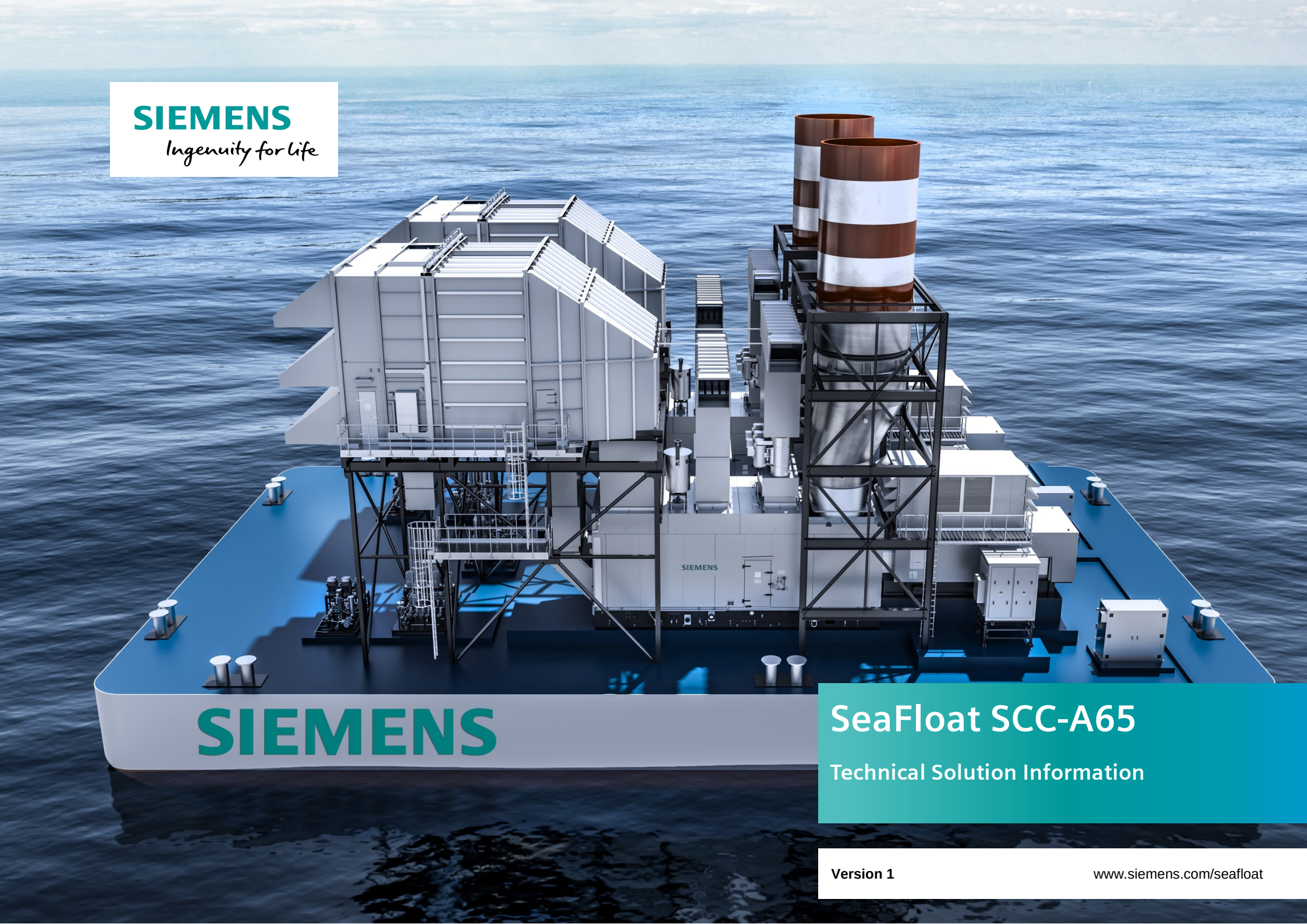


SeaFloat SCC-A65

Technical Solution Information

Version 1

www.siemens.com/seafloat

Engineered for industry-leading power output and fuel savings available in SeaFloat application

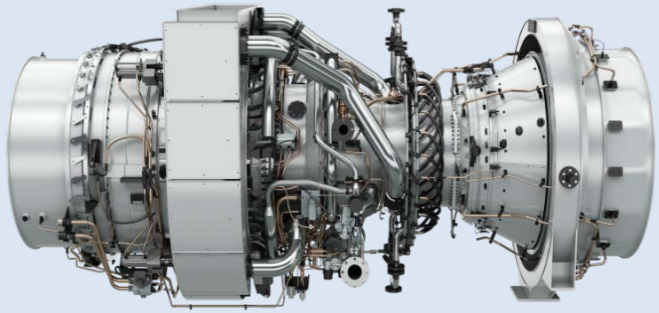
With a proven, long-term track record of more than 115 Units successfully installed around the world, the aero-derivative gas turbine SGT-A65 is an excellent choice for both industrial power generation as well as oil and gas applications, in particular when high cyclic start-stop and fast start is required.

Being the most proven powerful pure aero-derivative gas turbine in its class, the SGT-A65 (Industrial Trent 60) has established a new benchmark for power output as well as fuel and cost savings. This highly flexible gas turbine provides high power, high efficiency and excellent part-load operating performance. It is available with Wet Low Emission (WLE) and Dry Low Emission (DLE) combustion systems and comes with inlet wet compression as standard or optional.

The SGT-A65 is proven in many different environments and applications with more than 1.8 million fleet hours experience with the fleet leader having more 110,000 Operating hours in applications ranging from peaking to base load, in simple and combined cycle and as mechanical drive.

The SGT A65 aero heritage unique three independent shaft design makes this the most flexible gas turbine available in the market today with cold start to full load in 5 minutes, 2 minutes for a hot restart, exceptional high cyclic life and start stop capability and no lock out conditions. The aero-derivative heritage provides continued operation at a variety of sea state conditions.

The high degree of modularized design and delivery based on pre-assembled and pre-tested plant modules maximizes quality control and minimizes the manpower required at yard and hook up times at place of operation. The barge can be offered with all balance of plant installed on the Barge as a manned unit for remote locations with all an on-board equipment based on international codes and standards. An alternative design offers a minimum footprint shallow draft module for locations with very restricted access locations and mooring space. Balance of plant and systems are housed in pre-designed modules located on a Dockside or riverside adjacent to the Barge. Marine adaptions are implemented to suit the marine environment with respect to, but not limited to air intake filters, materials, surface treatments and protection against water ingress and corrosion.



Key benefits

- 60 to 75 MW(e)
- Above 55MW at 30 deg C with or without inlet air augmentation
- 41.3 to 44 % simple cycle efficiency
- Designed for high operational flexibility including fast start and stop
- Fast start 2 min for hot start
- Modular and single-lift design for ease of maintenance
- Robust, reliable technology
- Well-proven dry low emission combustion system
  < 25 ppmvd for fuel Gas (42ppm for Diesel No.2)
- 100%-load fuel changeover (gas to liquid fuel and liquid fuel to gas)
- Low lifecycle costs
- Minimal efficiency drop-off at part-load
- Easy maintenance: engine swap within 24h possible

Architectural Impression

Infographic

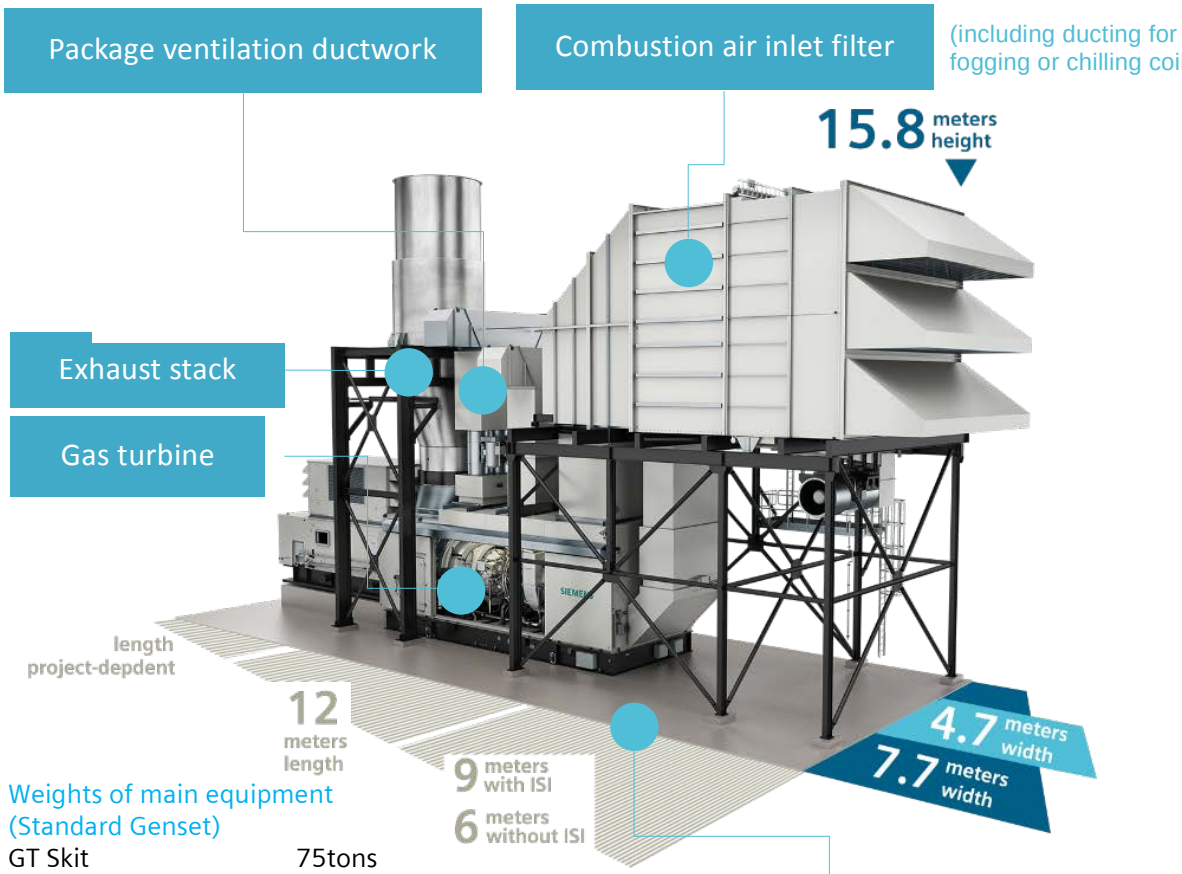
Architectural Impression

SeaFloat Gas Turbine SGT-A65

A SeaFloat power plant equipped with SGT-A65. Units can be provided as dual fuel units with natural gas as the primary fuel and Diesel No.2 as the secondary fuel. Fuel changeover in both directions is possible while the unit keeps operating at 100% load. There is no penalty for operating on liquid fuel as the primary fuel. The SGT-A65 can also be operated with 100% hydrogen and it is an important player for floating Power-to-X application. The lightweight SGT A65 aero-derivative gas turbine (<12 tonnes) is designed to withstand the most demanding high cycling operating profiles without incurring maintenance penalties. The start reliability on either gas or liquid fuel is >99% with a start time from cold to full load in 5min or in the event of a grid interruption restart in 2 minutes to full load because lock out timers are not required.

The SGT-A65 based Power barge provides unparalleled operational flexibility, high ambient temperature power output levels (>55MW at 30 deg C) and excellent support services including Black Start (only 350kW) for weak Grids.

Operation and Maintenance of the SGT-A65 is simple and easy. Strategically placed boroscope ports allow easy engine inspections and a 24 hour exchange philosophy with a lease engine or spare core avoids the need for on-board engine maintenance. Remote satellite conditioning monitoring and start up and shut down capability is also a feature of the design. The SGT-A65 package can also be provided with an optional tubular torque design to withstand particularly demanding offshore sea conditions.



Weights of main equipment (Standard Genset)

GT Skit	75tons
GT Package Roof	18tons
GT Engine DLE	14tons
Filter	107tons
Total	235tons

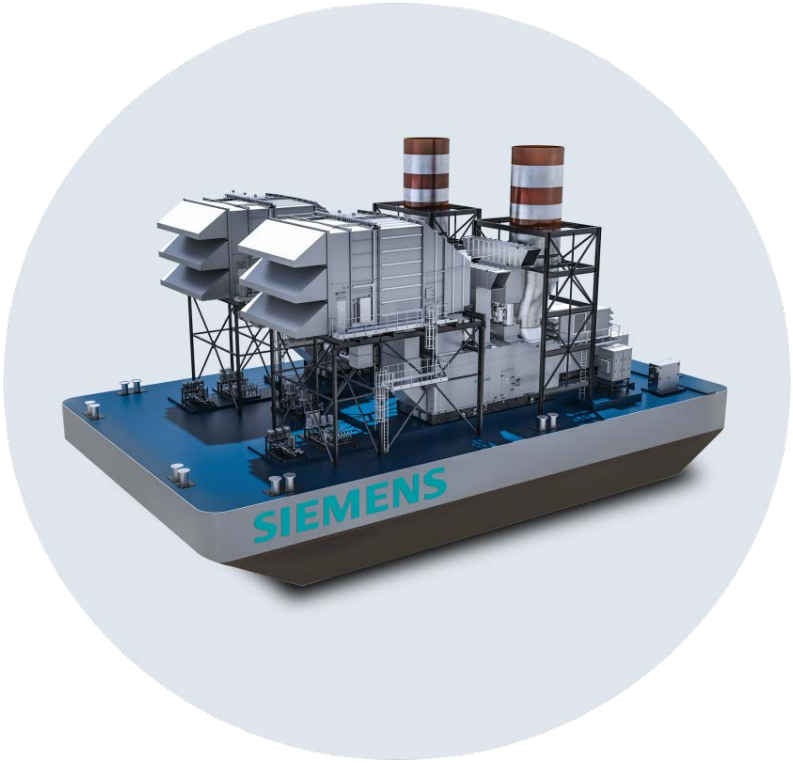
Weight with Torque Tube Mount (Off-shore Genset)

Total	270tons

SGT-A65 (SeaFloat nearshore applications)

Main features and performance information

- High GT reliability of 99.5%
- High GT availability of 98.7% with core engine exchange in 24 hours
- All maintenance possible on board
- High efficiency, refer to below table
- DLE Dry Low Emissions (option)
- WLE Wet Low Emission (option)
- ISI Inlet Spray Intercooling (option)



Gross Performance at Generator Terminals

Simple cycle power generation	1 x DLE with ISI (50 / 60 Hz)	1 x WLE with ISI (50 / 60 Hz)	2 x DLE with ISI (50 / 60 Hz)	2 x WLE with ISI (50 / 60 Hz)
Net Power output	65 / 67 MW(e)	68 / 71 MW(e)	130 / 134 MW(e)	136 / 142 MW(e)
Net efficiency	42.3 / 43 %	41.1 / 41.2 %	42.3 / 43 %	41.1 / 41.2 %

Combined cycle power generation	DLE 1x1 (50Hz/60Hz)	DLE 2(50 / 60 Hz)x1 (50Hz/60Hz)	DLE with ISI 1x1 (50Hz/60Hz)	DLE with ISI 2x1 (50Hz/60Hz)
Net plant power output	72.5 / 74.5 MW(e)	147 / 151 MW(e)	86.0 / 88 MW(e)	175 / 151 MW(e)
Net efficiency	54.4 / 54.7 %	55 / 55.3 %	54.5 / 55 %	55.3 / 55.3 %

Emissions	
NOx, [ppmV / mg/Nm3]	<25 / 51.3 @ 15% O2 (50-100% GT load)
Emissions, CO, [ppmV / mg/Nm3]	<5 / 6.3 @ 15% O2 (50-100% GT load)

Installed performance at:

- 25°C ambient air temperature
- 25°C sea water temperature
- 60% relative humidity

Gas fuel supply 60 Bar(a), 90°C, 48.6 MJ/kg LHV

(Siemens standard gas composition). Including transformation and auxiliary losses. Excluding condenser cooling water pumps and auxiliary consumption of the barge,

power ship or other structures.

DLE - Dry Low Emissions (option)
WLE - Wet Low Emission (option)
ISI - Inlet Spray Intercooling (option)

Table: Installed performance

Automation and Control

Highest degree of automation and control with fully automatized start-up and shut-down procedure provide an efficient and safe operation of the plant from an on-board control room as well as from a remote location e.g. from a load dispatch center.
Optimized operator and engineering environment have been considered with a large flexibility for localization in various operation rooms on-board the vessel/barge. Interfaces are available for any dedicated automation or control systems on board by means of OPC interface to superimposed systems, SCADA etc.
Data logging, compression and storage into history data base servers ensure the possibility to evaluate events and performance over time including valuable feature for maintenance planning. Connection to Siemens service centers for operations support and various services can be provided as part of service contracts.

Typical project details

A typical project is characterized as a floating or fixed off-shore power generation installation near to shore, moored to a jetty or located in a Dock or river coffer dam close to an electrical substation for import of the generated power via cable or overhead lines.

Basic design support from Siemens:

The Power Plant equipment is installed onboard the vessel/barge with Gas Turbine packages (Steam Turbine packages in case of combined cycle), main transformers, HV switchgear and electrical and control equipment modules for fully equipped manned vessel/barges. For river or dock locations this equipment can be housed in pre-designed modules for adjacent off-barge locations. Siemens provides generic 2D/3D models as guidance towards an optimal layout.

Main Generator Circuit Breakers, GCB's for the gas are installed on the base frames of the turbine generator sets why no generator switchgear rooms are needed.
From the GCB switchgears auxiliary power to the plant is derived. At plant stand still, power is supplied via the main generator step up transformers taking power from the HV grid for keeping the plant energized and for starting of the GT's. An on board generator may be providing power to the aux power switch gear and if so the plant can be black started or be ready for start upon a restored HV grid. The generator is typically part of the onboard utilities and not part of Siemens scope.
The power plant is designed with a highly compact and highly reliable Gas Insulated Switchgear, GIS, two incomers form the generator transformers and one export feeder breaker for either cable or OH line connection to an onshore tie in point. Optional configurations are possible.
The plant is intended for normal operation on gaseous fuel. Back-up operation with liquid fuel is an option. An additional option is to equip the gas turbines with heat exchangers (for glycol/water to air) in front of the gas turbine air intakes where the inherent heat in the combustion air flow may be used to assist vaporizing the LNG needed for the operation of the power plant, while the chilling effect of the combustion air on the other hand functions as inlet cooling and hence increases power output of the Gas Turbine.

Overview of typical Siemens Obligation

- Engineered for full power plant functionality, flexibility and guaranteed performance
- SGT-A65 TR gas turbine packages on common rigid base designed for surge, sway and heave accelerations of up to 1.25 m/s, 3.3 m/s and 6.8 m/s respectively with a proven torque tube design. A closed loop fresh water-cooling ACW system is used for cooling auxiliary plant items

- Electrical and control module with all electrical and I&C equipment for the GTG
- Generator (GCB) and Auxiliary power Circuit Breakers (ACB) as part of the GTG skid
- All equipment prefabricated and pre-tested in the shipyard.
- Main step up transformers in three winding design complete with protection relay system and on-load tap changer for ratio control on HV side is a Project specific item. Main step up transformer of two winding design for one GT, complete with protection relay system and on-load tap changer for ratio control on HV side
- Single busbar Gas Insulated HV Switchgear (GIS), two incomers from generator transformers, one outgoing export feeder (option two feeders) for cable or overhead line to shore, complete with protection and automations system integrated with plant DCS system
- auxiliary power transformers 3x50% 750kW (for manned barge with fuel storage)
- Naturally air cooled epoxy insulated auxiliary power transformers for mounting in transformer/switchgear room on board

Plant DCS for the above scope with engineering and operator stations for placing in a control room arrangement on board

- 110V DC UPS system for above scope
- 230VAC UPS distribution board, UPS supply from vessel main AC UPS system
- Supervision of installation at Yard at daily rates
- Cold Commissioning supervision at Yard at daily rates
- Training at Yard at daily rates

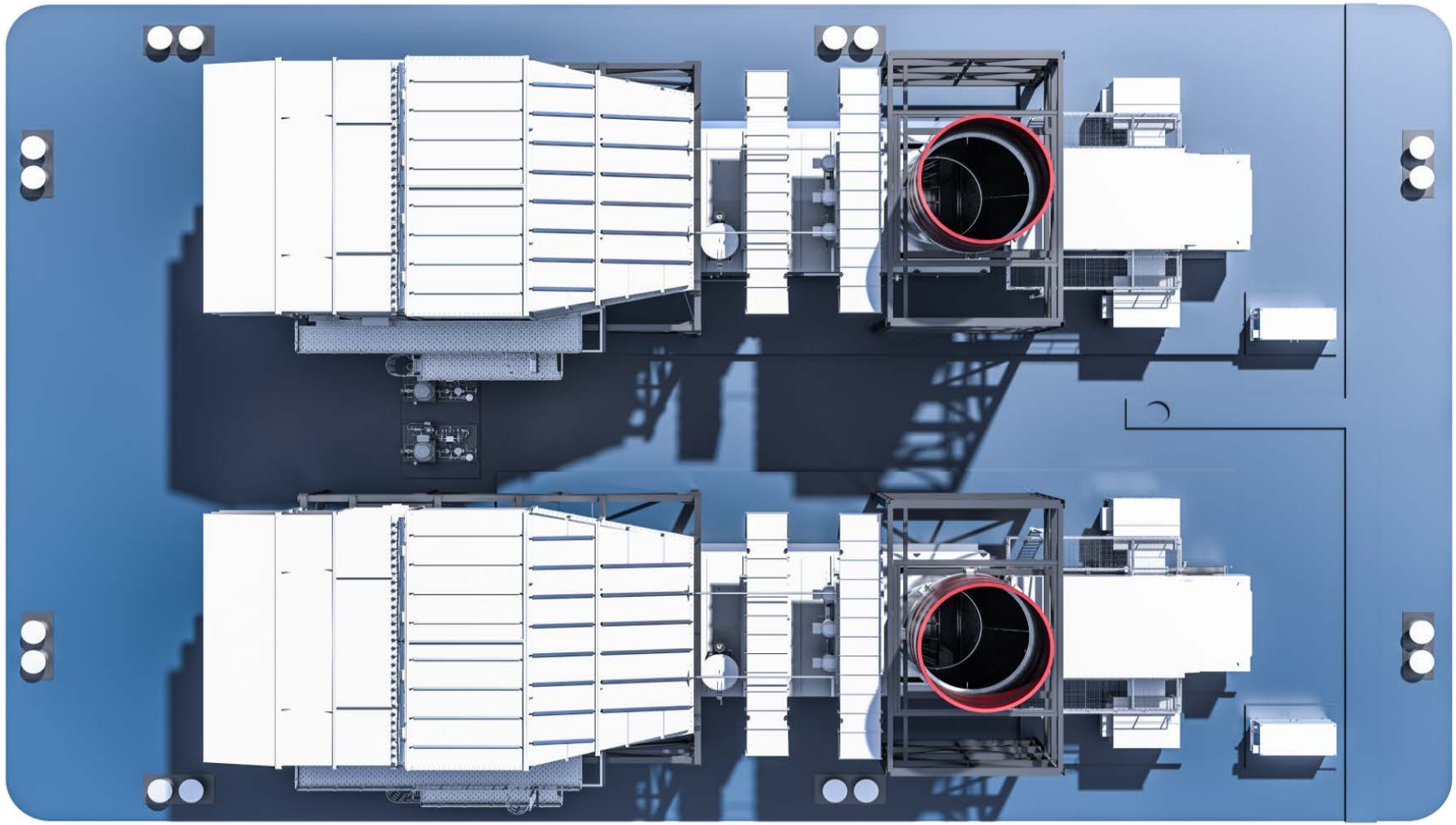
Terminal points

- All terminal points on Siemens delivery scope at interface connections of packages and components

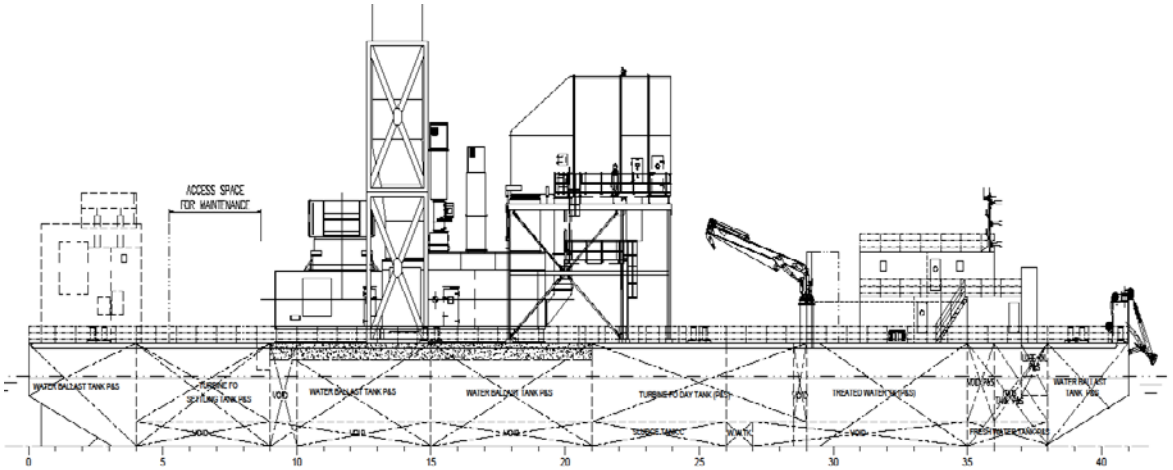
Overview of shipyard's obligation

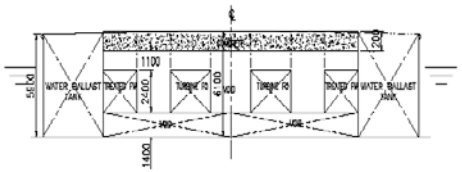
- Installation of equipment
- Cold Commissioning of equipment (Under TFA, Technical Field Assistance by Siemens)
- Interconnecting piping and cabling between equipment
- Pipe and cable racks
- Supporting steel structures for equipment
- Platforms and stairs
- Weather shelter for the steam turbine including gantry crane for maintenance
- Maintenance building (~175m2) for GT, including 8 ton gantry crane
- Electrical rooms for aux. power transformers and switchgears
- Rooms for installation of DCS UPS equipment, plant DCS panels
- MV/LV transformer(s) and sub-distribution for on board utilities
- AC UPS system for plant DCS
- Control room area and necessary furniture's
- Make-up water treatment/demineralization plant
- Service and instrument air system
- Fresh water cooling circuit for GT's, ST, main transformers and sampling rack for steam and water sampling
- Condenser cooling water pumps
- Condensate Extraction pumps
- Drain system from power plant drains
- Gas fuel supply
- Any black start/emergency generator
- First fill of lube oil

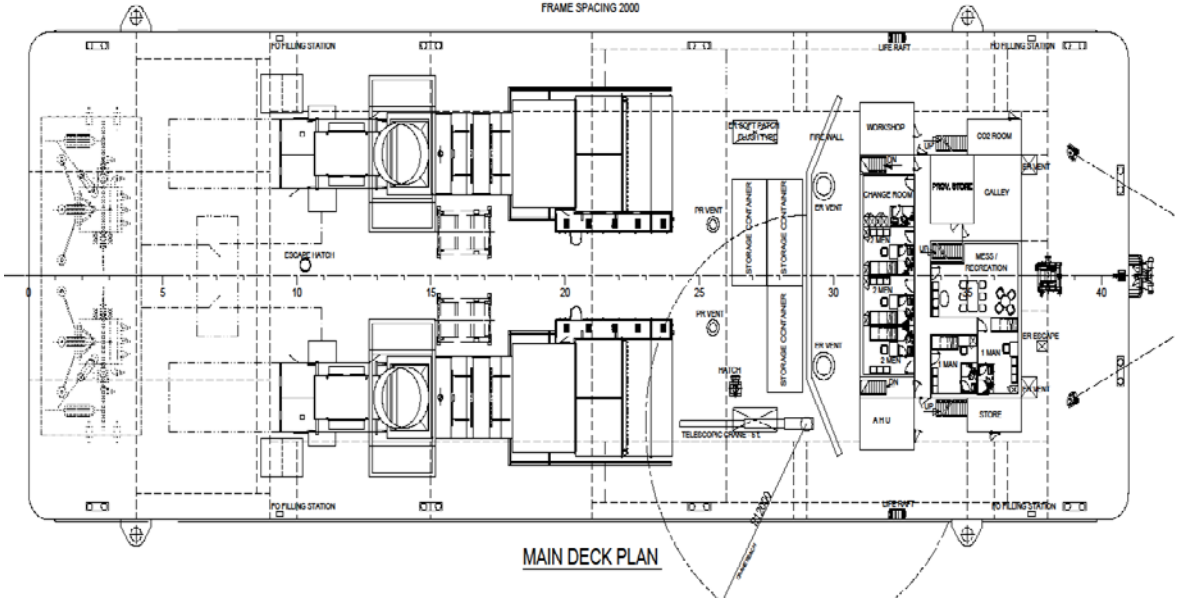
Typical Plant layout open cycle (manned) (~ 50x22m / draft 3.5m)

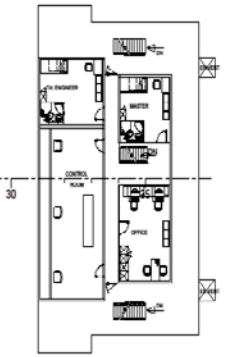


Typical Plant layout open cycle manned barge





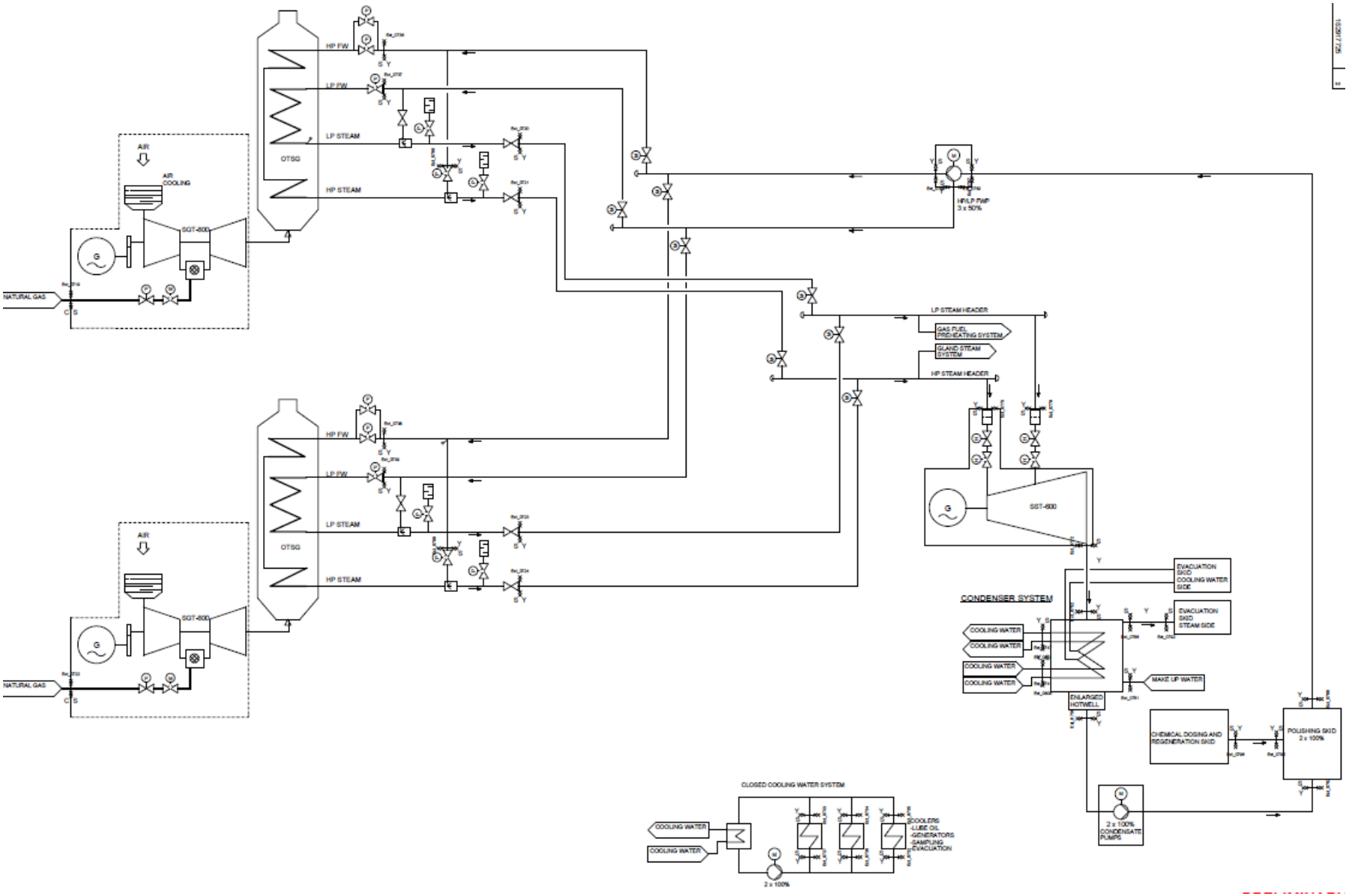




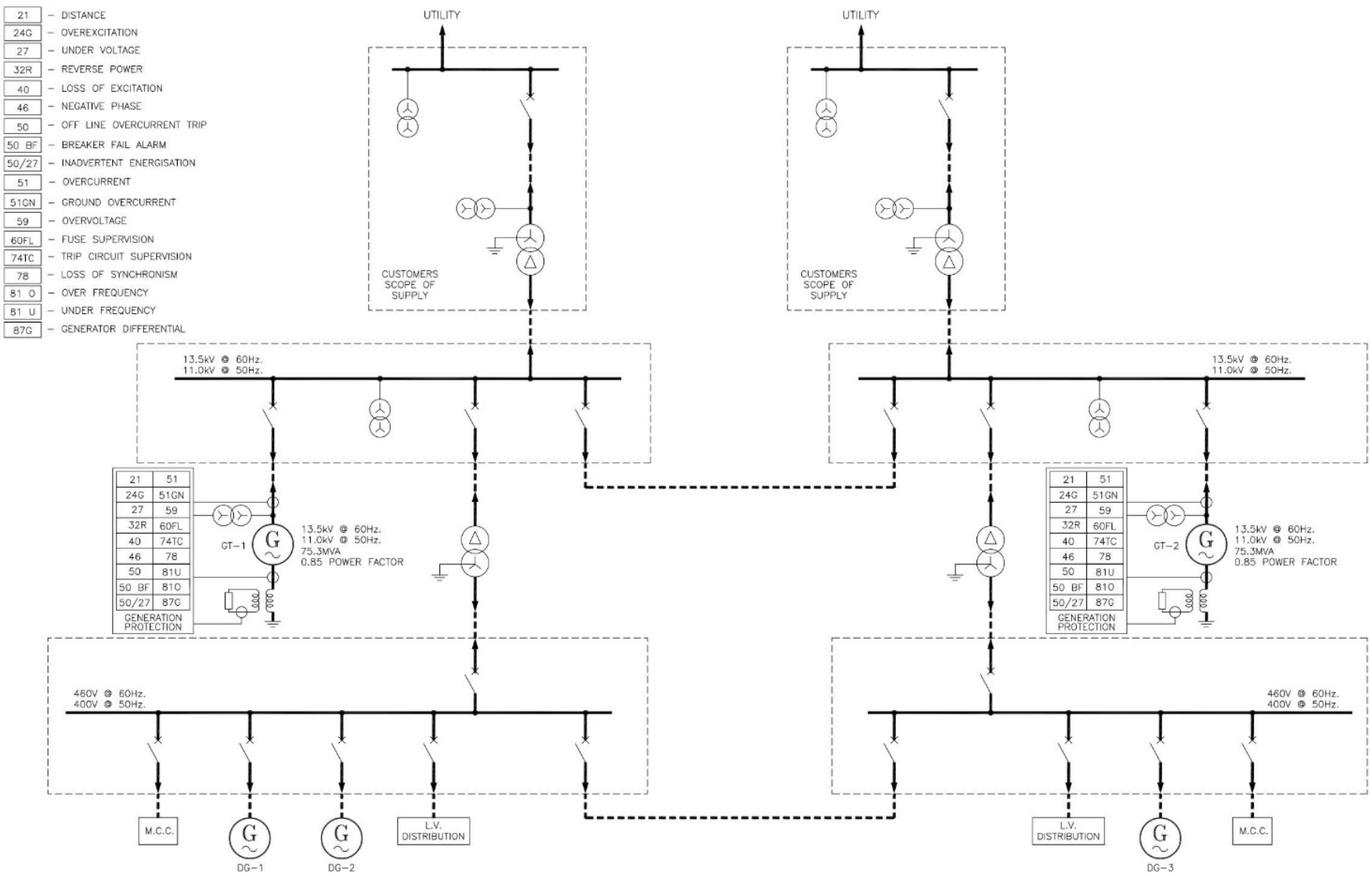
MAIN PARTICULARS:

LENGTH O.A	-	82.00 mtrs.
BEAM MLD.	-	28.00 mtrs.
DEPTH MLD.	-	5.90 mtrs.
SUMMER LOAD DRAFT	-	4.00 mtrs.
COMPLEMENT	-	10 MEN
FRAME SPACING	-	2000 mm
TURBINE FUEL OIL	-	STANDARD NO. 2 FUEL (DIESEL)
BARGE FUEL OIL	-	DMA FLASH POINT ABOVE 60° C
CLASS	-	AMERICAN BUREAU OF SHIPPING
CLASS NOTATION	-	✠ A1 BARGE FOR POWER PLANT

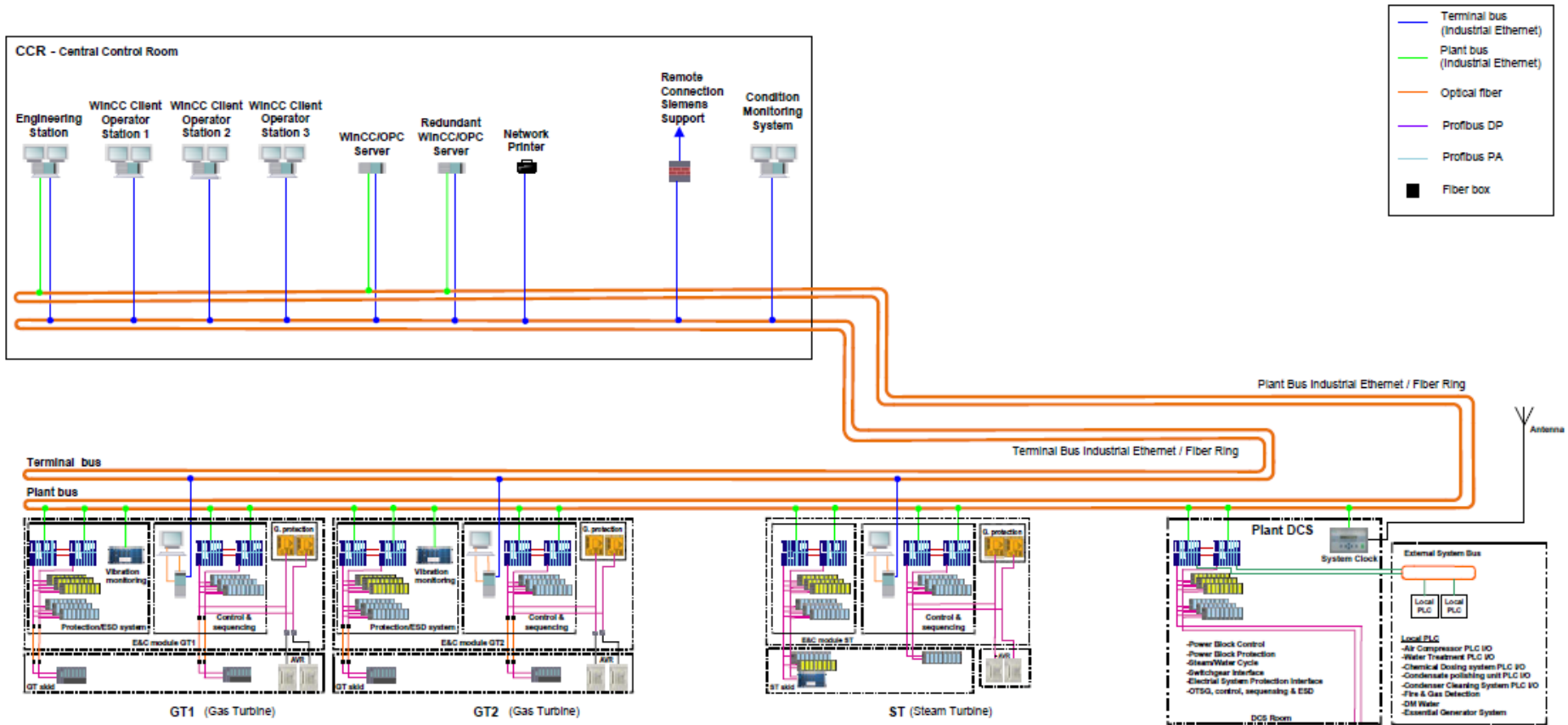
CCPP typical main flow diagram, 2x1 configuration



Principal OCGT single line diagram



Principal plant DCS topology



Note 1: This drawing might describe, reproduce or relate to equipment outside Siemens scope of supply.
This drawing shall only be used as a generic information.

Note 2: Physical computers in CCR will be placed in separat server cubicle.

Note 3: CCR building is not in Siemens Scope of Supply.

Note 4:Other Aux. system is not in Siemens Finspång Scope of Supply.