Technical University of Sofia

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Advanced gas turbine plant cycles for more efficient natural gas transmission

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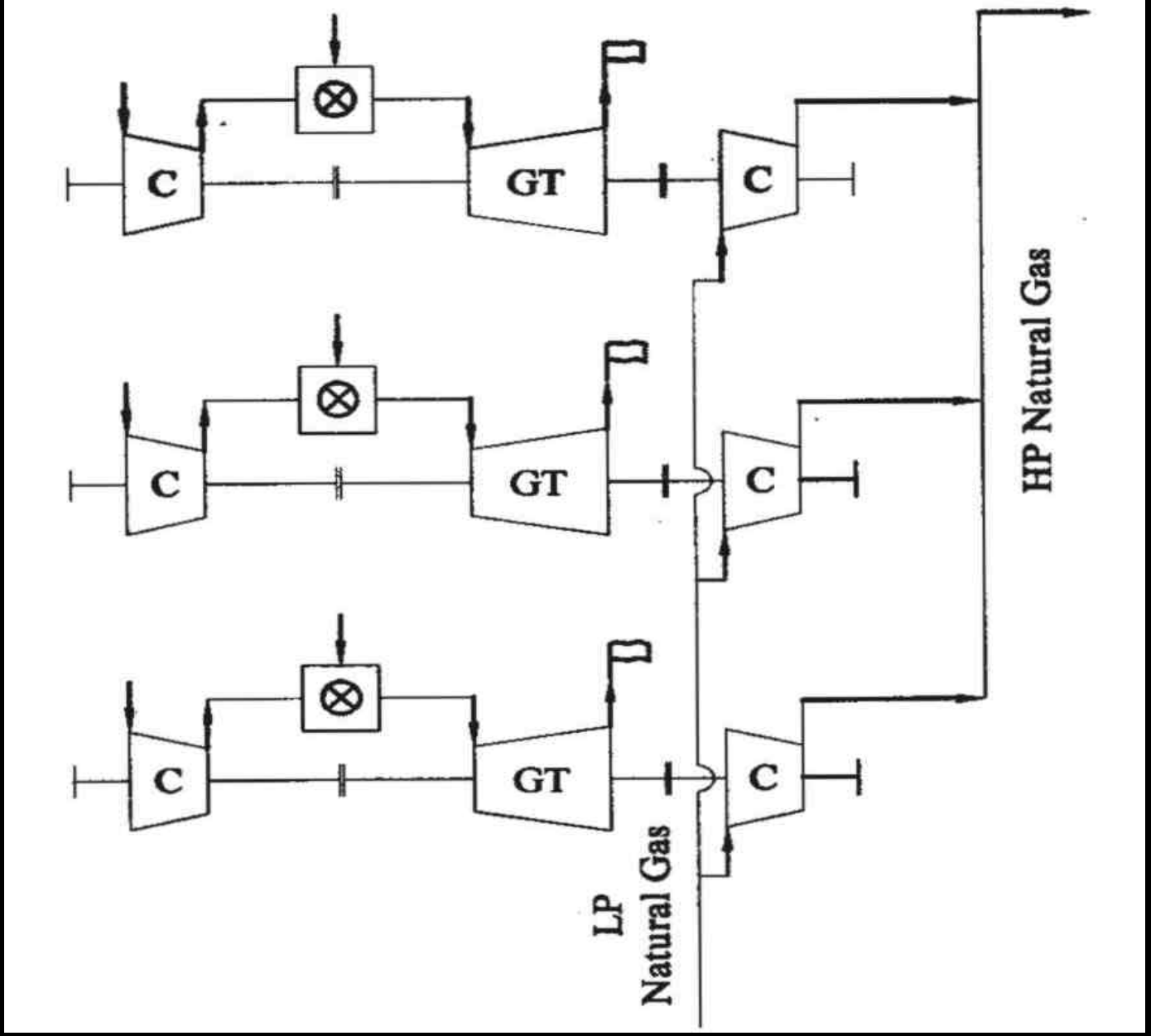
European gas transmission pipeline network comprises more than 200,000 km stretching from the North Sea and the Baltic Sea to the Mediterranean and from the Atlantic to Eastern Europe;

Ruhrgas only, operates 26 compressor stations with a total of 80 compressor units and with a total power installed of almost 800 MW;

Compressor stations are used to boost the gas pressure in gas transmission systems;

Turbo-compressors, which are dynamic compressors with rotating blades, are usually employed. These units are driven by simple cycle gas turbines

Typical layout of gas compression station

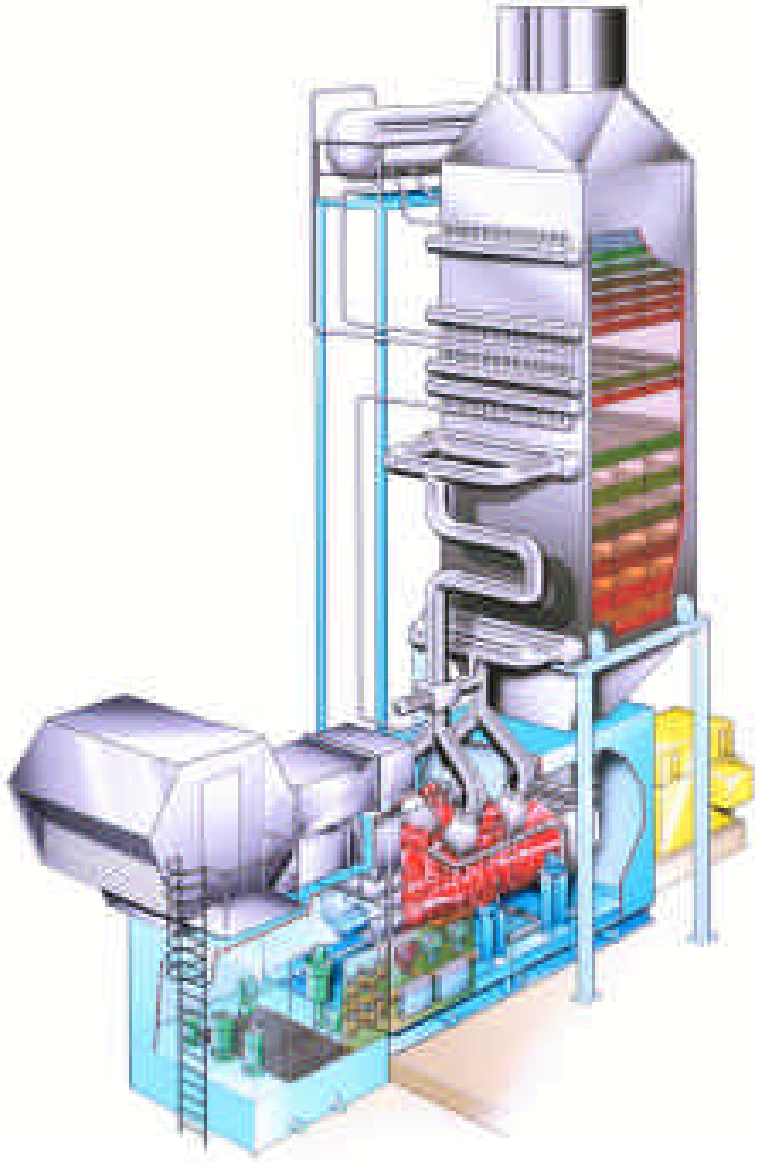


Gas turbines	Power kW	Thermal efficiency %	Exhaust gas temperature °
Rolls-Royce 501-KC7	**5518**	**31.7**	**520**
Solar Taurus 70 CS	**7690**	**34.8**	**495**
Alstom Tornado	**7489**	**34.3**	**485**

In this way valuable clean energy in the form of exhaust heat is entirely wasted.

Assembly drawing of a Cogeneration plant

with Recuperator and Waste Heat Recovery Boiler

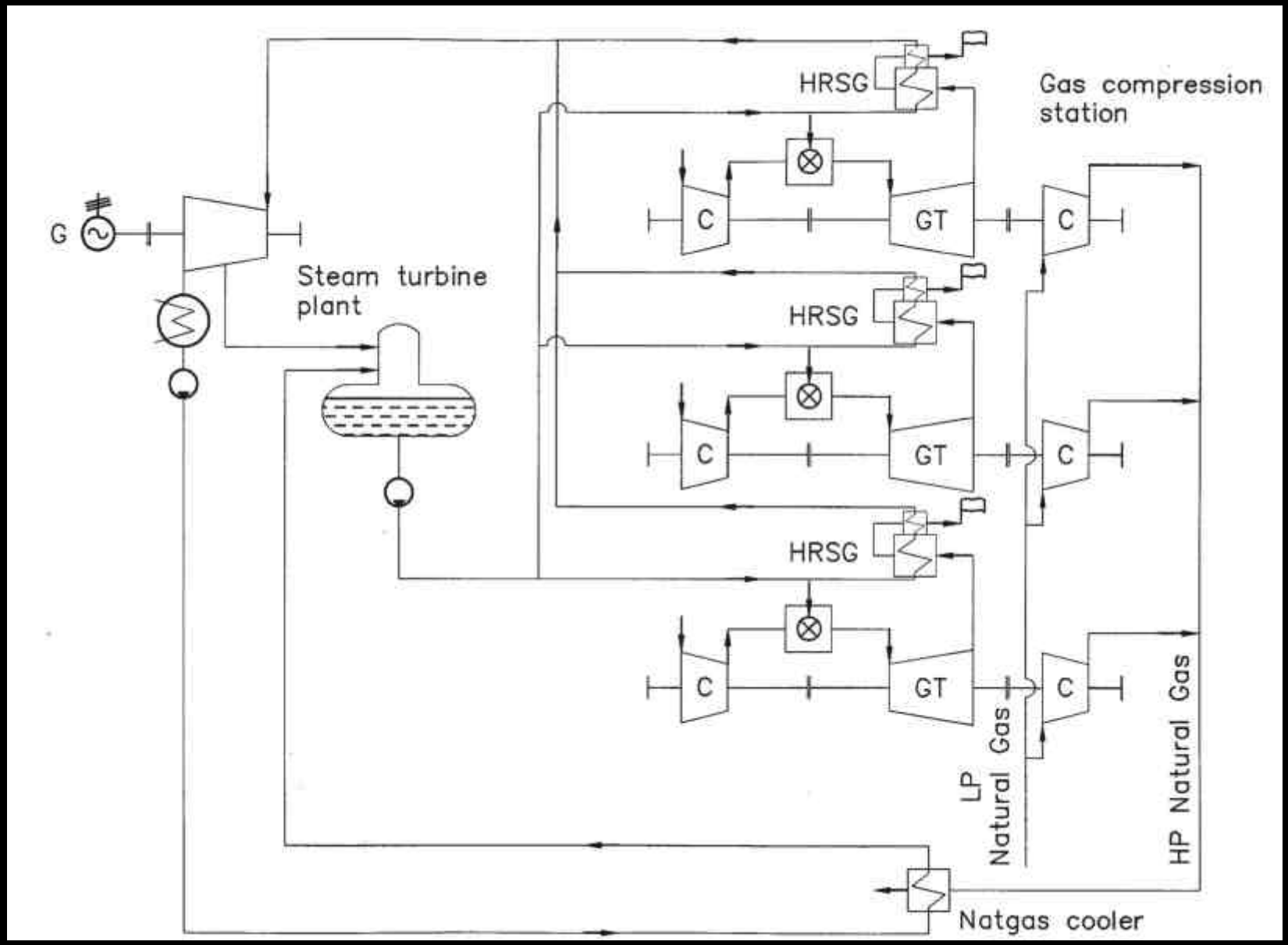


The main task of each gas compression unit is to keep up the gas pressure in the transmission systems and to work with highest degree of availability, durability and flexibility.

Steam turbine as mechanical drive is not able to meet this stringent requirement due to its technical nature and especially due to its very long start-up period.

More efficient and more reliable gas compression could be achieved when electricity is generated.

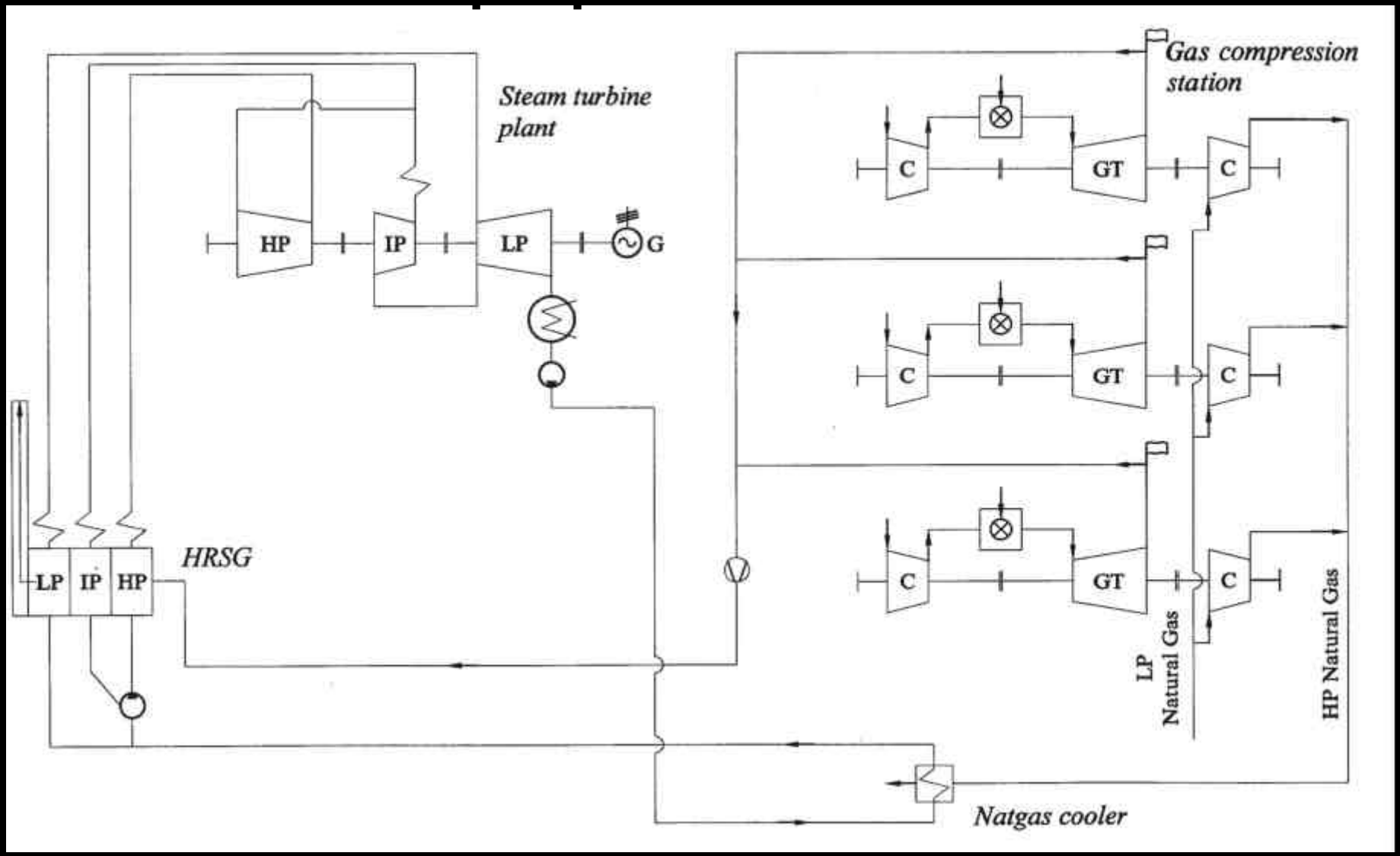
Two-generation gas compression station concept


HRSG
Gas compression station
G
C
GT
C
Steam turbine plant
HRSG
C
GT
C
HRSG
C
GT
C
LP Natural Gas
HP Natural Gas
Natgas cooler

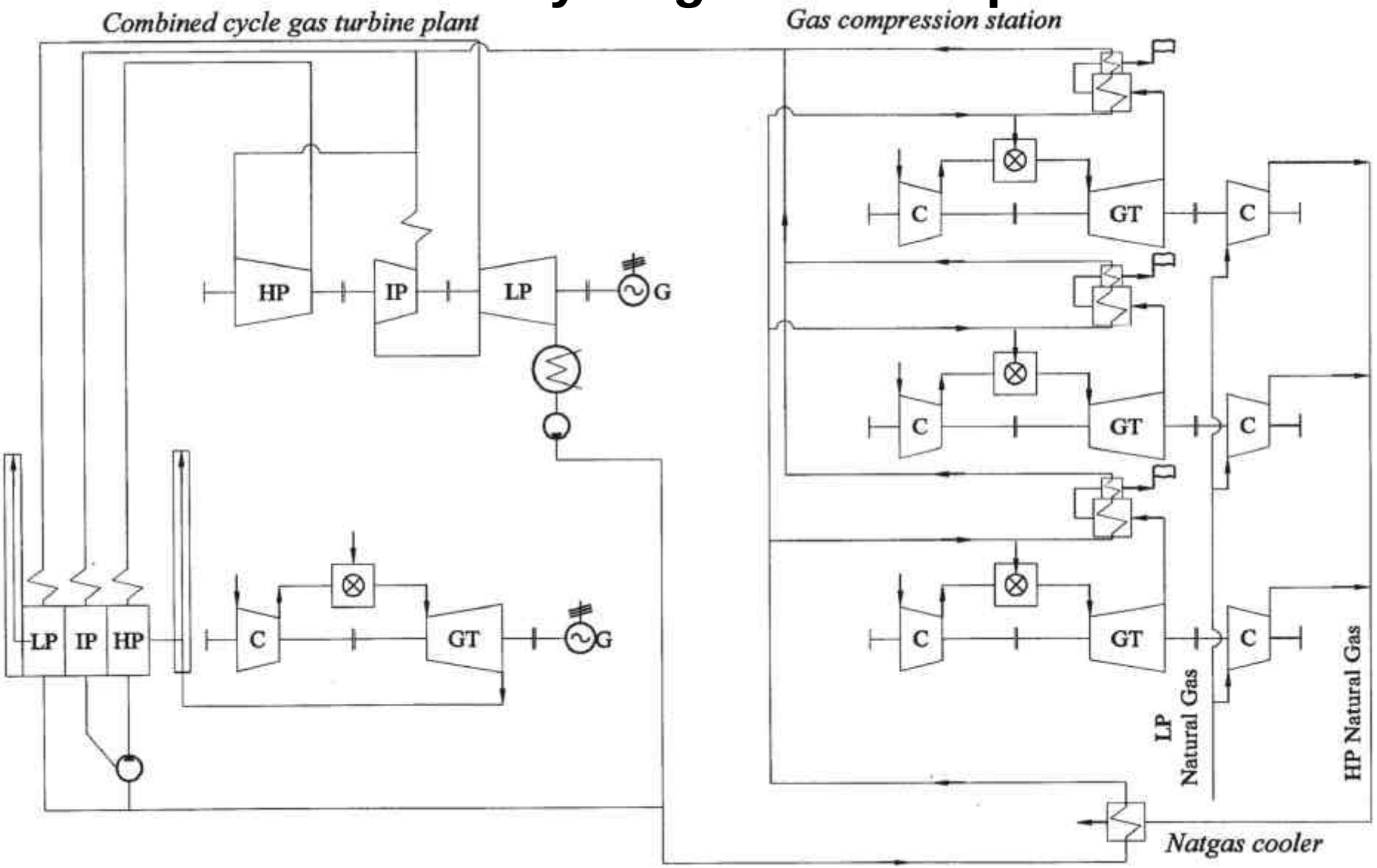
The plant consists of three gas turbines Solar Taurus 70 CS, each with a capacity 7690 kW. The exhaust gas temperature is 495°C. Each gas turbine is equipped with single-pressure HRSG. The steam generation is calculated to have a capacity of 10.2 t/h superheated steam with temperature 410°C and pressure 28 Bar.

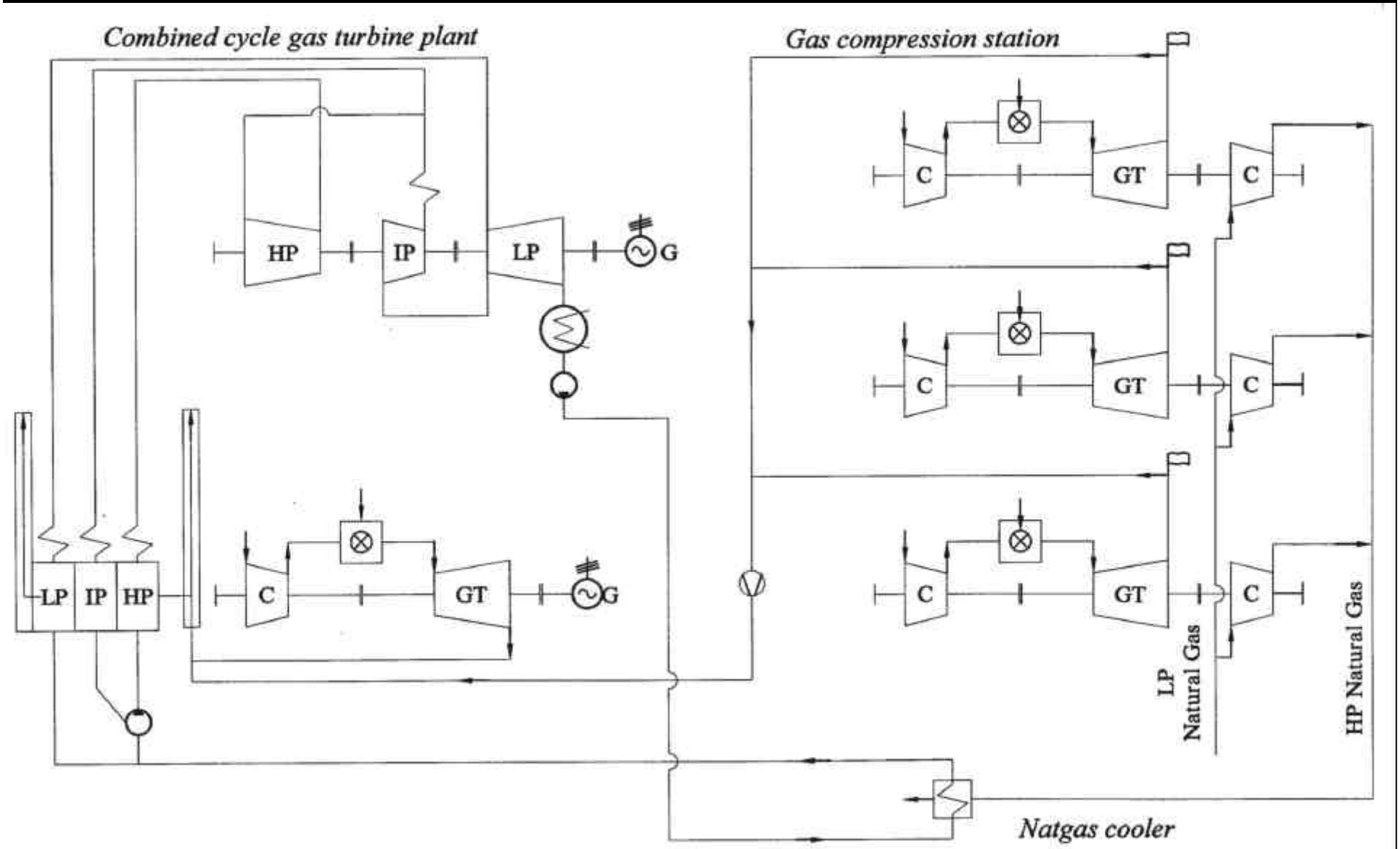
Steam turbine capacity will be 7425 kW under these live steam conditions and condenser's pressure 0.05 Bar.

In this way compression station's efficiency is boosted to 46% instead of 34.8% in simple cycle operation.


Steam turbine plant
HP
IP
LP
G
HRSG
LP
IP
HP
Gas compression station
C
GT
C
C
GT
C
C
GT
C
LP Natural Gas
HP Natural Gas
Natgas cooler

Large power generation and gas compression at one site


Combined cycle gas turbine plant
Gas compression station
HP
IP
LP
G
C
GT
LP
IP
HP
LP Natural Gas
HP Natural Gas
Natgas cooler

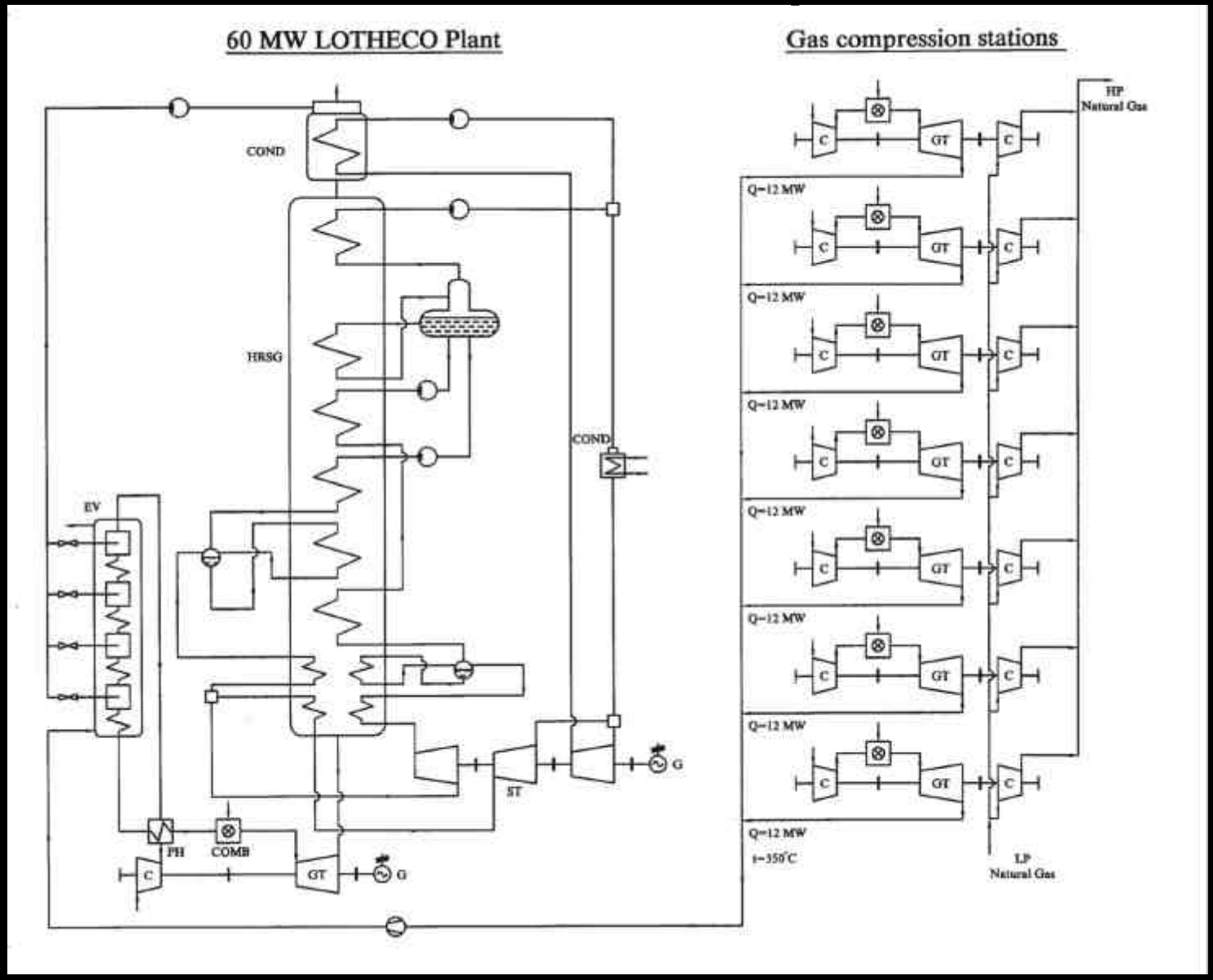

Combined cycle gas turbine plant
Gas compression station
HP
IP
LP
G
C
GT
LP
IP
HP
LP Natural Gas
HP Natural Gas
Natgas cooler

Some advanced CCGT concepts could be also considered as a part of combined cycle mechanical drive and power generation plant;

The LOTHECO Combined Cycle plant, created by prof. Leithner makes use of waste heat;

One of the difficulties met within LOTHECO cycle implementation is the need of continuous hot and clean enough waste heat sources;

Gas compression stations as a heat source could respond exactly to LOTHECO cycle needs


60 MW LOTHECO Plant
COND
HRSG
COND
EV
PH
COMB
C
GT
G
ST
G
Gas compression stations
HP
Natural Gas
C
GT
C
Q=12 MW
Q=12 MW
Q=12 MW
Q=12 MW
Q=12 MW
Q=12 MW
Q=12 MW
t=350°C
LP
Natural Gas

Conclusions:

- The efficiency of the gas compression stations can be substantially increased when two-generation concept is employed;

- Gas compression sites could be feasible locations for newly developed CCGT plants;

- Gas compression stations are appropriate sources of waste heat for LOTHECO plant development.

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