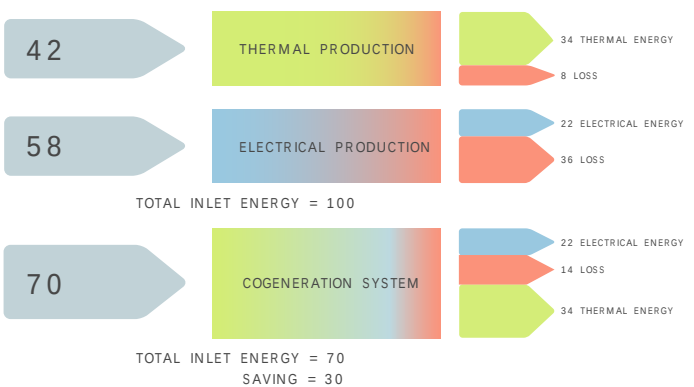
COGENERATION AND TRIGENERATION

The term “cogeneration”, means the combined production of electrical and thermal energy using conventional fuels such as natural gas or Diesel.
This technology allows us to efficiently exploit the energy contained in the fuel used, avoiding dispersing heat which has not been used into the atmosphere.
A reduction in energy consumption and pollution emissions into the atmosphere is also achieved.

The electrical and heating needs of commercial, residential and industrial sites can thus be satisfied (wholly or in part) by recovering heat that is produced in the operating of an internal combustion engine joined to an electric synchronous three-phase generator (power unit).

Trigeneration may be considered an evolution of the cogeneration process.
Trigeneration can be defined as the conversion of a single fuel source into three energy products: electricity, steam or hot water and chilled water, with lower pollution and greater efficiency than producing the three products separately.



SYSTEM CONFIGURATION.

The heat recovery comes about in the form of hot water (95° C) mainly used to feed a water/ lithium bromide absorber that produces chilled water for air-conditioning.
Part of the heat retrieved is used to produce warm clean water and for air-conditioning.

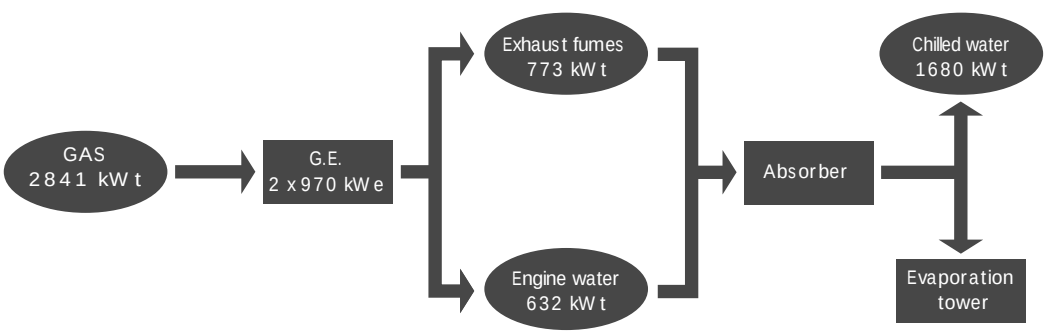
An initial step in thermal recovery is produced by the warm water circuit of the engine which collects the heat given to the engine water, to lube oil, to the first stage aftercooler.

Recovered heat power from this circuit is 632 kW.

A second heat recovery system is produced with the exhaust fumes by a tube bundle exchanger. Heat thus recovered is added to that recovered during the first process, by further increasing the water temperature of the system.
Regulation of the power recovered comes about through fume by-pass valves linked and commanded by temperature signal. When calibration temperature has been reached, the exhaust fumes are then sent directly to the exhaust silencer, without going through the fumes exchanger.

Thermal power thus recovered from exhaust fumes is equivalent to 773 kW.

Total thermal power recovered from the cogenerator is equivalent to: 632 kW + 773 kW = 1,405 kW.



MAIN COMPONENT PARTS OF THE SYSTEM

GAS RAMP

The natural gas feed to the generator comes about by a gas street system [fig.1] which is situated on the outside of the cogeneration room and is made up of a complete set of command, control and measuring devices.

Proceeding towards the generator, the gas street consists of:

- a general hand-operated cut-off valve (VM101);
- a hand-operated rearming solenoid valve, interlinked to a gas leakage detector exchange and detectors situated above the generator (EV101)
- a gas filter, filtering any slag (FG101);
- two safety solenoid valves, with a differential pressure switch (EV102-103);
- a gas gauge with volume corrector based on fuel temperature (MSG101);
- a work solenoid valve;
- an flexible joint (FX105);
- pressure gauges.

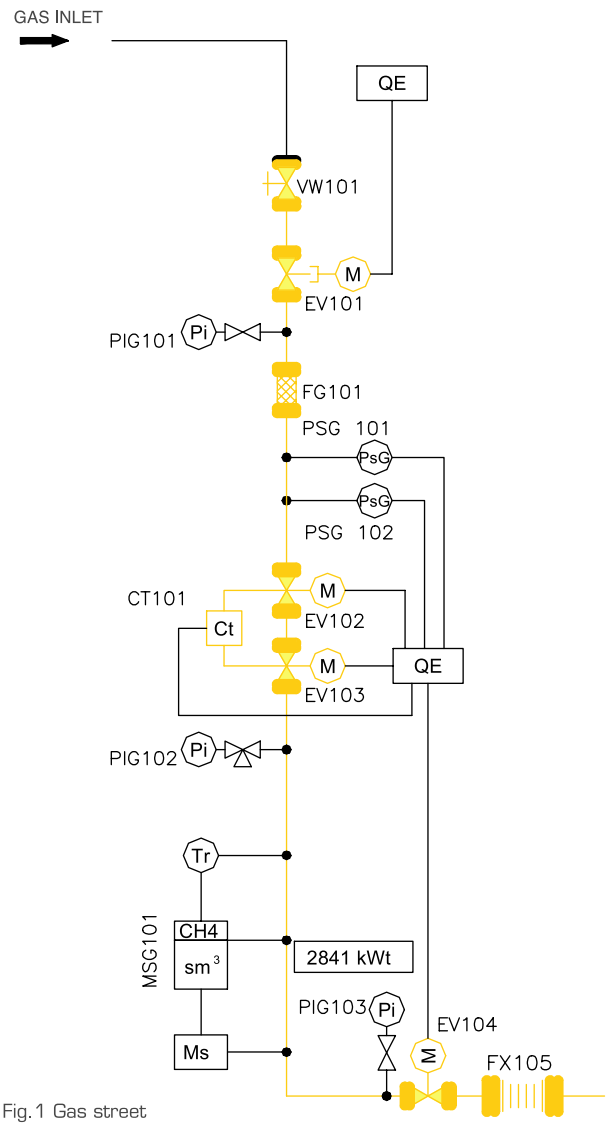


Fig.1 Gas street

COOLING ENGINE CIRCUIT

The cooling circuit as well as to thermal energy recovery, may be described beginning from the generator.
Generator is connected by a pipeline (DN125) to a twin exchanger, 632 kW t (SC103).
W ith no heat recovery the engine cooling system is assured by an additional exchanger (SC102).
A pumps group (VI113 116) having a differential pressure switch, control the flow through the pipes till the exhaust exchanger (SC104) whcich increase water temperature from 89.5° C to 95° C.

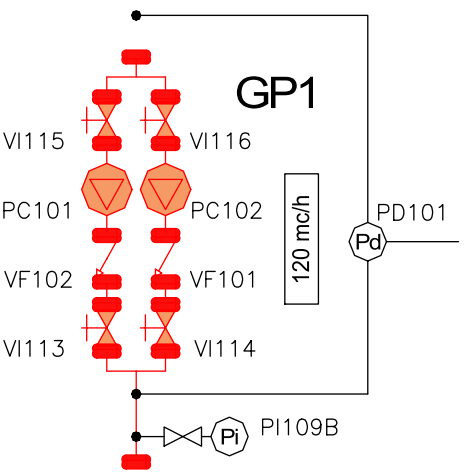


Fig.2 GP1 Pumps group

ENERGY RECOVERY, THE NEW FRONTIER

2nd STAGE AFTERCOOLER CIRCUIT

The aftercooler is dual-stage, made up of two finned air/ water heat exchangers, for the cooling of the air/ methane mixture once it has passed the overfeeding compressor, and before has entered into the cylinders. The 2nd stage has a low temperature (54° C) and low power, therefore thermal recovery does not take place. The heat is exchanged through a plate exchanger (SC101). On the secondary side does the tower water operate.
Water flow within the circuit is maintained by centrifugal pump mechanically activated by the engine.

WATER ENGINE RECOVERY EXCHANGER

Heat recovery of the water engine temperature – lubricating oil – 1st stage aftercooler (primary side) comes through a plate exchanger (SC103). The plant water pass trough on the exchanger secondary side, maintained the two system completely separated.

Heat recovery = 632 kW

EMERGENCY ENGINE COOLING EXCHANGER

When heat recovery is not needed on the plant, the engine cooling system is assured by an additional exchanger (SC102)

Heat rating = 632 kW

2nd STAGE AFTERCOOLER EXCHANGER

The heat of the 2nd stage aftercooler not recoverable is exchanged through a cooling tower.

Heat rating = 87 kW

EXHAUST EXCHANGER

Thermal recovery from hot engine exhaust is achieved by tube bundle heat exchanger (SC 104). Upon the primary side operate the exhaust fumes and upon the secondary side operates the system water circuit.

Heat recovery = 773 kW

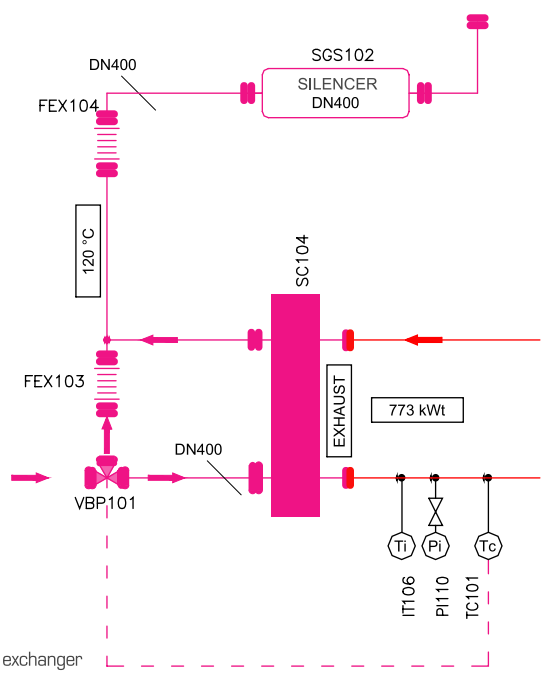


Fig.3 Water exhaust exchanger

ENGINE COOLING SYSTEM

This circuit connects the secondary sides of the water engine recovery exchanger, of the fume exchanger and of the absorber.

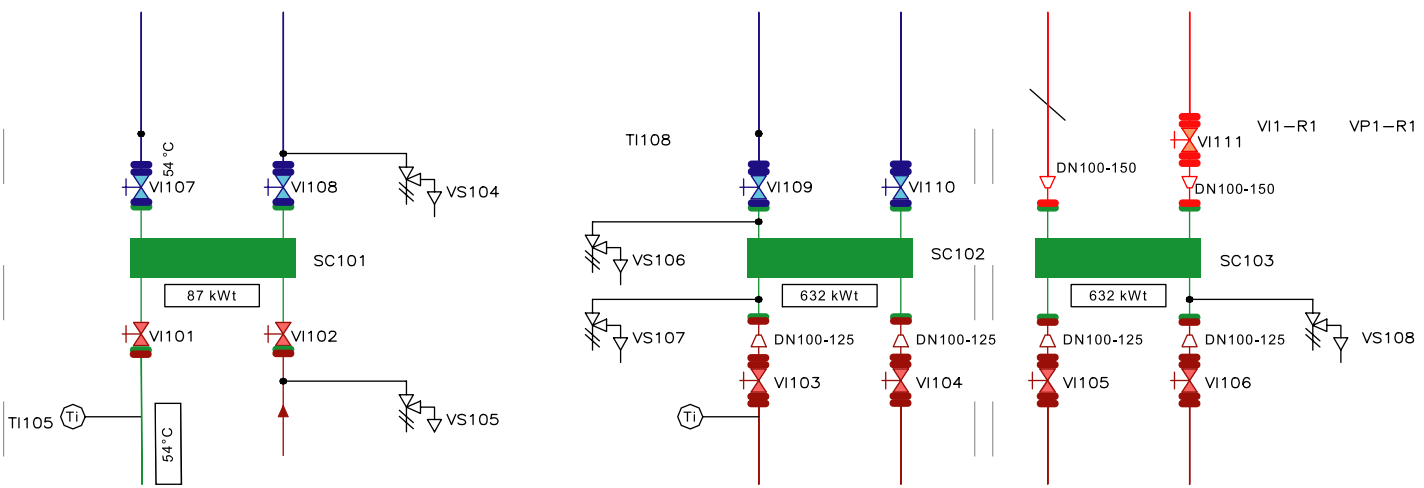


Fig.4 Plate exchangers

ABSORBER (AS001)

An water/lithium bromide type absorber, fed by hot water, produces cold water (7/12° C) for air-conditioning of shopping centre areas.

Three hydraulic circuits are connected to the absorber:

• Hot water circuit: is headed towards the "generator" and constitutes the "main circuit" of the absorber. Uses heat retrieved from cogeneration;

• Cold water circuit: is headed towards the "evaporator" and constitutes the "useful result" of the process and the interface with the air-conditioning system;

• Tower water circuit: is headed towards the "condenser" and is used to transfer heat into the atmosphere towards the cooling tower.

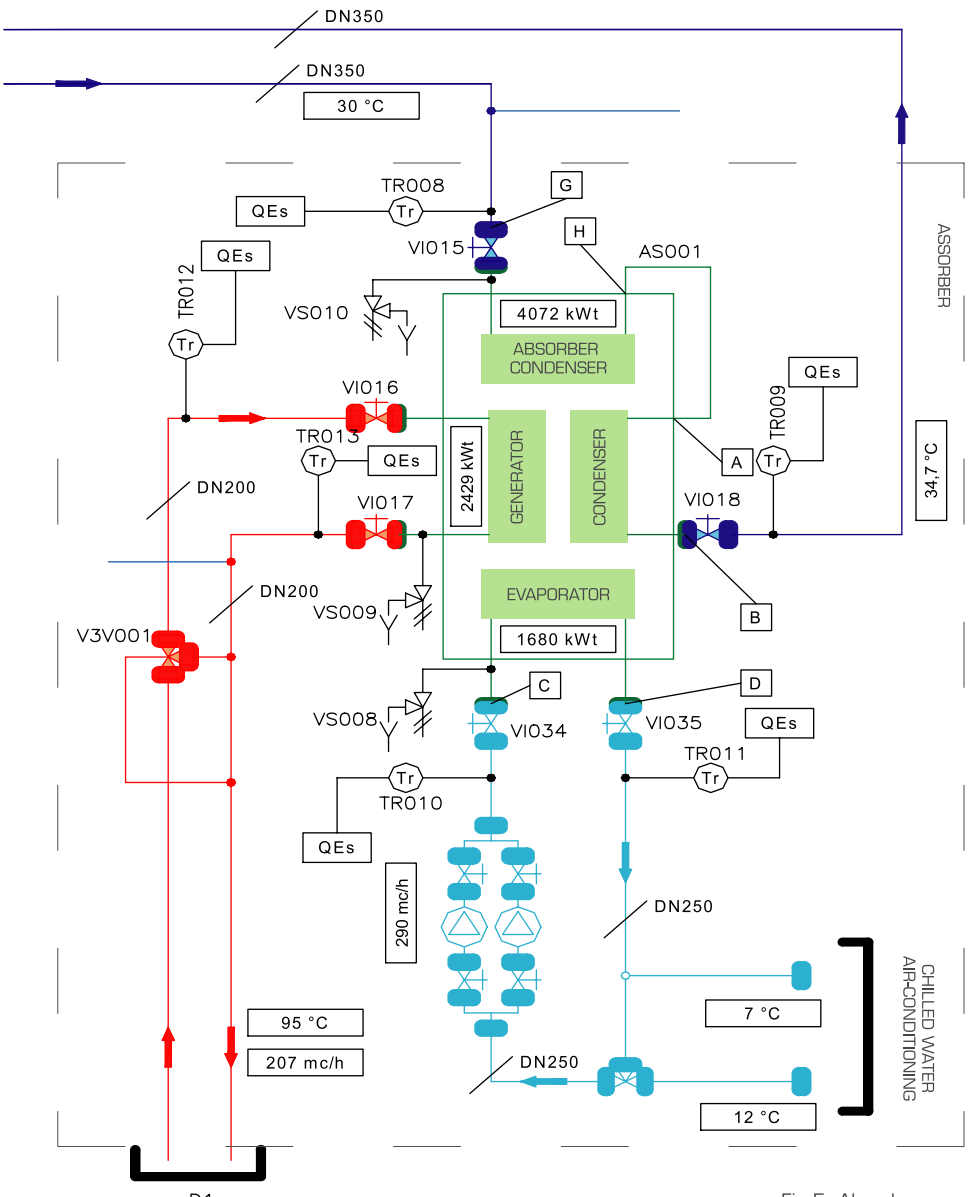


Fig.5 Absorber

COOLING TOWER (TDR001)

The non recoverable heating is exchanged through a cooling tower exchangers of the generators and from the absorber, after vertically crosses the tower from up to down, collecting in the concrete basin below.
During movement downwards, the water meets the air which crosses the tower vertically, from the bottom going up, drawn by axially-positioned electrical ventilators (M).
Cooling takes place because of both thermal exchange of water and air and because of evaporation of part of the same water.

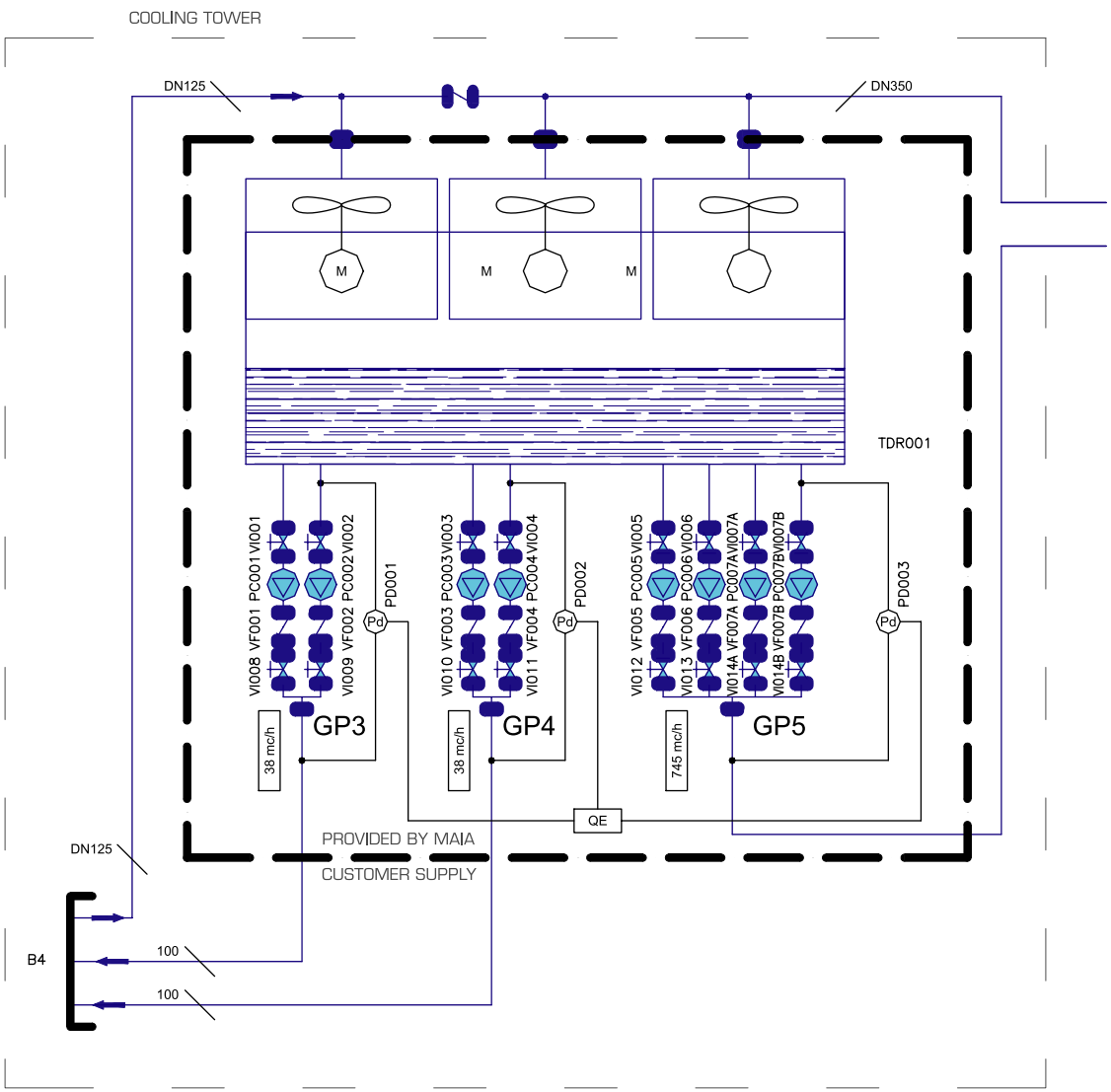


Fig.6 Evaporation tower

PLANT CIRCULATION PUMPS

System water circulation, between recovery exchangers of the generators, the absorber and other hot-water user devices takes place through a bench of two motor-driven pumps (one a spare for the other). (fig.2)

COOLING TOWER CIRCULATION PUMPS – GENERATORS (GP3÷4)

Water circulation between heat exchangers of the generators and cooling tower, through two benches of two motor-driven pumps (one a spare for the other). (fig.6)

COOLING TOWER CIRCULATION PUMPS – ABSORBER (GP 5)

The circulation of tower water, between absorber and evaporation tower, takes place through a bench of four motor-driven pumps. (fig.6)

HOT-WATER CIRCUIT

Thermal recovery allows the production of sanitary hot water through a plate exchanger (SC001).
Heated water is collected in a 5,000 - litre boiler (SCC001), thermally insulated. (fig.7)

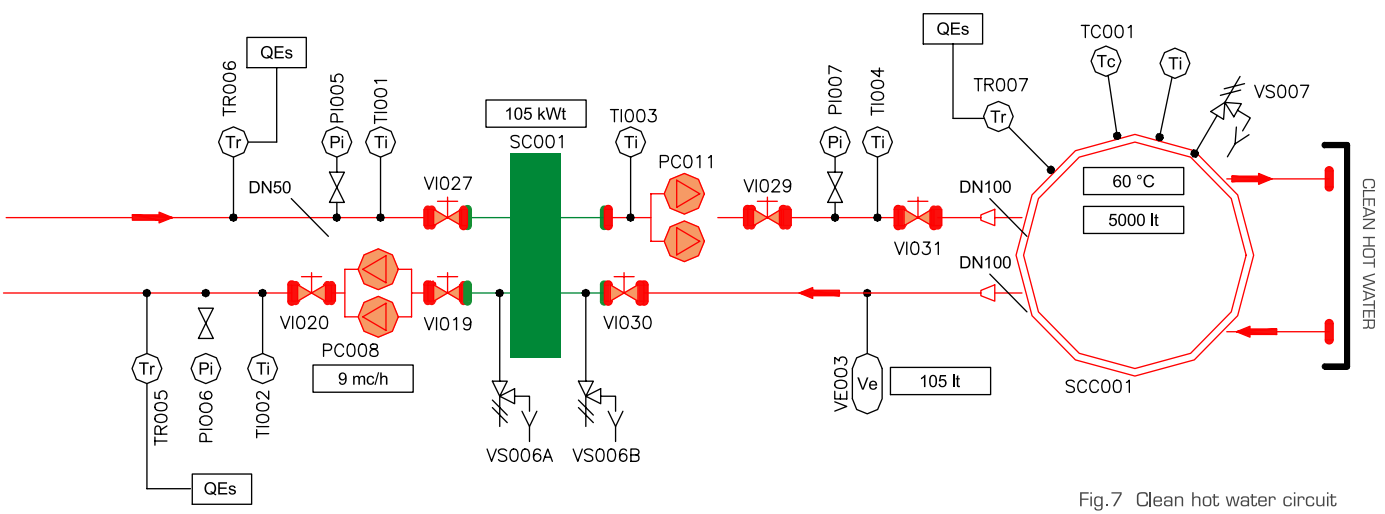


Fig.7 Clean hot water circuit

AIR-CONDITIONING HOT-WATER CIRCUIT

A circuit allows the production, by a plate exchanger, of hot water for air-conditioning. (fig.8)

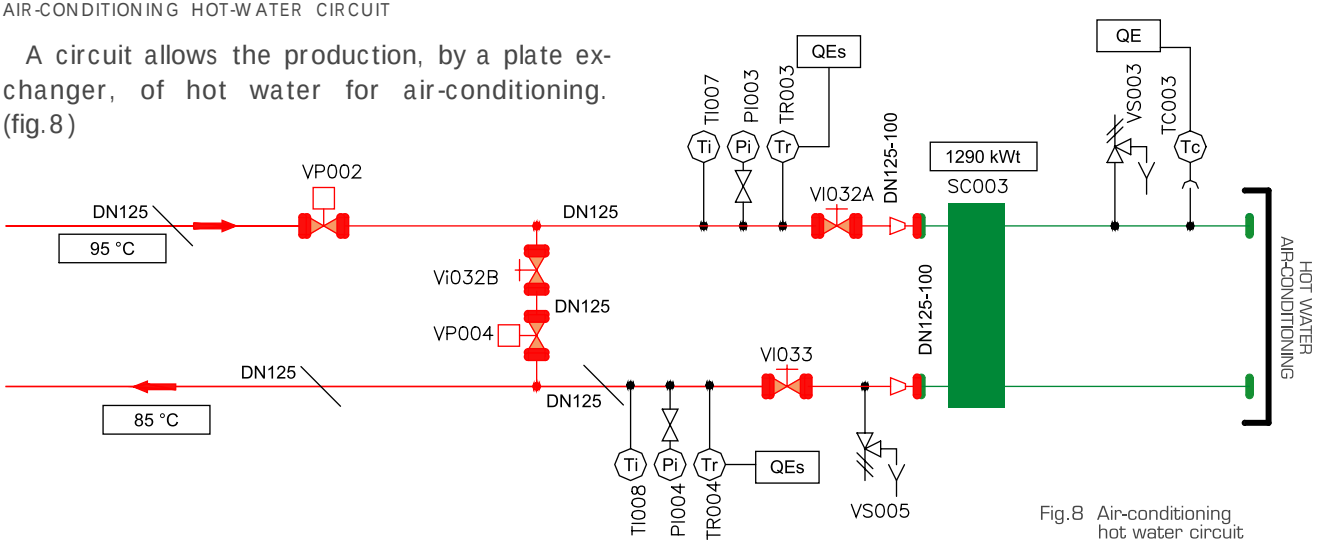


Fig.8 Air-conditioning hot water circuit

DEHUMIDIFYING HOT-WATER CIRCUIT

Water heating for heat pump dehumidifying is achieved using a plate exchanger. (fig.9)

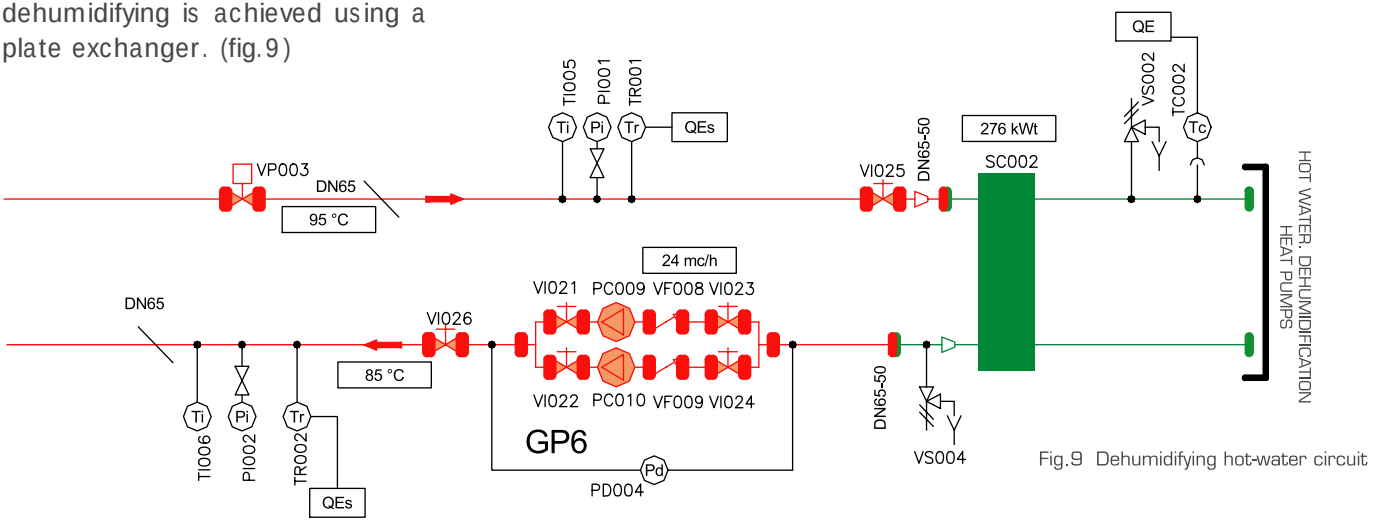


Fig.9 Dehumidifying hot-water circuit

EXHAUST TREATMENT CIRCUIT

The engine exhaust system includes : two silencers and a catalysts connect to a inox steel chimney till the roof of the building.

WATER TREATMENT SYSTEM

A water treatment system is foreseen in order to prevent rust and pipe harmful attack as well sea-weed phenomena in to the cooling tower. This consists of a sweetening device, an anticorrosive film dosing pump (for tubing of the closed circuits), an anti-algae bioacid agent (for tubing of tower circuits). This system also provides for the reintroduction of inevitable evaporation into the tower. (fig. 10).

SUPERVISORY SYSTEM

A computerized system allows acquisition and recording of the main thermal and electrical parame-ters of the system (temperatures, pressures, powers, etc.)

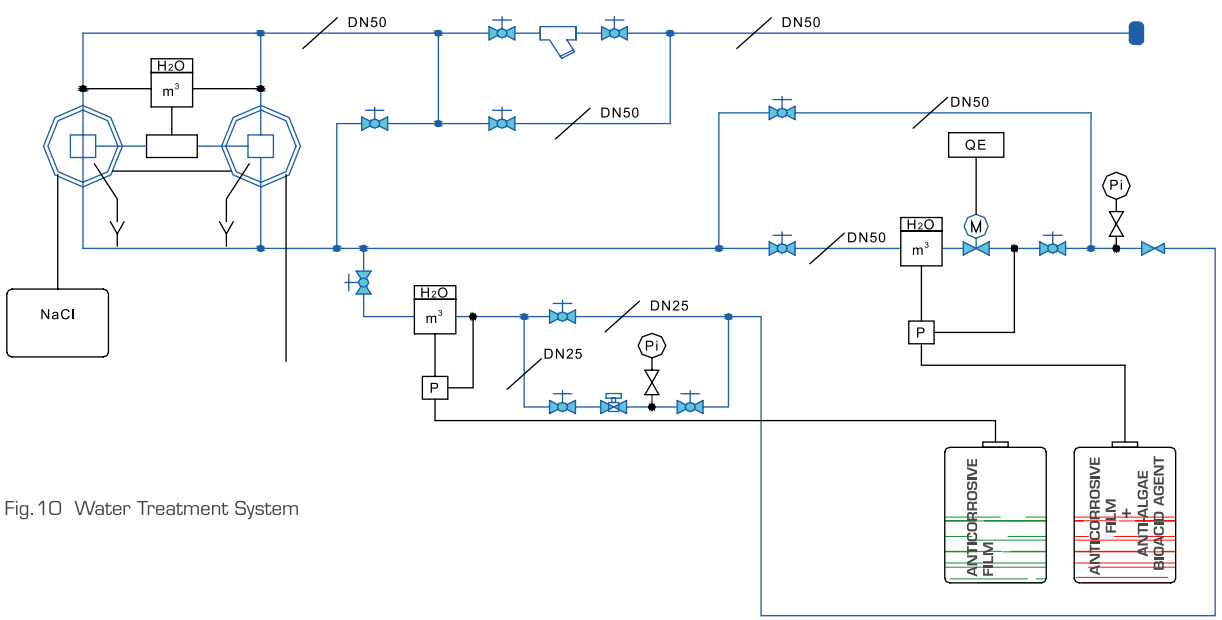
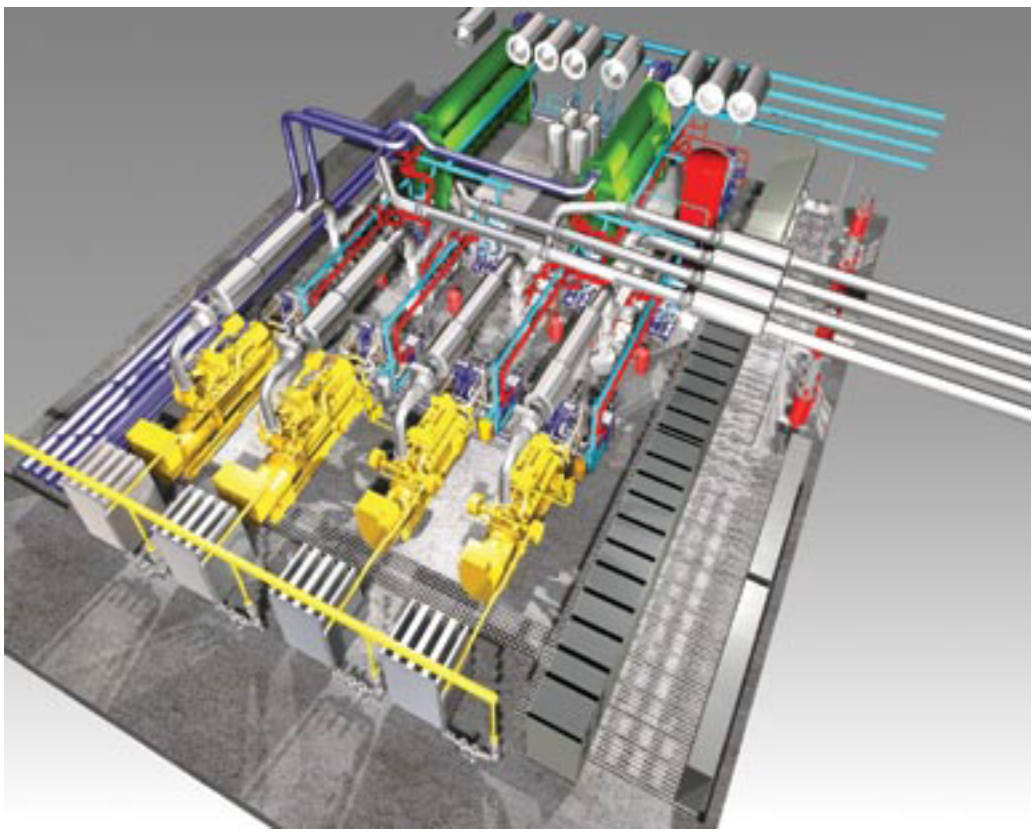


Fig.10 Water Treatment System



CATANIA shopping centre

Installed power 1940 kW

Future power 4860 kW

BUSINESS LIST

MAIA CAT power generators, engineering, maintenance

ALMACIS Plant engineering

LA LEGA Plant engineering

STEI Electrical systems

SICES Automation

SIGMA Software supervision

YORK Absorbers

ALFA LAVAL Exchangers

ABB Electricity panels