

TRENT 60 POWER GENERATION PACKAGE

SCOPE OF SUPPLY (GENSET)

GAS TURBINE

- Rolls-Royce Industrial Trent 60 Gas Turbine.
 - Single annular combustion system with twenty four (24) Wet Low Emissions Single Fuel (natural gas with water injection for emissions control) injectors
 - On-engine mounted gas fuel injection manifold.
 - On-engine mounted liquid fuel injection manifold.
 - On-engine mounted water injection manifold.
 - On-engine electric start motor.
 - Two (2) on-engine ignitors and off-engine mounted exciter unit.
- Inlet Spray Intercooling (ISI) overspray fogging array with three separate injection manifolds and nozzles mounted on eighteen (18) nozzle rails and manifolds mounted in the inlet plenum for power augmentation and heat rate improvement above 7°C (45°F) ambient air temperatures.

AC GENERATOR

- Two pole, open air cooled AC generator rated at 74,294 kVA at 15°C (59.0°F), 11.5 kV, 50Hz or 13.8 kV 60Hz , 3 phase, 0.85 power factor in accordance with IEC 34- or ANSI C.50-14, fitted with class "F" insulation and designed for class "B" temperature rises with a brushless exciter.
- AC generator cooling air system comprising air filter media, ducting and silencer and a generator shaft mounted cooling fan.
- Line and neutral cubicles mounted on the AC Generator enclosure including current transformers for protection and metering, voltage transformers for protection and metering, surge arrestors, surge capacitors, neutral earthing transformer, secondary loading resistor as detailed on the HV Single Line Diagram

GAS TURBINE PACKAGE

BASE

- Fabricated continuous grout multi-point mount baseplate with 30 inches (762 mm) beam height.
- Baseplate houses gas turbine, radial intake plenum, fuel systems, gas turbine lubrication and control oil systems, exhaust volute, and gas turbine enclosure.
- The AC generator skid is provided on a separate baseplate that is bolted to the gas turbine skid.

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ENCLOSURE

Enclosure

- Fabricated weatherproof enclosure suitable for outdoor installation including;
 - Acoustic Treatment for an overall average package acoustics performance of 85 dB(A) average @ 1m (3 ft) from the package at an elevation of 1.5 m (5 ft) from grade and acoustics performance of 65 dB(A) average @ 120m (400 ft) from the module at an elevation of 1.5 m (5 ft) from grade.
 - Internal platforms and grating for maintenance.
 - Space heaters.
 - All internal lighting (main and emergency), tubing, piping and cabling.
 - DC Backup lighting provided in the enclosure.
- Maintenance access facilitating engine / module removal and in-situ maintenance.

Ventilation System

- Ventilation System mounted on the enclosure roof module including;
 - Ventilation system using air from the combined combustion / vent air filter house (partition located internal to the air filter divides combustion and ventilation air).
 - Ventilation inlet / outlet ducting and silencer constructed of painted carbon steel interior and exterior.
 - Negative pressure ventilation system using three (3) x 50% AC motor belt drive ventilation fans.

FIRE PROTECTION SYSTEM

- Fire protection system including:
 - Two-shot CO2 (to NFPA 12) extinguishing system, including storage container located on a painted carbon steel skid, for 100% discharge to extinguish the fire and an additional 100% discharge to suppress re-ignition.
 - Fire dampers for the gas turbine ventilation exhaust and intake.
 - Warning lamps, lock-offs, interlocks and high temperature cabling.
 - Fire and gas detectors including:
 - Multi-spectrum infrared gas turbine enclosure flame detectors - Quantity - Four (4).
 - RTD type gas turbine enclosure heat detector - Quantity - Two (2).
 - Point IR ventilation outlet gas detectors - Quantity - Two (2).
 - Detector electronics - Dentronic Eagle Quantum Premier fire and gas controller.
 - Manifold and pipework to nozzles within the gas turbine compartment.

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PIPE, CABLE AND TUBE

- All on skid flexible conduit with galvanized steel inner core in accordance with Rolls-Royce standards (GER 0018).
- All wiring will terminate in junction boxes.

COUPLING

- Dry Flexible element - disk flexible coupling shaft including bolts for use between the gas turbine and driven equipment.
- A separate shaft guard is not required as the coupling shaft is protected by the cone arrangement in the exhaust diffuser.
- The coupling is designed with a service factor of 1.2.

COMBUSTION AIR SYSTEM

Air filter

- Painted carbon steel high efficiency pulse clean combustion air intake filter housing including:
 - Structural supports manufactured from galvanized carbon steel.
 - Pulsed cleaning control system fitted on the filter unit.
 - Access ladders and platforms for access of the Air Filter are provided.

Inlet Fogging system

- Inlet Fogging system is provide as part of the Inlet Spray Intercooling (ISI) system and mounted in the air intake system after the air filter including:
 - Inlet fogging nozzle array mounted in the air intake system.
 - Additional 3.5 m (12ft) of ducting to provide complete evaporator prior to the intake silencer.

Intake Silencer

- Intake Silencer located within the air intake ducting including:
 - Combustion air inlet silencer splitter constructed of 304 stainless steel with mineral fiber insulation and ducting constructed from painted carbon steel interior and exterior, with flexible joints to accommodate thermal movement.
 - Acoustic Treatment for an overall average package acoustics performance of 85 dB(A) average @ 1m (3 ft) from the package at an elevation of 1.5 m (5 ft) from grade and acoustics performance of 65 dB(A) average @ 120m (400 ft) from the module at an elevation of 1.5 m (5 ft) from grade.

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Intake Plenum

- Intake Plenum located within the gas turbine enclosure including:
 - Intake Plenum constructed of painted carbon steel interior and exterior.
 - Radial air intake scroll with gas turbine compressor water wash supply rings.
 - Gas Turbine Compressor water wash (off-line) spray ring mounted in the air intake scroll.

Exhaust

- The combustion exhaust system located within the gas turbine enclosure including:
 - Gas turbine exhaust diffuser
 - Exhaust volute positioned horizontally from the gas turbine enclosure.

GAS TURBINE OIL SYSTEMS

Synthetic Oil System

- Gas Turbine Synthetic Oil System located within the gas turbine enclosure including:
 - 316 stainless steel lube oil reservoir with thermostatically controlled electric heater.
 - Simplex shaft driven pump including eight supply and two savage pump sections.
 - Simplex oil filter.
 - Air / Oil separator.
 - Plate Type Water-Oil.
 - Pipework, fittings, and associated valves / instrumentation.
 - The gas turbine oil system provides lubrication and cooling oil flow to the electric start motor.

Synthetic Control Oil System

- Gas Turbine hydraulic control oil system located within the gas turbine enclosure including:
 - 316 stainless steel control oil tank.
 - Two (2) x 100% AC motor driven variable displacement pumps.
 - One (1) x bladder type accumulators.
 - Simplex Oil Filter for high pressure control oil and the second for lubrication / cooling of the electric starting motor.
 - Oil mist separator.
 - Pipework, fittings, and associated valves / instrumentation.

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FUEL AND PURGE SYSTEMS

Gas Fuel Metering System

- Fuel gas system, located within the gas turbine enclosure, designed to operate from a customer supplied source of fuel, including:
 - High speed shutoff / isolation valves.
 - The fuel gas connection at skid edge will be flanged.
 - Pipe work and fittings, associated valves and instrumentation.

Liquid Fuel Metering System

- Liquid fuel metering system, located within the gas turbine enclosure, including:
 - High speed shutoff / isolation valves.
 - The liquid fuel connection at skid edge will be flanged.
 - Pipe work and fittings, associated valves and instrumentation.

Purge Air System

- Purge Air System, located within the gas turbine enclosure, including:
 - Shell and Tube Type Water-Air.
 - Pipe work and fittings, associated valves and instrumentation.

GAS TURBINE AIR SYSTEMS

Gas Turbine Bleed Air System

- Gas Turbine Bleed Air System, located within the gas turbine enclosure roof module, including:
 - Bleed air exhaust ducting and silencer.

Gas Turbine Internal Auxiliary Gearbox Cooling Air and Bearing Pressurization Air System

- Gas turbine air system, located within the gas turbine enclosure, including:
 - Shell and Tube Type Water-Air.
 - Pipe work and fittings, associated valves and instrumentation.

WATER INJECTION SKID FOR EMISSIONS CONTROL

- Emission control water injection system, mounted on a separate skid, located adjacent to the gas turbine package including:

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- AC electric motor driven pump - Quantity – Three (3) x 33% variable frequency drive water injection pumps.
- Simplex filter water injection filter.
- On skid pipe work and fittings, associated filter, valves, and instrumentation.

LIQUID FUEL INJECTION SKID

- Liquid HP injection system, mounted on a separate skid, located adjacent to the gas turbine package including:
 - AC electric motor driven pump - Quantity – One (1) x 100% liquid fuel pump.
 - AC electric motor driven pump - Quantity – One (1) x 100% variable frequency drive water flush fuel pump.
 - Simplex filter liquid fuel filter.
 - Pipe work and fittings, associated filter, valves, and instrumentation.

ISI INJECTION SKID

- ISI Pump system, mounted on a separate skid, located adjacent to the gas turbine package including:
 - AC electric motor driven pump - Quantity – Four (4) x variable frequency drive water injection pumps staged for the ISI and evaporative fogging system.
 - On skid pipe work and fittings, associated filter, valves, and instrumentation.

WATER WASH CART

- Mobile gas turbine compressor cleaning system supplied one (1) per contract including.
 - Attachment points for the water wash system are externally located on the outside of the gas turbine module and on the wash cart.
 - Gas turbine package suitable for offline washing.
 - Water wash tank.

AC GENERATOR PACKAGE

BASE

- AC Generator is designed to be concrete plinth mounted.

ENCLOSURE

- The AC Generator is suitable for outdoor installation without a separate enclosure;
- AC Generator is provided with Acoustic Treatment for an overall average package acoustics performance of 85 dB(A) average @ 1m (3 ft) from the package at an elevation of 1.5 m (5 ft) from grade and acoustics performance of 65 dB(A) average @ 120m (400 ft) from the module at an elevation of 1.5 m (5 ft) from grade.

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- All on skid flexible conduit with galvanized steel inner core in accordance with Rolls-Royce standards (GER 0018).
- All wiring will terminate in junction boxes.

MINERAL OIL SYSTEM

- Mineral Oil System mounted on a separate skid, located adjacent to the AC Generator:
 - Mineral lube oil reservoir with thermostatically controlled electric heater.
 - One (1) x 100% shaft (AC generator) driven pump.
 - One (1) x 100% AC motor driven pump.
 - One (1) x 100% DC motor driven backup pump.
 - Simplex oil filters with changeover valves.
 - On-skid pipework, fittings, and associated valves / instrumentation.
 - Plate Type Water-Oil (1x100%).

CONTROLS (FREE ISSUED FOR MOUNTING IN CONTROL ROOM)

- Gas Turbine unit control panel including:
 - Gas Turbine monitoring, start, stop, sequencing and indication.
 - Gas Turbine fuel control functions including electric valves.
 - Oil flow protection function for gas generator oil console.
 - Vibration and position monitoring.
 - Control House for the Unit Control Panel.
 - Equipment Health Monitoring ready, no EHM equipment (no monitoring, unless LTSA is purchased).
 - Distributed I/O through the gas turbine driver skid.
- AC Generator control and protection panel with Simplex automatic voltage regulator.
- Gas turbine mounted electric variable frequency drive start system including electric air cooled power electronics and controller unit for variable frequency drive.

SPECIAL TOOLS

- Special tools, one (1) set per contract including AC Generator rotor withdrawal tool.

TESTING

- Gas Turbine - Full load factory test including performance and emission verification.
- AC Generator - Factory Acceptance Test per contract.
- Control Panel - One (1) Factory Acceptance Test per contract.

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- Gas turbine packages standard factory testing and loop checks.
- Witness of site test of gas turbine generator package.

DOCUMENTATION

- Documentation including outline and system schematic drawings, engineering data and equipment test reports will be supplied according to the Supplier Documentation Requirements List (SDRL) included in the proposal in the English language.

TRAINING

- Trent new unit turbo generator package training (Ph 1, 4 and 6) at the Rolls-Royce Training Facility.

SPARE PARTS

- Recommended commissioning spare parts.

PREPARATION AND SHIPPING

- Preparation, boxing, crating, and making Ready for Shipment to a Domestic Site
- Delivery EXW (OEM) Factory.

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CODES AND STANDARDS

- The base Price is based on RR's design, manufacture and delivery of the Equipment in accordance with
 - (i) Rolls-Royce's standard design criteria listed below, manufacturing processes and procedures, and quality assurance program, and portions of industry specifications, codes and standards in effect as of the date hereof which RR has deemed applicable to the Equipment and Services as shown below.
 - (ii) If the location of the delivered Plant is subject to any special or local codes, not explicitly stated in the contract, which are in conflict with these international standards then Customer shall obtain, with the reasonable assistance of the Rolls-Royce waivers from the relevant authorities to permit the use of the plant as supplied. Where such waiver cannot be obtained and it is practicable to modify the plant to achieve compliance then the Customer shall be granted the appropriate extension of time and variation in price in order to execute the modifications.
- The Rolls-Royce Package offered has been designed to conform to the internationally recognized codes and standards listed below:
 - 98/37/EC The Supply of Machinery (Safety) Regulations
 - 97/23/EC Pressure Equipment Directive (PED)
 - 94/9/EC ATEX Directive (Electrical/Mechanical)
 - 89/336/EEC The Electromagnetic Compatibility Regulations
 - 73/23/EEC Low Voltage Equipment
 - 93/465/EEC Rules for CE Marking
 - ASME VIII Div 1 U-Stamped Pressure Vessel
 - ASME B31.3 and BS EN 13480 Process Piping
 - ASME B16.5 Pipe Flanges and Fittings
 - ASME V Non-Destructive Testing
 - ASME 1X/BS EN 25817/PED Welding Piping/Weld Acceptance
 - AWS D1.1/BS 5950 Structural Design Fabrication
 - Material Traceability Certification to Section 3.1 of EN-10204
 - Hazardous Area Classification North America Class 1 Div 2
 - Institute of Petroleum Model Code of Safe Practice Part 15
 - Fire Codes – NFPA 72 / NFPA 12

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TERMINATION POINTS (GENSET)

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Interface Description	Terminal Points
Combustion Air	Inlet to intake filter house.
Compressed / Instrument Air	Compressed air connection at air intake filter house and skids edge connections as necessary.
Exhaust Gas	The exhaust flange from the gas turbine module.
Ventilation	Enclosure vents outlets.
Mountings	Locations on skid baseplates and all other structural members.
Fuel Gas	Inlet flange on side of gas turbine module and vent flange on gas turbine module.
Liquid Fuel	Inlet and outlet connections on liquid injection skid and gas turbine module.
Water Injection	Inlet and outlet connections on inlet spray injection (ISI) skid, water injection skid, liquid fuel skid and gas turbine module and air intake system as necessary.
Lubricants	Filling points at oil reservoirs. Drains connections at oil reservoirs.
Drains	Drains system connections on all modules as necessary.
Coolant	Inlet and outlet connections on gas turbine and AC generator modules skids edge connections as necessary.
Compressor Cleaning	Filling point of wash tanks.
Control and Instrumentation	Serial link connection between HMI and gas turbine module mounted control panels. UCP Terminal blocks in control panels and on-skid connections. GCPP Terminal blocks in control panels and on-skid connections.
Grounding	Grounding terminals on modules and auxiliary skids.
HV Electric Power	Lineside terminals of AC generator. Neutral terminal of AC generator
Medium Voltage Electric Power	At motor terminals inside the package. Motors include, AC generator lube oil pumps, gas turbine control oil pumps, starting motor, water injection pumps and enclosure ventilation fans.
Low Voltage Power	Single line connection on the gas turbine module, AC Generator module, CO ₂ extinguishant skid and water injection skid.

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TERMINATION POINTS (GENSET)
