SIEMENS

**Type of Installation:** 3xSGT-800 Classic Package

**Turbine Type:** SGT-800

## Table of contents

*Comment*

# SGT-800 Gas Turbine, Generator Drive.

# Scope of Supply and Terminal Points

## Part 1 General

### Basic definition:

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

## Part 2 Technical specification

**Application**

- 3 x SGT-800, Onshore Classic Package (simple cycle delivery)

**Operating mode**

- Continuous base load

**Units**

- SI-units

**Design conditions**

- 5 to +47°C ambient temperature.
- Moderate dust loading

**Installation**

- Outdoor

**Wind speed and seismic zone**

- <= 44 m/s and IBC code (1997) zone 3, S3 (foundation not considered)

**Site handling forces**

- Site 0.5 x g in any horisontal direction and 0.5 x g in vertical direction.

*Comment*

**Area classification**

- Safe area

**Surface treatment**

- Onshore (<5 km/<3 miles from sea), Corrosivity category C4 high. The internal equipment and the generator are treated for corrosivity category C2.
- Corrosivity factors according to ISO 12944.

**Design sound level**

- 85 dB(A) near field at 1 m distance (outside the GT enclosure wall and 1.5 m above ground level), far field 65 dB(A)/100m. Measured according to ANSI S 12.36 and ISO 3746-1995.

**Combustion chamber**

- Dry Low Emission system

**Fuel**

- Dual fuel (natural gas / diesel oil), fulfilling the Supplier fuel specifications (X241010E/1CS26810 and X242004E/1CS26811) or accepted project fuel data sheets (W241009E/1CS26748 and W242003E/1CS26750)

**Lubricating oil cooling**

- Water (water / antifreeze fluid TEMPER or equivalent), cooling media, supply temperature <+40 °C

**Generator cooling / protection form**

- Cooling/protection form: IC8 A1 W7/IP55
- Cooling water temperature to generator, ambient air temperature plus max 10 deg. C.

**Generating voltage / frequency**

- 11.0 kV / 50 Hz

**Auxiliary voltages, frequency and standards for motors**

- 400 – 420 (not exact specified) VAC, 50 Hz, (TN-C-S system) start motor 690 VAC, 3-phase. 230 VAC UPS. Standards: EN/IEC.
- Anti-condensation heating for motors

*Comment*

**Emergency battery voltage**

- 440 VDC

**Shutdown system**

- Enhanced instrumentation reliability, " 2 out of 3" on instruments tripping during operation, excluding flame detectors.

**Control system**

- Simatic providing a fully automatic unit.

**Vibration probes**

- Vibration transducers (accelerometer type) and additional shaft vibration probes. See also system code 300, 330 and 501

**Designation system**

- German based KKS tag number system. The components are identified in a hierarchical system according to the functional placement in the plant.

**Codes and standards**

| | |
|---|---|
| - Drawings: | ISO5457-1980 |
| - Noise emissions: | ISO3746-1995 and ANSI S 12.36 |
| - Exhaust emissions: | ISO9096-1992 and ISO10849-1996 |
| - Pressure vessels, filters and coolers in auxiliary systems: | PED. |
| - CO2 bottles: | European Directive 1999/36/EC, on-skid/off-skid |
| - Pipe fittings: | DIN or ANSI, on-skid/off-skid |
| - Package piping: | EN13480 |
| - Interconnecting piping: | EN13480 or ASME B31.3 for main gas fuel piping. |
| - Structural steel: | UBC-97 with exeption for use of European standards. |
| - Terminal point flanges: | ANSI (fuel systems) |
| - Pipe coupling threads: | ISO 228:1-1994 and SMS 2165 |
| - Fire extinguishing (design): | NFPA12 with clarifications |

| | | *Comment* |
|---|---|---|
| - Gas detection: | IEC/EN 50018 Explosion group IIC (zone 1) | |
| - Gas fuel system: | Siemens design | |
| - Liquid fuel system: | Functional design according to RN78 and AFS 1994:39. | |
| - Pumps: | DIN and/or ISO | |
| - Bolts/nuts: | DIN | |
| - Vibration: | ISO10816-4, 1998 | |
| - Gear: | AGMA 421.06 & API 613 with E & C | |
| - Generator: | IEC/EN60034 | |
| - MCC: | IEC/EN60439 part1, IEC/EN60529, IEC/EN60947 part 2, 3 and 4-1 | |
| - Control cubicles: | IEC/EN60439 part1, IEC/EN60529, IEC/EN60947 part 2, 3 and 4-1 | |
| - Control system: | IEC/EN61000-6-4, IEC/EN61000-6-2, IEC/EN60068 part 2, IEC/EN60439-1, IEC/EN60950, IEC/EN61010-1 | |
| - Power cables: | IEC/EN60227, IEC/EN60228, IEC/EN60331, IEC/EN60332, IEC/EN60502, IEC/EN60811 | |
| - Control cables: | IEC/EN60227, IEC/EN60228, IEC/EN60331, IEC/EN60332, IEC/EN60502-1 | |
| - Cables joints of MM-type: | IEC EN50262 | |
| - Frequency converters: | EN60204 part 1, EN60529, EN61800 part 3. | |
| - Other electrical equipment: | Applicable IEC/EN-code | |
| - Enclosure and base frame: | BSK-1994 (corresponding to ISO2394-1986) | |
| - Balancing: | ISO 1940-1 and ISO 11342-1998 | |
| - Site performance test: | ASME PTC22 | |
| - Lubricating oil system: | API 614 with E & C | |
| - Gas turbine: | API 616 with E & C | |
| - Vibration monitoring: | API 670 with E & C | |
| - Welding procedures: | EN 287/288 or ASME IV | |

*Comment*

The Package is complying with the Machinery directive, Pressure equipment directive (PED), the low Voltage directive and the EMC requirements valid within the European Community.

A classification plan of the installation according to the European standard EN 60079-10, as well as a Risk Analysis which is the base for the Certificate of Conformance according to the Machinery Directive, are available.

A life cycle assessment study (LCA) 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.

**Hazop study**

- Hazop study for the suppliers scope of supply

**Enclosure**

**Electrical and controll modules**

- Electrical and control module
- Battery module

**Exhaust direction from the Gas Turbine outlet**

- Horisontal, axial

**Maintenance opening**

- Left side (looking from the exhaust towards the air inlet)

**Delivery**

- Delivery acc. to INCOTERMS 2000 as defined in commercial T&C. Local sourced equipment will be delivered Ex work.

## Terminal Points to Customer

For data at the terminal points, please refer to separate document. Counter flanges in Siemens scope of supply

431

**Gas Fuel System**

– Gas fuel connection, on gas fuel skid in the enclosure wall

432

**Liquid Fuel System**

– Liquid fuel connection, on outer liquid fuel skid

*Comment*

– Drains from supply pipe to filter, filter unit and tank

442

**Cooling Water System**

– Common in/out flange connections for cooling water to watercooled lub.oil and AC generator.

482

**Instrument Air**

– Connection located at the , not to be descided yet

491

**Drains**

– Connection for emptying of the drain tank located at the enclosure wall, maintenance door side.

590

**Medium Voltage**

– Generator lineside, busbars located inside the AC Generator MV terminal box.

626

**Auxiliary Power**

– Incomming feeders for 400 to 420 (Not exact specified) volt and 690 in the electrical and control cubicle

–

630

**Control & Instrumentation**

– Terminals in control panels.

684

**Grounding**

– Grounding connections on delivered equipment.

720

**Interface to Foundation**

– Lower end of multi point support for the GT and driven equipment
– Lower end of the support structures for:
  - Air intake system.
  - 2x100% watercooled coolers for the lubricating oil system.
  - Propane start fuel unit for dual fuel & liquid fuel only
  - Ventilation system GT
  - Electric start and barring motor
  - Electrical and control module
  - Battery module
  - Central fire suppression unit.
– Incoming / outgoing water connection flanges located , not to be descided yet

Comment

740

**Exhaust system**

– Delivery limit is exhaust diffuser bellow

## Outlets to Atmosphere.

For data at the outlet points, please refer to separate document.

410

**Lubricating oil**

– Outlet from lubricating oil system ventilation fan, located on the GT enclosure roof.

423

**Ventilation**

– Outlet from the GT and EG enclosure to atmosphere, downstream the weather louvers

431

**Gas fuel system**

– Gas fuel ventilationon the roof

432

**Liquid fuel system**

– Liquid fuel service tank ventilation, located above the GT enclosure roof

438

**Purge air**

– Purge air ventilation, outlet located above the GT enclosure roof.

740

**Gas Turbine exhaust**

– Exhaust gas from the Gas Turbine diffuser, bellow included

*Comment*

# Scope of supply

## Part 3 Gas turbine - Principal components

300

**Industrial design, single shaft with modular concept:**

- Compressor inlet casing and inlet bellmouth casing.
- Thrust bearing #1 (tilting pad, directed mineral oil lubrication) combined with radial journal bearing #1 (tilting pad, directed mineral oil lubrication), located in the inlet bellmouth casing.
- 15-stage axial flow compressor with 3 rows of variable guide vanes (AC servo motor driven), electron-beam welded compressor rotor, inner stator casing with vane carriers forming air flow path, vertically split outer casing
- 2 bleed valves (pneumatically actuated) for air bleed during start-up and shutdown.
- Central casing with diffuser for compressor discharge air.
- High energy spark plug for cross-ignition during engine start-up.
- 3rd generation DLE system with annular combustion chamber, 30 burners and 2 optical flame detectors.
- 3-stage bladed turbine rotor, connected to the intermediate shaft by tie-bolts.
- Turbine casing with gas flow path and 3 stages of turbine guide vanes.
- Radial journal bearing #2 (directed mineral oil lubrication), located in the turbine exhaust diffuser casing.
- Turbine exhaust casing with exhaust diffuser.
- Drain valves (manually operated) from compressor inlet plenum, compressor bleed cavities #1 & #2, central casing and exhaust casing.
- Proximity probes, 2 off (x-y) in bearing #1 and 2 off (x-y) in bearing #2
- Bently Nevada, accelerometer type, vibration probe: 3 off in bearing #1 and 3 off in bearing #2

330

**Speed reduction gear (6600/1500 rpm), double helical design.**

- High speed side, quillshaft connection to the gas turbine.
- Low speed side, quillshaft connection to the generator.
- Free wheel clutch (SSS-type) for connection of electric start and barring motor

*Comment*

- 4 journal bearings of sleeve type for mineral oil lubrication.
- 1 temperature transducer in each of the four bearings
- 3 BN, accelerometer type, vibration probe located on the casing at the high speed (pinion) turbine side.
- 3 BN, accelerometer type, vibration probe located on the casing at the low speed shaft (wheel) turbine side
- Proximity probes, 2 off (x-y) in pinion bearing (turbine side) and 2 off (x-y) in wheel bearing (turbine side).

380

**Mounting details**

- Pendelum supports, spring loaded supports, fix point support and side support for the gas turbine, down to the main baseframe. Supports for the diffuser, down to the foundation.

385

**Turbine base frame**

- Welded I-beam baseframe for the GT driver unit

390

**Insulation**

- Insulation of the Gas Turbine (including exhaust casing) for personnel safety, heat and noise reduction.

*Comment*

# Part 4 - Auxiliary systems

Some auxiliary systems and parts of the control system are mounted on a separate skid located side by side with the GT unit. See layout and General Arrangement drawings.

401

**Instrumentation**

- Instrumentation pipes, instrument valves and fittings in 316L stainless steel
- Enhanced instrumentation reliability, with "2 out of 3" voting logic for instruments tripping during operation. Due to physical restrictions flame detectors are duplicated on a 1oo2 tripping scheme.

402

**Cooling & Sealing air system**

- Extraction from compressor stage #3 for external turbine stator cooling and sealing air around bearing #2 during operation, including temperature measurement, strainer with diff. pressure transmitter, butterfly valve and orifice.
- Extraction from compressor stage #5 for bleed to exhaust, external turbine stator cooling and sealing air around bearing #2 during start-up and shutdown - and cooling to turbine stator stage #3 during start-up and shutdown, including temperature measurement, strainer with diff. pressure transmitter, butterfly valve, orifice and bleed valve.
- Extraction from compressor stage #10 for bleed to exhaust during start-up and shutdown - and cooling of turbine stator stage #2 and air supply to the balance piston during start-up, operation and shutdown, including temperature measurement, strainer with diff. pressure transmitter, butterfly valve, orifice and bleed valve.
- Instruments and components for cooling and sealing air system

403

**Electric Start & Barring system**

- Static Frequency Converter (SFC).
- Electric start and barring motor.
- Driver shaft of flexible type, steel plate coupling.
- Instruments and Components for Electric Starting & Barring system

410

**Lubricating Oil System designed for ISOVG46 mineral oil fulfilling Supplier specification 8121-09**

*Comment*

- Covering:
  - The Gas Turbine
  - The Speed Reduction Gear
  - The Generator
  - Start and barring motor.
- Carbon steel lube oil tank with 2 heaters.
- Supply piping for the lube oil system in carbon steel, stainless steel downstream the filter to the GT.
- Discharge piping in stainless steel.
- Pumps and fan with redundant power supply.
  - 3 x 80% AC motor driven centrifugal type pumps (2 in operation and 1 in stand-by mode). The pumps are normally utilised to 2 x 50% but the SFC's and motors are designed to increase the capacity of the pumps during tranfer from the operational to the stand-by pump.
  - 2 x 100 % AC motor driven oil system ventilation fan.
  - Oil system ventilation filter with filter housing in stainless steel

Each pump and the fan is driven by a Static Frequency Converter. DC back-up is provided on each pump and the fan by the 440VDC battery feed to the SFCs.

- 2 x 100 % water cooled lube oil cooler (plate type) designed for +40°C cooling media inlet temperature, including lub.oil piping
- 2 x 100 % lube oil filter with delta P transmitter.
- Oil purifier unit.
- Instruments and Components for standard Lubricating Oil system.

422

**Fire Extinguishing System, CO2**

- Fire detection and extinguishing system for the GT enclosure.
- Installation and maintenance according to NFPA 12 with clarifications
- 1 x 100 % discharge for fire protection as above.
- Piping, valves and nozzles.
- 10 IR detectors, 6 heat detectors covering the gas turbine and auxiliaries located inside the GT enclosure.
- 2 warning lights flashing red, located outside the GT enclosure.
- 2 acoustic alarms (one CO2 driven and one electrically driven), located inside the GT enclosure

*Comment*

- 1 CO2 released status light, 1 CO2 blocked status light and a manual release button, located outside each normal entrance door to the GT enclosure.
- Fire detection and extinguishing system for the control room
  - 1 acoustic alarm (electrically driven) and 1 portable extinguisher, located inside the control room.
  - Manual alarm button, located outside at each normal entrance door of the control room.
  - 1 warning light (flash light), located outside the control room
  - 4 smoke detectors in the electrical and control module and 2 smoke detectors in the battery floor of electrical and control module
- Fire detection and extinguishing system for the electric generator enclosure.
  - 2 acoustic alarms (one CO2 driven and one electrically driven), located inside the electric generator enclosure.
  - 1 warning light (flash light), located outside and above the normal entrance door of the generator enclosure (gable end).
  - 1 CO2 released status light, 1 CO2 blocked status light and 1 manual release button, located outside the normal entrance door of the generator enclosure.
  - 4 smoke detectors in the generator enclosure
- Central fire suppression unit. The central unit is connected to the control system for alarm announciation.
- Instruments and Components for standard Fire Extinguishing system.

423

**Ventilation system**

- Weather louvers at the ventilation inlet and outlet of the GT enclosure.
- Weather louvers at the ventilation inlet and outlet of the generator enclosure.
- Silencers as required for the specified sound level, on ventilation inlet and outlet of the GT enclosure.
- 1 stage air filter (barrier type, disposable) for the GT enclosure.
- Shut off fire dampers on the ventilation inlet and the ventilation outlet of the GT enclosure.
- 2 x 100 % AC driven fan placed in the ventilation outlet of the GT enclosure, i.e. GTenclosure subatmospheric pressure.
- Air conditioning unit (2x100%) for the electrical and control module.
- Air conditioning unit (2x100%) for the battery module.

*Comment*

- Ventilation ducts in Carbon steel.
- EG enclosure 2x100% ventilation fans including fire shut of dampers

424

**Gas detection system**

- 2 semi-conductor gas detectors, located in the ventilation outlet from the GT enclosure (one in low position and one in high position).
- 4 additional semi-conductor gas detectors, located in the ventilation outlet from the GT enclosure (two in low position and two in high position)
- The detectors are connected to the GT control system via the gas detection central unit. Each gas detector has an alarm and an engine shutdown level.

431

**Gas Fuel System**

- Total gas flow meter
- Stainless steel piping downstream strainer.
- Gas fuel unit
- Manual isolation valve
- Gas isolation valve (spring closing, pneumatically operated).
- Strainer, mesh size 200, with local diff. pressure indicator.
- Two quick shut-off valves in series (spring closing, pneumatically operated).
- Ventilation valve between the quick shut-off valve.
- Ventilation valve between the isolation valve and the first quick shut-off valve
- Gas control valve ( AC-servo motor operated) with position feedback, for the 2 pilot gas manifolds.
- Extraction line, upstream the gas control valves, for purge gas to the liquid fuel manifold
- 2 pilot gas manifolds with 18 and 12 connection points respectively from each manifold to the 30 burners.
- 1 main gas manifold with 30 connection points to the 30 burners.
- Gas control valve (AC-servo motor operated) with position feedback, for main gas manifold.
- Gas control valve (pneumatic positioner) with position feedback, for central gas manifold..
- All piping in gas fuel unit and internal GT-skid piping in stainless steel
- Ventilation lines to atmosphere, standard location above the air intake filter.

| | | Comment |
|---|---|---|
| 432 | **Liquid fuel system**<br>– Isolation shut off valve (spring closing, pneumatically operated)<br>– Last chance filter unit, consisting of 2x100% filter with drain valves, a deltaP switch and switch for manual change over.<br>– Level control, floating valve, for the liquid fuel service tank<br>– Liquid fuel service tank with 1000 litres volyme.<br>– Vent line from tank to atmosphere.<br>– Frequency controlled motors and high pressure pumps (internal gear type) for the main line (1x100%) and the pilot line (1x100%).<br>– Pressure relief valves<br>– 2 quick shut-off valves (spring closed, pneumatically operated)<br>– Drain valves (pneumatically operated) for purging after shut down.<br>– Pilot manifold with 30 connection points for the 30 burners.<br>– Main manifold with 30 connection points for the 30 burners.<br>– Piping from Customer interface to pilot and main liquid fuel manifold, Stainless steel downstream the filter.<br>– Flow meter in the supply line, located between the filter and the fuel service tank.<br>– Fuel heater for start-up, located in the fuel service tank. | |
| 438 | **Purge Air System**<br>– All internal piping.<br>– 3 shut-off valves (spring closing type), 1 on main supply line for pilot and main, 1 on pilot line and 1 on main line.<br>– Ventilation line with ventilation valve (spring opening type) to atmosphere. | |
| 439 | **Ignition System**<br>– Propane bottle cabinett<br>–<br>– Piping for propane supply from the bottles to burner #26 during startup<br>– Pressure reducing valves (one for each bottle) and a common control valve<br>– Shut-off and vent valves (spring closing, pneumatically operated).<br>– High energy spark plug for cross-ignition (see Item 300)<br>– Trace heating | |

*Comment*

442

**Cooling water system**

The unit valid for black start purpose, a fin fan cooling system is included, which will be used during start up, until the common cooling system is working

482

**Instrument air system**

- Internal piping in stainless steel.
- Last chance coalescer filter (0,01 micrometer)
- Instrument air supply by customer.

491

**Compressor washing system**

- Washing unit for compressor washing, one unit cover all three turbine units, consisting of:
  - Water tank with heater, level gauge and temperature gauge. Volyme 80L.
  - Detergent tank with heater, level gauge and temp. gauge. Volyme 80L.
  - Filter.
  - AC driven pump (reciprocating type).
  - Pressure regulating valve and pressure gauge.
  - Piping, inlet manifold and injection nozzles for offline washing.
- 7 manually operated drain valves with piping, to common location at skid edge via the internal drain tank. from the Gas Turbine.
- Internal drain tank including drain pump and level switch. Volyme app. 100L.
- Instrumentation and piping according to P&ID
- Equipment acc. to "Safe area" area classification.

*Comment*

# Part 5 - Generator

500

**Equipment according to MV Single Line Diagram**

501

**Generator type AMS 1250 A LF**

58,415 MVA at 35°C cooling water temperature and P.F. 0.8.

- Frequency / speed / voltage : 50 Hz / 1500 RPM / 11 kV.
  Standards, IEC.
  Four pole (salient) three phase synchronous generator.
  Cooling form: IC8 A1W7.
  Brushless AC-exciter with rotating rectifier.
  PMG for excitation power supply.
  Insulation according to class F.
  Temperature rise at rated output and P.F. 0.8 within class B absolute according to § 16.3.4 of IEC 34-1 within the ambient temperature range.
- Temperature monitoring by RTD.
- Vibration monitoring by accelerometers.
- Additional proximity probes, 2 in X-Y direction on each bearing.
- Lube oil supply from the turbine system.
- Line and neutral side termination points for MV terminal enclosure.
- Anti condensation heaters in the main machine, exciter and MV terminal box.
- Separate junction boxes for instruments, excitation and heaters.
- Witness point for routine test EG

580

**Excitation and voltage regulator system**

- Dual channel Automatic Voltage Regulator (AVR) including:
- Automatic Voltage Regulator (AVR)
- Built in DC-chopper for regulation of field current
- Power factor control.
- Reactive power control.
- Excitation current limiter with cooling air bias.
- Stator current limiter with cooling air bias
- Under excitation limiter.

590

**Generator Medium Voltage (MV) terminal enclosure**

*Comment*

Enclosure for line and neutral side MV equipment. Phase conductors of solid copper bars.

Design prepared for various earthing options.

Equipment data:

| | |
|---|---|
| Rated voltage: | 11 kV |
| Rated current: | Max FLC (Full Load Current) |
| Rated frequency: | 50 Hz |
| Highest system voltage: | 12 kV |
| Rated insulation level, 1 min 50/60 Hz: | 28 kV |
| Impulse 1.2/50 microseconds, peak: | 75 kV |
| Short circuit current, 1 s: | 50kA |
| Short circuit current, peak: | 125kA |
| Degree of protection: | IP55 |

The enclosure accomodates the following:

- Undrilled Cu busbars at lower end of enclosure suitable for cable or busduct connection.
- Lightning/surge arrestors, line side. (3 nos. single phase units, connected YN).
- Surge capacitors (3 nos, single phase units, connected in YN)
- Voltage transformers line side (3 nos. single phase units, connected YN).
- Current transformers line side.(3 nos, 3 secondaries, 1 A/phase).
- Generator stator terminals (6 nos.).
- Generator star point.
- Current transformers neutral side. (3 nos, 3 secondaries, 1A /phase).
- One CT and one PT used for client tariff metering
- Neutral point resistor, 10A, 10 sec., contactor, arrestor and CT.
- Excitation rectifier module with transducers for electrical quantities.
- Mobile earthing tool for maintenance work.
- Air condition unit for the exitation converter enclosure.

*Comment*

# Part 6 - Electrical and control equipment

600

**Electrical auxiliary systems**

Electrical auxiliary systems as specified below:

626

**Motor Control Centre**

Siemens MCC board, Isc=50kA.
Supplies all consumers (except starting system) within the scope of supply and is provided with:

- Withdrawable circuit breaker incomer.
- Withdrawable fuseless motor starters and MCCB feeders.
- Dual redundant incomers with automatic transfer.

Protection class IP42.

625

**UMD (Uninterrupted Motor Drive) and UPS (Uninterrupted Power Supply) systems**

The system provides uninterrupted AC and back-up DC power to the AC motor driven lube oil pumps and the oil ventilation fan(s) of the turbine package.
A UPS distribution board for supply of the I&C equipment of the turbine is as well integrated within the free standing panel arrangement. UPS feed supplied by others.
A common battery supply DC power to the UMD and UPS system. (Only to UMD system when UPS supply is provided by others.)
The system is completely self contained and designed with protection class IP42, (IP20 internally)
The panel arrangement mainly contains the following equipment:

- One AC power distribution board with MCCB breakers supplying the frequency converters, and the battery charger.
- One DC power distribution board with MCCB breakers supplying the frequency converters.
- Static frequency converters for the lube oil pumps and the oil ventilation fan(s).
- Static frequency converters for UPS supply. One hour autonomy time.
- MCB distribution board for I&C equipment. Fed from UPS supply.
- Battery charger, 440 VDC.
- PLC based emergency back-up operation system.

*Comment*

**UMD battery**

Valve regulated 440VDC lead acid battery. Eurobatt classification: High Integrity, design life 10 years.
Capacity for one hour with UPS system load and a complete 10h emergency cool down cycle.

629

**Frequency converter(s).**

- Starting frequency converter, Siemens Sinamics S120, 690VAC 50/60 Hz supply, protection class IP42.
- Frequency converter for the main liquid fuel oil pump, Siemens Sinamics G120, protection class IP43.
- Frequency converter for the pilot liquid fuel oil pump, Siemens Sinamics G120, protection class IP43.

630

**Control equipment for automatic start-up, operation and shut down.**

Micro Processor based control, supervision and protection system with a PC based operators station. The system is designed for highest possible operators friendliness with colour process graphics, log and alarm /event displays, printer for lists and hardcopies from the screen. The system has various openings to external computer systems. The system program provided is in the US English language.

PCS7 licence for control system programming included in a separate PC. (At deliveries of more than one GT at the same installation, the tool is common for all GT units.

The following division of functionality described below constitutes the turbine control system:

634

**Operators station**

PC based (Windows XP) operators interface, Simatic WinCC with necessary software to operate the GT in all operation modes. Rack type computer with redundant Hot-Swop, RAID controllers.

The PC based operators interface consists of:

- Rack mounted turbine HMI with 17 inch TFT screen, keyboard, mouse and laser colour printer.
- Additional desk mounted turbine HMI with 21 inch TFT screen, keyboard and mouse
- Ethernet interface to turbine controllers

*Comment*

The OS station performs apart from providing normal operators dialogue:
- Trending and storing of process parameters.
- Self diagnostics and displays of system and individual board status.

Other indicators:
- Start counter.
- Operating, equivalent operating hour and cycle counter.

635

**Main process controller Simatic AS400**

The main Simatic controller contain system and application programs to perform both open and closed loop control in order to run the turbogenerator set. The programs are battery backed up for appr. 2 month.. The main tasks of the AS400 controller are:
- Analogue and Binary I/O handling.
- Sequencer for start and stop.
- Gas turbine set monitoring.
- Frequency/load control.
- Gas turbine speed and temperature control.
- Gas turbine acceleration and deceleration control.

631

**Unit protection system**

The unit protection system is built up around one redundant fail safe controller (AS400-FH), proven according to IEC61508 with the principle “2 out of 3”. All trip signals works with the principle of “fail safe”, i.e. signal loss equals signal tripped. The “fail safe“ principle is also valid for alarms. The system operates with 24 VDC

The “2 out of 3” tripping logic is applied only to signals / instruments (excluding flame detectors) creating a turbine trip during normal operation.
All protection system actions are registered and informed to the operator on the main operators station.

630

**WHRU control (Basic level)**

I/O interface in turbine control system for signal interfacing with control and monitoring system for WHRU provided by others.
- 8 Digital inputs, 24VDC
- 4 Digital outputs (potential free relay contacts)
- One signal to the GT control system
- One display page in GT operator station.

*Comment*

637

**Condition monitoring system (CMS).**

The standard CMS systems main objectives are; collecting, monitoring and analysing historical data storage of process and control system values from the GT process.

A Software Licence Agreement (SLA) must be signed by the end Customer before the installation at site.

Base Module/ Software.
- Trends.
- Alarm and Event.
- Statistics tool for digital tags.
- Report tools at site.

Hardware.
- Computer / 1 (one) for 1-3 GT (approx. 2 years data storage capacity)
- Monitor/1 (one) for 1-3 GT

Service.
- Customer configuration.
- Installation.
- Commissioning.

Environment.
- The CMS computer is to be placed within 5m range from a common Terminal Net used by all Operator Stations and the Remote access connection.

Software corrections.
- Included for the first 2 years
- Software corrections (bug fixing)
- Thermodynamic performance module for monitoring and calculation of GT performance, using the Suppliers performance programs. Present performance is compared to nominal new and clean performance. The module indicate performance losses due to fouling and aging and furthermore various errors in the core engine and the measuring system.
- Vibration module for monitoring and analysing of vibrations. Module based on key parameters of the rotor train, i.e. 1xN, 2xN, amplitude, phase, speed, load etc. Correlations possible with appropriate turbine and process parameters from the basic module. Ethernet interface with BN3500 vibration monitor.

| | | *Comment* |
|---|---|---|
| 631 | **Generator protection system**<br><br>Protection system Siemens Siprotec 4. Protection functions as indicated below. | |
| | | IEEE-code(Sub) |
| | – Differential protection | 87G |
| | – Stator earthfault protection | 59N |
| | – Voltage restraint over current protection | 51V |
| | – Under impedance protection | 21 |
| | – Negative sequence protection | 46 |
| | – Under excitation protection | 40 |
| | – Rotor earth fault protection | 64R |
| | – Over/under voltage protection | 59/27 |
| | – Reverse power protection | 32 |
| | – Rotating diode fault protection | 58* |
| | – Block differential protection | 87GT |
| | – Directional earthfault protection | 67N, the extra torodial current transformer needed for this protection is excluded from Siemens scope of supply |
| | – Out of step protection | 78 |
| | – Breaker Failure | 50BF |
| | – Frequency protection | 81 |
| | – Trip Lockout function | 87G |
| | *) AVR system function | |
| 639 | **Synchronising equipment**<br><br>Automatic and manual (semiautomatic) synchronising system for the Generator Circuit Breaker (GCB). The system is provided with a "Synchronising by-pass" switch for breaker closing against a "dead bus". | |
| 660 | **Remote Connection** | |

*Comment*

The standard Remote Connection makes it possible to an online connection between customers control system and Siemens intranet.
The Remote Connection requires a internet connection (DSL or similar) provided by the customer.

630

**Included options for control system**

- Optical interconnection of 2-3 control systems (no cable included) for common access to GT units on the same control network
- Communication. Hardwired interface

Extra wall mounted electrical cabinett, empty, for hubs and fibreoptic communication interface

- Redundant OPC link with standard scope of signals for communication with external computer system
- Redundant CPUs, Profibus and power supplies on AS400
- Redundant OS Server
- Hot replacement of I/O modules
- Second operator station, desktop with flat screen
- Clock synch by GPS
- PCS7 Engineering Station, one common for all three units

680

-

*Comment*

# Part 7 - Installation and building

710

**Enclosure**

- Weatherproof, outdoor:
  - Acoustic enclosure for the Gas Turbine, auxiliaries, gear and Electric Generator.
  - Complete with access doors, emergency doors, walkways, stairs, internal lighting and a 8 tonnes maintenance overhead crane in the GT enclosure.

711

**Electrical and control equipment module(s)**

- Control room;
  - Operators station
  - Control panels.
  - Condition Monitoring System (CMS) (If not otherwise agreed)
  - MCC
  - Starting frequency converter
  - Frequency converters for the liquied fuel pumps.
  - Lube oil drive system
  - Emergency back-up battery
  - UPS-unit for turbine controls
  - Fire fighting panel
  - Servo Motor Drivers

The module is provided with internal lighting, heating and air conditioning systems. All systems are tested together with the GT and auxiliary systems (factory tests).

720

**Foundation**

- Outline drawing of the foundation with static and dynamic loads
- Embedded steel plates
- Necessary fastners to attach included units and equipment to foundation according to valid drawings.

731

**Static air intake system**

  - Double sided filter house with disposable 1st, 2nd and 3:th stage filter. Pre filter class F6, second filter F9 and high efficency filter class H12.
- Ducting for standard outdoor installation with support structure.
- Acoustic-lined duct and silencer for the air intake

*Comment*

- prepared for inlet chiller coils
- Hoist for filter replacement, hand operated.

740

**Exhaust gas system**

- Insulated exhaust duct (horisontal, axial outlet).
- Bellows allowing a maximum thermal expansion of axial 15 mm and lateral 20 mm from connecting duct.