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## 1. Introduction

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We are pleased to provide the following Technical Proposal and Specification for the design and supply of a completely refurbished Taurus 60S T7001 Gas Turbine Generator Package.

## 2. Gas Turbine

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Taurus 60 SoLoNox 7001 Single Shaft Industrial Gas Turbine  
Inlet and Exhaust Outlet Duct Losses.

Zero Altitude, No Air

- Air inlet casing phased vertically upwards.
- Air inlet flexible joint.
- Compressor assembly with variable guide vanes.
- Variable guide vane control mechanism.
- Combustor assembly.
- Seal air system.
- Thermal lagging of exhaust casing.
- High energy igniter unit.
- Exhaust outlet casing phased axially.
- Exhaust outlet flexible expansion joint.
- Thrust bearing temperature thermocouples.
- Air inlet casing temperature thermocouples (T1).
- Turbine temperature thermocouples (T5).
- Power turbine/gas generator magnetic speed pick up probes.
- Casing mounted vibration accelerometer.

## 3. Reduction Gearbox

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- Direct Coupled Epicyclic speed reducing gearbox with output speed of 1500 rpm.
- Flexible coupling drive assembly between gearbox and alternator.
- Coupling guard, carbon steel.
- Casing mounted vibration accelerometer.
- Magnetic speed pick up probes

#### 4. Gas Fuel System

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- Gas filter
- Gas Pressure regulator
- Gas Pressure transmitters
- Torch valve, pressure regulator, solenoid valves
- Double block system with isolation valves
- Throttle valve and actuator assembly
- PCD pressure transmitter with calibration valve block
- Downstream throttle valve
- Speed pick ups, temperature & pressure sensors
- Bleed valve and IGV control
- Electrical connection box and wiring

#### 5. Lubricating Oil System

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- Integral lubricating oil system serving the turbine, gearbox and driven unit.
- Main lube oil pump mechanically driven from gas turbine gearbox.
- AC motor driven pre/post lube oil pump.
- DC motor driven back up pre/post lube oil pump.
- Duplex lube oil filters.
- Lube oil supply and drain piping.
- Lube oil pressure transmitter
- Lube oil temperature RTD
- Pressure and temperature control block.
- Lube oil tank immersion heater.
- Lube oil tank gauge and level switches.
- Oil cooling plate heat exchanger
- Air blast water cooling radiator matrix and fan
- Cooling water circulation pump
- High efficiency lube oil tank vent filter

#### 6. Turbine Water Wash System

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- Cold crank water wash manifold assembly
- 24VDC solenoid control valve
- 120 litres capacity water tank
- AC motor drive pump capable of delivering the cleaning medium at the flow and pressure required.

## 7. Turbine Base Plate

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- Turbine baseplate of fabricated steel
- Machined mounting surfaces for the gas turbine, gearbox and alternator.
- Turbine flexible mounting assembly, allowing thermal expansion of the gas turbine.
- 1400 Litre Turbine lube oil tank in carbon steel.
- Carbon steel lube oil drain piping.
- Sealed base with drain outlet.
- Turbine package lifting points.
- Turbine instrument gauge panel.

## 8. Alternator

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- 11.0 kV, 3 Phase, 50 Hz
- Horizontal, 2 sleeve bearing, 4 pole.
- Salient pole brushless.
- Open air circuit cooling.
- Enclosure IP21.
- Insulation Class F.
- Continuous rating matched to T60 gas turbine (Class F temperature basis) at 0.8 pf
- Automatic voltage regulator including parallel operation CT's and droop assembly, three phase sensing, power factor control and manual operation (AVR etc. mounted in control panel).
- CT's and VT's as required for monitoring and protection.
- Stator winding temperature monitoring 6 x RTD detectors.
- Drive end and non-drive end bearing temperature 2 x RTD detectors.
- Drive end and non-drive end bearing vibration accelerometers
- Anti-condensation heater

## 9. Turbine Enclosure

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- Acoustic enclosure to reduce noise emitted from a Taurus 60 Gas Turbine Generator to a level of 80 dBA at 1 metres distance in assumed free field conditions to the following specifications:
- Single construction close fit mounted on turbine baseplate
- Separate CO2 bottle storage cupboard
- 2 off single access doors and 2 off double leaf access doors.
- AC lighting, DC emergency lighting, 4 off light switches, 4 x 13amp socket outlets. This equipment will be EX rated for hazardous area
- Enclosure cooling air inlet ducting and attenuation consisting of:-
- Hinged weather louvres complete with bird guard
- Washable synthetic media filter pads and frame
- 1 off splitter type 90° bend attenuator
- 1 off vertical duct section mounted on roof
- 2 off ATEX rated 400V, 3PH, 50Hz ventilation fans suitable for inverter control

- 2 off internally mounted ATEX rated (24V DC) motorised fire dampers (one per fan)
- Enclosure cooling air outlet ducting and attenuation consisting of:-
- 1 off internally mounted ATEX rated (24V DC) motorised fire damper
- 1 off vertical duct section mounted on roof
- 1 off splitter type 90° bend attenuator
- 1 off weather cowl
- Ducting and attenuation equipment sizes based on a cooling airflow of 652 m<sup>3</sup>/min
- Transition piece from combustion inlet ducting and flexible connector to inlet manifold
- Gas turbine exhaust outlet in end wall with split plate to fit around exhaust
- Internal beams approximately 6000 mm L fitted with a sliding lifting beam to take a 3500 kg hoist
- Apertures to be provided for cable entry points, fire detection, cabling, CO2 pipework, pipework exits and entries
- 2 off earth bosses to be provided
- Acoustic seal for base
- Lifting points for enclosure only
- External blast SA 2.5 and finish painted to the following paint system as specified by International Paints to BS4800 or RAL colour:
- Transportation frames and covers

## 10. Turbine Combustion & Ventilation Air Filtration

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- Combustion/Ventilation air intake system for a Solar Taurus 60 gas turbine
- Airflow: Combustion 35,000 cfm per filter
- Type: Double elements horizontally mounted.
- Single Stage filter with 24 off Double Low Temperature Super Hurricane, horizontally mounted filter elements, arranged 4 wide x 6 high. The end-caps and guards would be manufactured from 304 stainless steel.
- Compressed air header tank and blow tubes in 304L stainless steel
- Solenoid enclosures and diaphragm valves suitable for low temperature
- Stainless steel control box containing WT standard pulse sequencer. To be inclusive of heaters.
- Removable weather hood which comes with integral trash screen.
- Filter housing in mild steel painted to Paint Specification PG63A – colour RAL 7035.
- Flanged at rear for mounting to the ventilation/silencer air ductwork
- All electrical equipment suitable for hazardous area
- 316SS nameplates attached to main equipment
- Initial pressure drop is 250 Pa
- Combustion air intake silencer & cascade bend
- 80dBA @ 3.0 metres, 90 degrees
- Outer casing impact tested mild steel
- Inner linings and perforated – 304 stainless steel
- Maximum attenuator pressure loss – 150Pa
- Ventilation filter housing with removable weather louvres to access filters
- First stage G3 filter cartridges mounted 3 wide 4 high panel frame
- Second stage G4 Bag filters mounted 3 wide 4 high panel frame
- Differential Pressure switch

## 11. Fire & Gas Detection System

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- The fire detection and control equipment will comprise of a number of Heat Probes/Flame detectors as detailed within this specification. The detectors will be interconnected on one separate zone or circuit by low voltage electrical cables, terminating at the integrated fire detection and Extinguishant control unit.
- Operation of one zone will generate an audible and visual fire alarm indication at the control unit, which in turn will initiate fire alarm procedures and plant shutdown etc.
- The extinguishant equipment will comprise of five cylinders complete with actuators and discharge nozzles, which will operate automatically when one detector, one on every zone of a discharge area are in the alarm condition. A zone will consist of heat probe detectors and flame detection.
- Zone 1 Turbine and Alternator Room
- A key switch is provided at the control unit, to enable the automatic feature of the system to be locked-off whilst personnel are working within the protected area. There will also be automatic contacts connected to the door lock, which will put the system in manual mode. (Auto mode will not be reselected automatically on the re-closure of the door(s)).
- The extinguishant may be released manually by operating the manual 'extinguishing release' units. Manual release of the extinguishing pre-discharge alarms.
- On completion of the pre-discharge delay cycle Co2 would be discharged (via nozzles to flood the area to the concentration required).

### Equipment schedule:

- 1 x 3 & 1 Extinguishant Panel 24VDC
- 1 x Set of batteries
- 1 x Status panel and manual release
- 3 x ATEX Heat Detectors
- 3 x ATEX Flame Detectors
- 1 x ATEX Electronic sounder/beacons
- 1 x Gas Release Pressure Switch
- 5 x 50kg Cylinder
- 250Kg Co2
- 1 x 24VDC Electrical Actuator
- 6 x Distribution nozzle
- 2 x Co2 Caution Signs
- 1 x Co2 Manual Release Signs
- 2 channel Methane detection system
- 3 x Gas detectors

## 12. Turbine Exhaust Silencer (Optional)

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- Turbine type: Taurus 60
- Turbine exhaust gas flow rate: 2784 m<sup>3</sup>/min
- Turbine exhaust gas temp: 565 deg.C
- Turbine exhaust outlet flange: 914 mm nominal bore.
- Exhaust system allowable pressure loss: 6" WG
- Turbine noise data:
- Freq. (Hz) 63 125 250 500 1K 2K 4K 8K
- Unsilenced exhaust
- sound pressure level (dBA) 89 87 87 94 84 79 69 61  
at 15M/90
- Noise Specification: 80 dB(A) at 7.5M/90
- The proposed silencer for this application consists of a cylindrical steel casing, flanged at both ends and containing an acoustic lining and central acoustic pod. The silencer outlet has a 90 degree lobster back bend, nominally 1145 mm diameter and an inlet transition section from 914 mm diameter to 1300 mm diameter over a length of 700 mm.
- Silencer casing: 1900 mm diameter x 2500 mm parallel length c/w support feet.
- Flanges: Angle 100 mm x 100 mm at 10 mm thick.
- Exhaust outlet: 1145 mm diameter 90 degree lobster back bend.
- Acoustic splitter lining: 1300 mm internal diameter x 2500 mm acoustic length.
- Central acoustic pod: 600 mm diameter x 2300 mm acoustic length,
- Silencer Inlet: Tapered transition from 914 mm diameter to 1300 mm diameter over a length of 700 mm and flanged at 914 mm diameter.
- Silencer outlet: Short transition from 1300 mm diameter to 1145 mm diameter over a length of 300 mm and flanged at 1145 mm. 90 degree lobster bend flanged at 1145 mm diameter, to connect to the short transition, with a mitred outlet to atmosphere.
- Silencer casing: 5.0 mm stainless steel 304
- Acoustic element framework: 2.0 mm stainless steel gr.304
- Acoustic pack retention: 1.5 mm perforated stainless steel gr.304
- Acoustic pack/density Basalt Fibre/approximately 125 Kg/m<sup>3</sup>
- Inlet ducting, bend, transition: 4.0 mm stainless steel 304
- Weight per silencer: 2500 Kg (including outlet bend and inlet transition)
- Acoustic Performance
- Frequency (Hz) 63 125 250 500 1K 2K 4K 8K
- Silencer Dynamic
- Insertion Loss
- @ 560 C (dB) 11 17 25 27 29 21 12 7
- Calculated sound pressure at 7.5 m/90 from open outlet, after silencer ~ 73 dB(A).
- Pressure drop across the silencer and outlet bend at 565 C and 2784 m<sup>3</sup>/min calculated at approximately 465 Pa. (excluding dump loss to atmosphere).  
Average velocity through the silencer approximately 44.4 m/sec.  
Pressure drop across inlet transition, outlet transition and lobster bend at 565 C and 2784 m<sup>3</sup>/min, calculated at approximately 590 Pa.

### 13. Turbine Control Panel

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PLC based turbine control panel comprising of the following

- Turbine control and protection PLC
- Operator interface touch screen HMI
- Free standing panel 800mm x 800mm x 2200mm
- Turbine T5 temperature monitoring and protection
- Turbine speed monitoring and protection system
- Turbine systems display and trending facility
- Turbine communication Ethernet hub
- 4 channel Vibration monitoring and protection system
- Analog and digital metering
- Fuel control interface
- Emergency Stop
- Hard wired PLC back up system
- Panel anti-condensation heater
- Panel ventilation and filter
- Panel internal lighting
- 24 volt DC battery supply and mains charger

### 14. Alternator & Auxiliary Control Panel

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PLC based alternator and auxiliary control panel comprising of the following

- Generator protection relay to include over current, earth fault, differential, neutral voltage displacement, under/over voltage, under/over frequency, reverse power protection.
- Generator synchronizing and load sharing control
- Digital Automatic Voltage Controller
- Fire protection display unit
- Free standing panel 800mm x 800mm x 2200mm
- Panel anti-condensation heater
- Panel ventilation and filter
- Panel internal lighting

## 15. UPS Panel

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- Uninterruptable Power Supply Panel
- Sealed Lead acid Batteries

Note: The specification for the UPS to be clarified for actual size and duty requirements.

## 16. Remote Monitoring Panel

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Remote monitoring system comprising of the following

- Remote desk top PC HMI Interface
- Interface module for site data acquisition system

## 17. MCC Control Panel

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Motor Control Panel including Starters and Control for the following Auxiliary Supplies

- Turbine Lube Oil PP Pump
- Turbine Lube Oil Tank Heater
- Turbine Oil Cooler Radiator Fan Motor
- Turbine Oil Cooling Water Pump
- Enclosure Ventilation Motor
- Alternator Anti Condensation Heater
- Water Wash Motor
- Enclosure Heating & Lighting

