinders containing CO2 mounted on the auxiliary module. A 24 V DC battery and charger to power the fire protection system is also included. 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 the system is activated, the package shuts down, and the primary CO2 cylinders are discharged into the turbine and generator compartments via multiple nozzles, and the ventilation dampers automatically close. After a time delay a slow extended discharge of CO2 is provided.

1.1.14 Winterization

Being the Equipment operating outdoors in relatively cold climates (–15°C absolute minimum ambient temperature) GE Energy provides the winterization of the Equipment. The winterization includes the following modifications:

- Inlet air anti-icing (see above)
- Heat tracing and insulation of applicable unit mounted piping
- Enclosing and heat exposed instruments and equipment

For ambient temperatures below −15°C, additional special equipment available as an option will be required.

1.1.15 Gas Turbine Generator Control System

The equipment package is supplied with a free-standing control panel suitable for mounting in an indoor, non-hazardous area provided by Customer. The control system key features are:
- Full MicroNetTM (Woodward MicroNet Simplex Digital Control) microprocessor based control panel for gas turbine fuel/airflow management, and auxiliary system sequencing/protective functions.
- GE EX2100 AVR.
- Bently Nevada digital microprocessor-based vibration monitor
- Digital generator system multifunction meter (Watts, VARS, Amps, Volts, etc)
- Beckwith M-3425 digital microprocessor-based generator protection system.
- Desk top HMI computer (human machine interface) provides graphical displays in English language, and logging of key gas turbine, generator, and auxiliary system data. The HMI software will be Intellution.
- Manual and Automatic Synchronization

1.1.16 Generator Protective Relays

The equipment package is supplied with a microprocessor-based Beckwith M-3425 Integrated Generator Protection System module (IGPS®), mounted in the turbine control panel.

Protective relay system includes functions necessary for protection of the generator. GE Energy supplied protections are listed in the “One-Line Diagram” included in Section 20 of this proposal.

A detailed description of the Beckwith M-3425 integrated generator protection system is included in Section 14 of this proposal.

1.1.17 "On Line" and "Off Line" Cleaning and Soak Wash System

The equipment package is supplied with an "on-line" cleaning system, which allows customers to clean the compressor section of the engine during full power operation. The water wash equipment is mounted on the auxiliary module that is provided with a weather protection enclosure. The same system reservoir and piping are utilized for off-line soak washing. Customer is required to provide purified water (per GE specification MID-TD-0000-4) at 104-449 kPag filtered to 20 microns absolute and air at 552-690 kPag filtered to 5 microns absolute, at the auxiliary skid connections.

1.1.18 Piping Connections

In the equipment package configuration provided, the Customer's piping connections are on the right side, as viewed from the exciter. As an option, the unit can be built with the Customer's piping connections on the left side, as viewed from the exciter. The turbine removal door is placed on the side opposite the piping connections.

1.1.19 Line-side Cubicle

As viewed from the exciter end of a standard unit, the generator line-side cubicle is on the right-hand side and the neutral cubicle is on the left-hand side. When specified, the location of these cubicles can be reversed. However, the termination box for generator instrument and control wiring box, (MGTB) must remain on the right-hand side, and the turbine main terminal box (MTTB) must remain on the left.