

**Industrial and civil applications for cogeneration plants: from paper mills to hospitals - the experience of MAIRE Engineering, with a special focus on control and supervision solutions**

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## **Alberto Cavallo**

He is graduated in Electrical Engineering at the Politecnico di Torino and he started his activity in power plant design (control system and technological plant for industry and civil infrastructure).

He also worked on the cogeneration plant of Burgo paper industry, remote warming system network in Turin and combined cycle in Italy and Brasil.

Currently, he is in charge with Maire Engineering for electrical power plants and automation.

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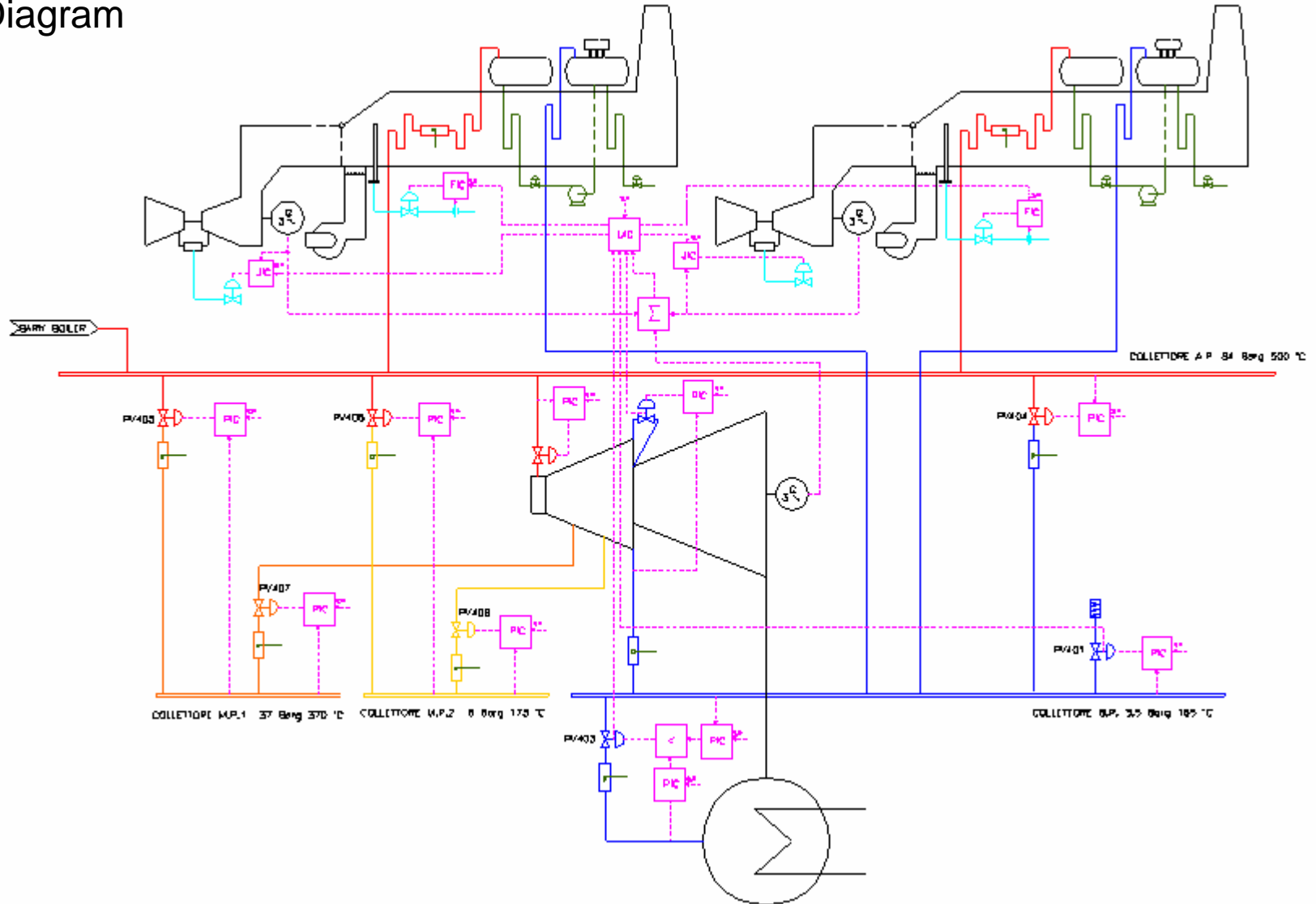
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# Verzuolo Cogeneration Plant

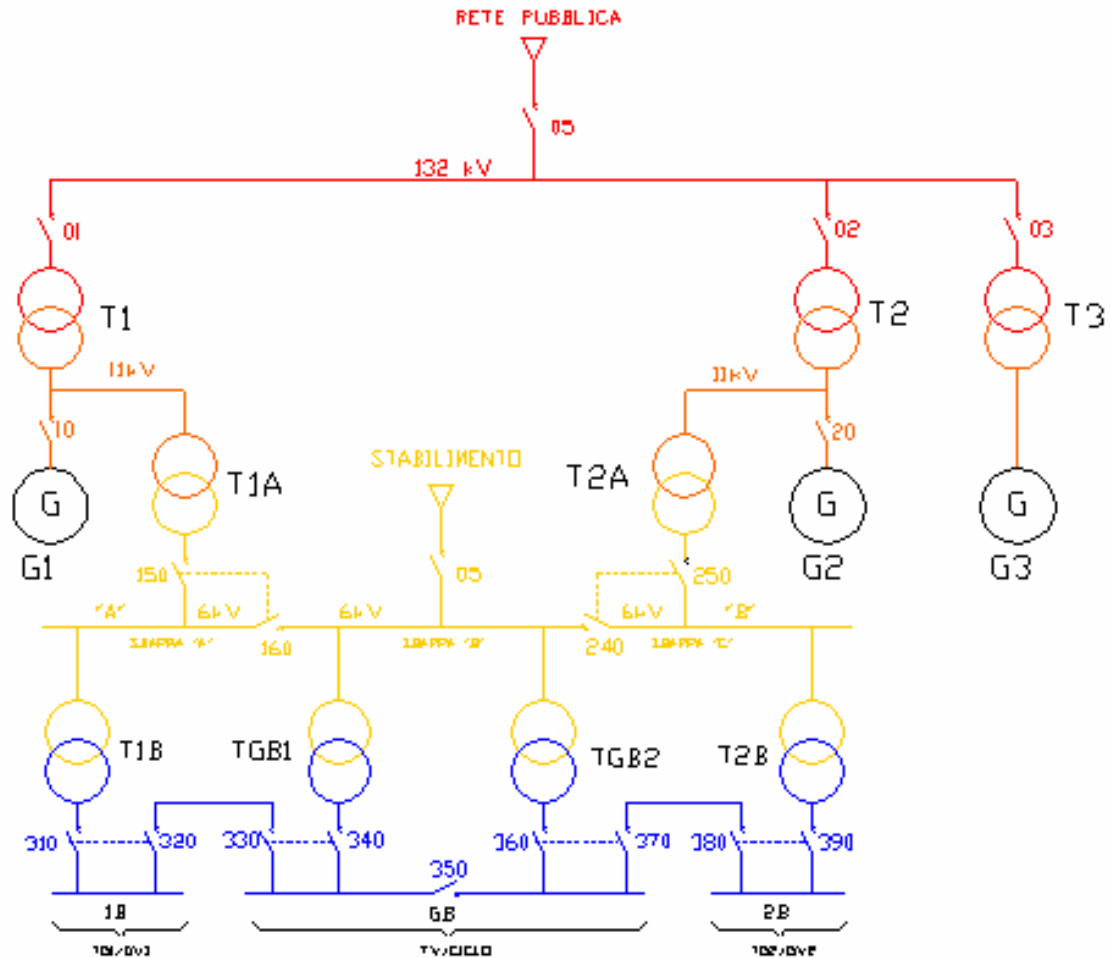
The Burgo paper mill of Verzuolo fulfills its power and steam needs through a combined cycle cogeneration plant composed of:

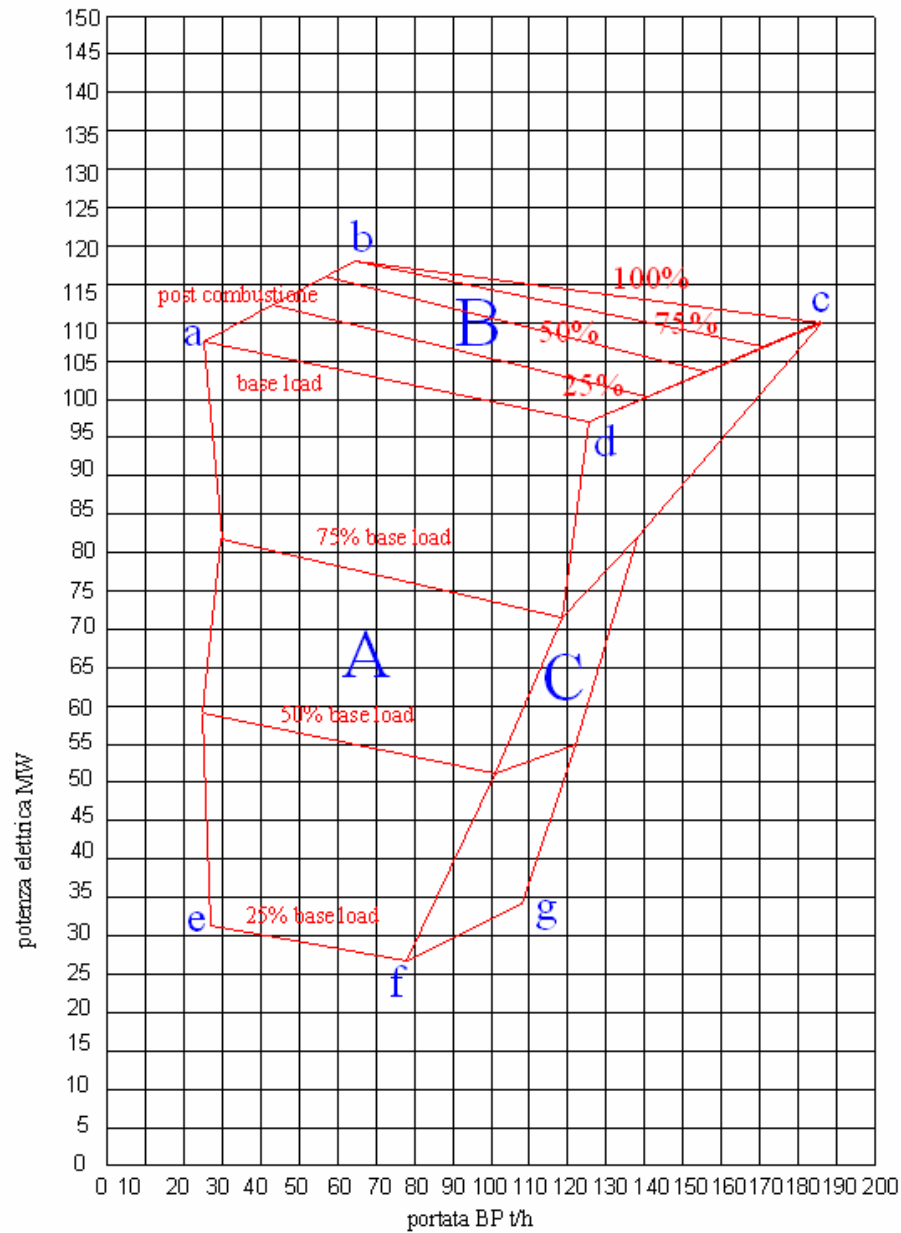
- N° 2 natural gas fuelled Combustion Turbines –rated power 39 MW each
- N° 2 Heat Recovery Steam Generators with 2 pressure levels - 85 Bar and 5 Bar – for a total output of 200 t/h and 28 t/h respectively
- Duct burners to increase steam production of the HRSGs
- N° 1 Steam Turbine of 41.7 MW rated power with :
- N° 1 controlled steam extraction at L.P. 5 bar
- N° 2 uncontrolled steam extractions M.P.

# General Flow Diagram



# Single line diagram





# Electrical Master Controller – 1 – Grid Connected

- 1. Generated power is controlled according to a total power set point or a power exchange set***
- 2. Power request increases operate first on gas turbine sets and then on duct burners***
- 3. Power request decreases operate first on duct burners, then on gas turbine power sets***
- 4. Duct burners are turned on or off automatically, keeping into account the regulation margin of the turbines***
- 5. The master controller changes its parameters according to the number of turbines in operation***



## Electrical Master Controller –2– Island mode

- 1. One of the gas turbines is set to frequency control***
- 2. The master controller balances load (secondary regulation) of the other gas turbine and the steam turbine (through the duct burners)***

## Thermal Master Controller

***Purpose of the thermal controller is to ensure steam production for the paper mill. It operates on the duct burners with a feedforward signal considering:***

- Thermal balance, including HRSG contribution and duct burners
- Operating configuration of the plant (steam turbine and burners status)
- Position of steam valves

## Alba – Bra Hospital Project

- Maire Engineering was assigned the contract for the new hospital for the cities of Alba and Bra (near Verluno, Piedmont) also thanks to proposals of improvements in energy and control systems – among the improvements:
  1. A cogeneration plant has been added
  2. Artificial lighting is controlled in the buildings
  3. An integrated control system coordinates all functions

## Alba – Bra Hospital - Cogeneration

- Maire Engineering collaborated with Politecnico di Torino ( Prof. Filippi , Ing. Corgnati , Ing. Simonetti ) in order to select an optimal solution to fulfill the energetic needs of the hospital
- A cogeneration plant with two natural gas fuelled engines has been selected
- Electric power 2x800 kW
- 2 x 500 kW as water at 90°C
- 2 x 500 kW as saturated steam at 10 bar

## Alba – Bra Hospital - Cogeneration

- Steam is used for sterilization, kitchen uses and humidification
- Hot water is used for the production of warm sanitary water and climatization
- 85% of electric loads and 30% of thermal ones are covered with the cogeneration plant
- The remaining part is supplied by the electric grid and by conventional boilers

## Alba – Bra Hospital – Lighting Control

- Energy saving has been considered as well
- For instance, offices and rooms for patients have automatic lighting control
- Sensors are used to determine actual illuminance of rooms
- Electronic units control the power of fluorescent lamps, coordinated through a digital bus connecting lamps and sensors
- Lamps are automatically switched off under a minimum request of light;
- Where applicable, human presence is taken into account to switch off artificial lights in unoccupied rooms

## Alba – Bra Hospital – Building Automation

- An integrated automation system manages HVAC, lighting, power grid and cogeneration system
- Operation and efficiency of cogeneration group as well as chillers and boilers is constantly monitored
- Coordinated control of the systems is performed to implement global strategies: for instance, the output of the cogeneration units is kept as high as possible, using the boilers to integrate heat production when necessary and switching them off when not required
- Recorded values can be used to track the performance of the systems and to make further analysis about how to improve it

## Alba – Bra Hospital – Work in progress

- Further improvements of the systems for the Alba-Bra hospital are under study and will be proposed in the near future