

Budgetary Offer

Project name
Quick Power

This scope of supply is valid for one item of Siemens Industrial Turbomachinery AB's model SGT-800 gas turbine for power generation, designed for continuous base load operating mode.

Reference number

The SGT-800 is a high performance industrial gas turbine suitable for a variety of applications including simple cycle, combined heat and power and combined cycle power plant. In order to ensure reliability in the SGT-800, its design philosophy has been based upon simplicity, robustness and the use of proven technology. Modularization, few parts, long component life and easy inspection ensure high availability and low maintenance costs.

Turbine type
SGT-800
Power Generation

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1. Scope of Supply

This scope of supply forms a separate unit within the terminal points (utilities/consumables such as auxiliary power, fuel, water, washing detergent, instrument air, lubricating oil and grease are excluded). Alternative configurations are available.

Siemens' model SGT-800 gas turbine Power Generation for Onshore applications comprises:

Gas turbine equipment

Gas turbine engine

Single shaft designed core engine with a nominal rating of 54 MW. The engine is arranged for cold end drive and meets electrical ISO conditions.

- Compressor inlet casing and inlet bellmouth casing.
- Two bleed valves for air bleeding during start up and shutdown.
- One annular third generation dry low emission combustion chamber including 30 low emission burners.
- Vibration probes of accelerometer type.

Combustion air inlet system

- Filter house with service platform and ladder.
- Two sided pulse clean filter system with two filter stages, class F7 pulse filters as first stage and static class E10 disposable high efficiency filters as second stage.
- Support structure for filter house.
- Silencer.

Exhaust gas system

- Insulated axial exhaust diffuser with support.
- Stack height: 18 m above ground.
- Prepared for installation of diverter valve (diverter valve not included).
- Exhaust stack including bellows, transition piece and silencer with internal insulation.

Base frame for gas turbine

Gas turbine enclosure

Enclosure for weather and noise protection equipped with ventilation, main and emergency lighting and external stairs & walkways.

- Left side maintenance opening, looking from exhaust towards inlet. Internal walkways.

Ventilation for gas turbine enclosure

- 2 x 100% AC driven fans creating atmospheric underpressure in gas turbine enclosure. The fan unit is placed outside the enclosure.
- One-stage disposable barrier type air filter, class G4.
- Ducts in carbon steel.
- Inlet and outlet are equipped with:
 - Silencers
 - Weather louvers
 - Shut off dampers

Gas fuel system

- Internal gas fuel unit.
- Manual shut-off valve and pneumatically operated spring closing gas isolation valve.
- Y-type strainer with differential pressure measurement.
- Stainless steel piping downstream strainer.
- Ventilation valve to atmosphere.

- Leakage test of the ventilation & shut-off valves with pressure transmitter at start-up.
- Two spring closing, pneumatically operated quick shut-off valves with ventilation valve in between.
- AC servo motor operated primary gas control valve to the two primary gas manifolds.

Ignition system

- Main gas fuel used as ignition gas.
- Pressure regulator, shut-off and vent valves (solenoid operated).
- High energy spark plug for cross-ignition.

Starting system

Static frequency converter controlled AC electric start and barring motor with gearbox.

- Driver shaft with bearings and free wheel of SSS-type clutch.

Lubricating oil system

System common for driver and driven equipment.

- Carbon steel tank with sub-merged oil heating.
- Three AC driven main pumps of centrifugal type, two in operation and one in standby mode. Fully automatic and bumpless switch over to standby pump. Coast down can be made safely with a single pump in operation.
- Electrical motors, fed via frequency converters. DC backup provided on all pumps by a 440V battery to the frequency converters. In case of failure in AC distribution, switch over to DC feeding is made automatically and without interruption.
- 2 x 100% oil filter with possibility to switch filter during operation.
- Oil mist filter with stainless steel casing.
- Piping downstream filter in stainless steel.
- 2 x 100% AC motor driven oil system ventilation fan.
- Air cooled lubricating oil coolers of tube type.

Cooling and sealing air system

- Instruments and components for standard cooling and sealing air system.

Washing and cleaning system

- Turbine compressor washing system.
- Water wash trolley.

Electric generator equipment

Electric generator

Four-pole synchronous AC generator of salient pole rotor type. Brushless excitation system with rotating rectifier and PMG for excitation power supply. Lubrication oil is supplied by the gas turbine package common system.

- 11 kV, 50 Hz and 1500 RPM.
- Power factor 0.8.
- Generator cooling IC6 A1 A6, TEAAC.

Line and neutral cubicle

Neutral earthing resistor.

Synchronizing equipment

- Automatic and manual (semiautomatic) synchronizing system for two circuit breakers: the generator circuit breaker and one additional breaker. The system is provided with a "synchronizing by-pass" switch for breaker closing against a "dead bus".

- Frequency/load control.

Main gear and couplings

- 6600/1800 rpm speed reduction gear of double helical design. High speed quill shaft between gas turbine and speed reduction gear. Low speed quill shaft between speed reduction gear and electric generator.

Weather protection for electric generator

- Weather roof over the electric generator. Material in carbon steel.

Auxiliaries

Foundation

Anchor bolts for auxiliaries, such as stairs, platforms, coolers, fuel systems etc.

Gas detection system

Enclosure provided with gas detection system to detect gas fuel leakages.

Fire detection and extinguishing system

Fire detection & extinguishing system for the gas turbine room.

- 1 x 100% CO2 discharge for fire protection.
- Central fire suppression unit for alarm and automatic extinguishing.
- Manual release buttons located outside each door of the gas turbine room.
- Extinguishant release audible and visible alarms.
- Extinguishant system distribution pipework, valves and nozzles.

Electrical and control equipment

- Freestanding LER including indoor lighting, HVAC and external stairs and platforms. Separate UPS battery module.

Motor control center

Motor Control Center (MCC) including

low voltage distribution of IEC 61439 form 4b and withdrawable unit design supplying all consumers, except starting system.

Control system

- Micro processor based control, supervision and protection system with PC based operators station. Application software in controllers are battery backed-up for two months. License for control system programming included in operator station.
- Package protection system is built around a fail safe EC 61508 SIL proven safety controller.
- The critical signals work according to the principle of 1oo2.
- Main control and monitoring of the gas turbine contains systems and programs to perform both open and closed loop control. Main tasks are analogue and binary handling, sequencer for start & stop and gas turbine set supervision and monitoring.
- Gas generator speed and temperature control.
- PC and Windows 7 based operators interface with necessary software to operate the package in all operation modes. Rack type computer with redundant hot-swap, RAID controllers.
- Communication, hardwired interface and Modbus serial link and modem with standard scope of signals for communication with external computer system.

UPS and motor drives

UPS with MCB distribution board supplying uninterrupted power to instrument and control system. Automatic and bumpless switch over between mains and back-up battery by static frequency converter.

- Common battery supply DC power to the UPS and UMD systems. Valve regulated lead acid 440 V DC battery including charger with temperature compensated charging voltage. Capacity for complete ten hours emergency cool down cycle and one hour autonomy time for the UPS system.
- Lubricating oil emergency PLC used for pump control during UPS powered cool down.

Electrical installation

Factory services

Packing and delivery

- FAS Norrkoping, Sweden delivery as defined in Incoterms 2010.
- Packaging for sea transport.

Factory assembly

Mechanical, electrical assembly and control system installation in workshop including tests.

Factory tests

- Balancing and over-speed testing of the gas turbine rotor.
- Electric generator routine test at the subcontractors workshop.
- Unit workshop stationary test with contract auxiliaries and UCP. During the stationary test settings and adjustments are verified and flushing of systems carried out. Test includes function test of lubrication oil system.

Installation and commissioning services

Installation and commissioning is offered on a daily rate basis.

Operation and maintenance

Customer documentation

Standard operation and maintenance documentation compiled in the As Designed and As Built delivery. Three electronic copies, except one copy of Manufacturing record book. The electronic version is supplied on DVD.

- Design phase documentation delivered during the project engineering phase.

Commissioning spare parts for core and start-up (electrical and mechanical).

2. Exclusions

Siemens does not accept any responsibility for items which are outside its scope of supply. Where design of the installation is to be provided by the purchaser, Siemens requests the opportunity to review and comment against the general arrangement. It is particularly important for safe and proper operation to ensure that the ductwork systems are compatible with the gas turbine.

The following items are specifically excluded from this budget offer:

- All civil works including foundations.
- Counter flanges, gaskets and bolts at terminal points.
- Embedded steel plates.
- Interconnecting piping and cables between skid and electrical cubicles.
- Back-up Spare parts and operation consumables.
- Supervision of installation commissioning.
- Training.
- Trial run.
- Generator Circuit breaker
- Start motor transformer
- Liquid fuel system
- Gas turbine inlet cooling

3. Design Requirements

The equipment listed within the scope of supply is designed according to the following requirements:

Codes and standards

Equipment	Code or standard
Base frames	EN 1993 Eurocode
Air intake filter	First stage filters: EN 779:2012. Second stage filter: EN 1822:2009.
Gas fuel system	ISO 21789
Lube Oil Unit	EN 60034 (corresponding to IEC 60034) and API 614, with exceptions and clarifications.
Electric generator	IEC 60034-1
Electric generator surface treatment	ISO 12944-2:1998 "Paints and varnishes. Corrosion protection of steel structures by protective paint systems."
Main gear and couplings	AGMA 6011-I03
Speed reduction gear	Design according to AGMA 421
Gas detection system	IEC/EN 60079-1:2004 Explosion group IIC (zone 1)
Fire extinguishing	NFPA 12 with exceptions and clarifications. CO2 bottles if applicable: European Directive 1999/36/EC
Motor control center	EN IEC 61439
Control system	EN IEC 61439
Frequency converters	EN IEC 60204
Electrical installation	EN IEC 60204
Control cables	EN IEC 60204
SIL	IEC61508/IEC61511
Factory tests	ISO 3977-8
Customer documentation	ISO5457-1999 with designation system: KKS. Documents' structuring principles based on IEC 81346: "Classification and designation of documents for plants, systems and equipment".

Life cycle assessment

A life cycle assessment study according to ISO 14040-43 is available. It contains quantifications of the resource depletion, generation of waste and emissions to the environment caused by the manufacturing, use and disposal of the product.

Design basis

- Minimum outdoor temperature: -5 °C.
- Maximum outdoor temperature: 55 °C.
- The altitude of the installation is below 1000 meters.
- Package location: Outdoor.
- Onshore installation.

- Seismic loads according to IBC.
Acceleration short period, S_s , up to and including 0.5g.
Acceleration long period, S_1 , up to and including 0.2g.
- Wind speed: 45 m/s according to IBC.
- Non-hazardous area.
- Far field, 100 m, sound pressure level: 65 dB(A).
- Design for sound pressure level 85 dB(A) surface sound pressure, near field.
- Auxiliary voltage: 400 VAC
- Air cooled coolers for all equipment.

4. Performance

Altitude 0. m above sea level
 Barometric pressure : 1.01325 bar
 Inlet pressure loss : 9.00 mbar (at ISO & Base Load, total)
 Outlet pressure loss : 5.00 mbar (at ISO & Base Load, total)

F U E L C O M P O S I T I O N

Component	Volume %	Component	Volume %	Component	Volume %
CH4	85.100	C2H6	8.100	C3H8	2.800
N2	4.000				
LHV	:	46409.1	kJ/kg		
Fuel Temp.	:	15.0	°C (Ref. Temperature 25.0°C)		

special notes : Generator Drive 50 Hz with Gear
 Powerfactor : 0.90

Summary of Gas Turbine Performance Data SGT-800 54MW

Run id	Amb. temp. °C	R.H %	Load case %	Output kW	el eff. %	Heat Rate kJ/kWh	Fuel flow kg/s	IGV angle ----	Exh. temp. °C	Exh. flow kg/s
1	15.00	60.0	100.00	53263	38.89	9256	2.951	1.34	561.62	135.61
2	25.00	60.0	100.00	50714	38.53	9344	2.836	1.34	567.00	131.28
3	35.00	60.0	100.00	46760	37.67	9557	2.674	1.34	577.61	124.00
4	45.00	60.0	100.00	40605	36.06	9982	2.426	-5.81	599.26	110.87

Exhaust Gas Composition

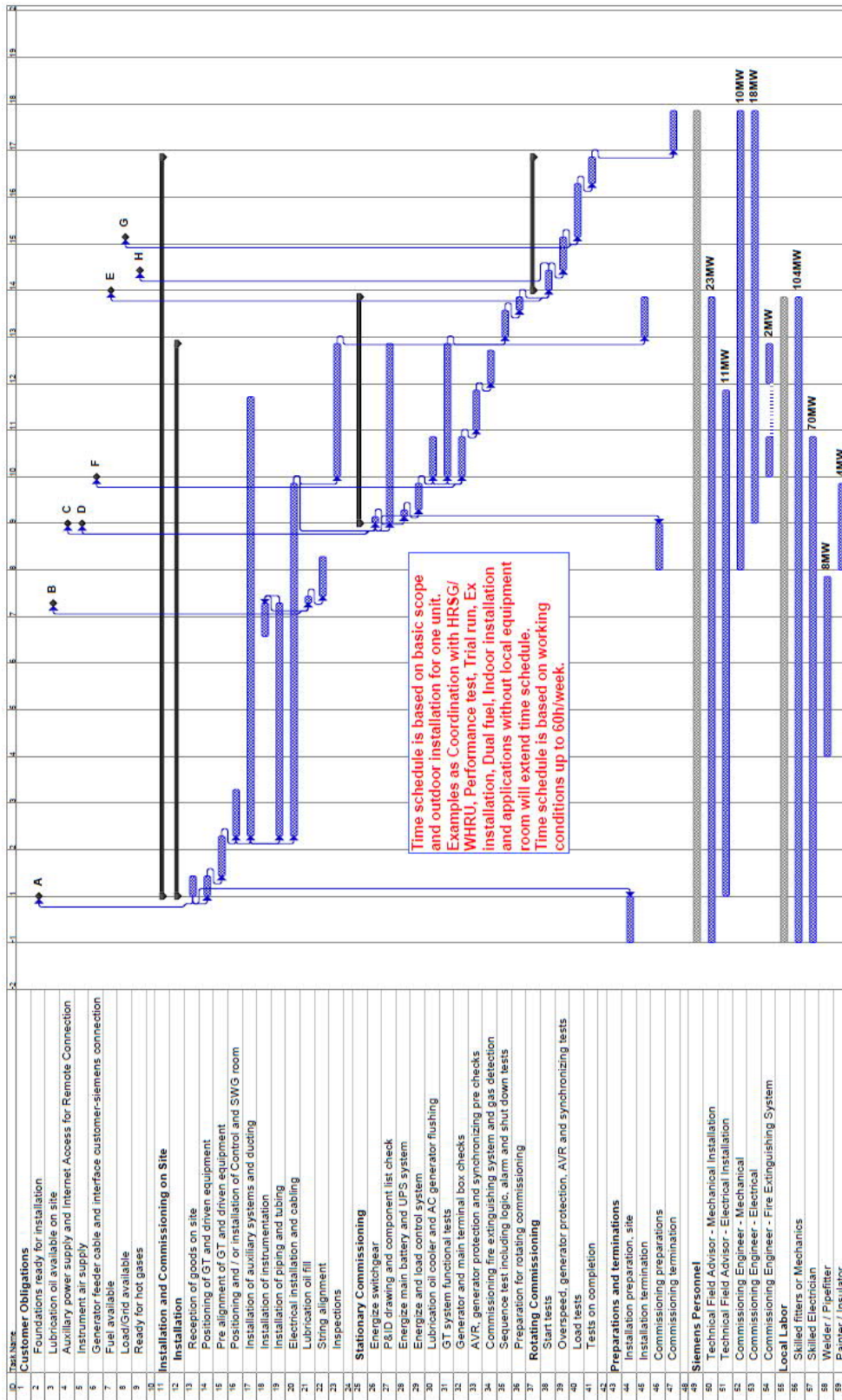
Runid		SO2	H2O	CO2	N2	O2	Ar	He
1	% WT:	0.0000	4.988	5.740	73.553	14.47	1.247	0.000
1	% VOL:	0.0000	7.874	3.709	74.668	12.86	0.888	0.000
2	% WT:	0.0000	5.490	5.699	73.161	14.40	1.240	0.000
2	% VOL:	0.0000	8.639	3.671	74.042	12.76	0.880	0.000
3	% WT:	0.0000	6.386	5.690	72.482	14.21	1.229	0.000
3	% VOL:	0.0000	9.996	3.646	72.965	12.52	0.867	0.000
4	% WT:	0.0000	7.924	5.771	71.346	13.75	1.209	0.000
4	% VOL:	0.0000	12.294	3.665	71.185	12.01	0.846	0.000

6. Shipping Specification

This shipping specification is for guidance only. Weight, dimensions and volumes may vary from project to project.

Item	Name	Gross weight (tonnes)	Packages dimensions (l x w x h meters / feet)	Volume (cu meters / cu feet)
1	Gas turbine block	93.5	10.4 x 4.45 x 4.0 / 34.2 x 14.6 x 13.1	~195 / 6886
2a	Generator	78.5	6.2 x 3.8 x 3.5 / 20.3 x 12.5 x 11.5	~82 / 2895
2b	Main terminal box	3	3.75 x 1.85 x 3.0 / 12.3 x 6.1 x 9.8	~21 / 742
3	Auxiliary skid	20	9.9 x 2.2 x 3.7 / 32.5 x 7.3 x 12.2	~150 / 5297
4	Gas turbine enclosure	40		~350 / 12360
5a	Filter housing	12	5.3 x 4.2 x 3.65 / 17.4 x 13.8 x 12.1	~162 / 5721
5b	Filter inserts	0.3	1.2 x 2.2 x 0.8 / 3.9 x 7.2 x 2.6	~4 / 141
5c	Inlet silencer	7.5	4.3 x 2.3 x 3.7 / 14.1 x 7.5 x 10.5	~32 / 1130
5d	Inlet air ducting	1.4	5.3 x 4.1 x 2.1 / 17.4 x 13.5 x 6.9	~46 / 1624
6a	Exhaust diffuser	15	7.0 x 4.3 x 3.8 / 23 x 14.1 x 12.5	~115 / 4061
6b	Flexible joint	1.0	3.9 x 3.9 x 0.7 / 12.8 x 12.8 x 2.3	~11 / 388
6c	Exhaust stack	25.0	15.6 x 4.9 x 5.3 / 51.8 x 16.1 x 17.4	~404 / 14267
6d	Exhaust splitter, lower	1.8	3.8 x 3.8 x 2.0 / 12.5 x 12.5 x 6.6	~27 / 954
6e	Exhaust splitter, middle + upper	1.6	3.8 x 3.8 x 1.7 / 12.5 x 12.5 x 6.6	~23 / 812
6f	Exhaust transition	1.4	3.8 x 3.8 x 1.4 / 12.5 x 12.5 x 4.6	~19 / 671
7	Lube oil cooler	3.6	4.5 x 1.0 x 2.8 / 14.8 x 3.3 x 9.2	~13 / 459
14	Gas turbine ventilation and generator cooling	23.1		~245 / 8652
45	External gas fuel unit	0.55	2.8 x 2.0 x 0.85 / 0.2 x 6.6 x 2.8	~5 / 177
16	Fire extinguishing system (CO2)	6.0	3.4 x 2.7 x 2.9 / 11.2 x 8.9 x 9.5	~27 / 953
17	General cargo	20.0		~150 / 5297
	Control equipment	15		~37 / 1300
		Σ ~370		Σ ~2118 / 74787

7. Installation and Commissioning Schedule



Above time schedule is a preliminary schedule only. The time schedule may be subject to changes depending on local environmental conditions, actual scope of supply or place of installation.

8. Maintenance General Information

Siemens' maintenance concept is focused on optimizing preventive maintenance with regards to cost and installation availability throughout the entire installation lifetime. This preventive maintenance philosophy has shown to return the lowest cost of ownership and maximum availability and reliability of the installation. Time has shown that employing an OEM recommended preventive maintenance plan will benefit owners directly in the reduction of unplanned downtime and unplanned maintenance cost. Whilst rare, it is important for operators to have in place support for corrective maintenance for those infrequent occasions that call for resolution of a forced outage and here Siemens supports with a range of spare engines, emergency spare parts and fast response field service personnel.

8.1 Service agreement

Correctly adopted and planned inspection and maintenance is the foundation for trouble-free and profitable Gas Turbine operation. Siemens' Long Term Service Agreement is named FlexLTP – designed for maximum flexibility to fit the operator's overall needs and priorities.

The scope of the services is adapted to your needs, ranging from a supportive contract up to a total maintenance coverage contract. The range can be summarized into the following:

- Essential: A set of agreed terms to simplify interaction. Basic services to support an emergency such as 24/7 support, remote diagnostics, etc.
- Advanced: All required scheduled maintenance activities including project management are included at a fixed price for the duration of the contract.
- Premium: Includes coverage for both scheduled as well as unscheduled events together with a tailored maintenance solution based on operators' needs and priorities, operating profile and site conditions. Through sensor data the scope of services can be continuously adapted during the Term for maximized use of the equipment and predictability of the Gas turbine maintenance budget.

The FlexLTP can be further adapted with features such as: performance guarantees, spare part kits, remote diagnostics, emergency back-up and lease engines and flexible (pay-per use, etc.) commercial and payment terms.

9.