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Combined Heat and Power Project Proposal

K . Zemmour[#1] , K .Saidi*[2]

[#]*Departement of Physics, Badji Mokhtar University, Annaba (Algeria)*

[1]kamzemmour@yahoo.fr

**MAN Diesel & Turbo SE, Steinbrinkstr.1,Oberhausen (Germany)*

[2] karim199@yahoo.fr

Abstract—**Today the power generation process by solutions allowing the reduction of the fossil dependency is one of the big issues. The other issue is the reduction of emissions (NOx, CO_2, CO). In order to achieve these objectives some interesting and innovative concepts were developed and proposed in the market. The Renewable systems and the combined Heat and power systems are the most important innovative concepts. Our Focus is the Combined Heat and Power (CHP) systems.**

***Keywords*—Cogeneration – Combined Heat - Power system – Heating - Cooling**

I.INTRODUCTION

Today the power generation process by solutions allowing the reduction of the fossil dependency is one of the big issues. The other issue is the reduction of emissions (NOx, CO_2, CO). In order to achieve these objectives some interesting and innovative concepts were developed and proposed in the market. The Renewable systems and the combined Heat and power systems are the most important innovative concepts.

Our Focus is the **C**ombined **H**eat and **P**ower (CHP) systems. What does mean a CHP system?

A Combined Heat and Power system (fig. 1) is defined as the sequential generation of two different forms of usable energy from a single fuel source. It is mechanical energy and thermal energy [1, 2, 3, 4, 5, 6] .The mechanical energy may be used either to drive a generator to produce electricity, or to drive rotating equipment such as a compressor. Thermal energy can be used either directly for process applications or indirectly to produce steam, hot water (district heating), or chilled water for cooling purposes.

The CHP systems are known since 1920. However the first system was realized in 1960. After that the activities in the CHP field were not really important during a lot of years. The significant increase of oil and natural gas prices was one of the main reasons for changing the direction of the research and development in the energy field. The specialists of the energy field consider the CHP concepts with the highest priority. There are two types of combined heat and power systems [1, 2, 3, 4, 5, 6]:

- The Topping Cycles:In these systems the fuel source is first of all used for power process. The second step consists of the use of the available heat of the exhaust gases for heat processes. In this case the available heat can be used for steam process, hot water production (for heating purposes or the domestic use) and chilled water production (for cooling process).The prime movers of topping cycles can be Gas and Steam turbines, Engines,…

- The Bottoming Cycles**:** In this case, the fuel source is used for a specific industrial process (as the production of special alloys at high temperatures in the hot furnaces). After that the heat of the exhaust gases is directly used for power generation. Per example: the exhaust heat can be used by a waste heat recovery unit (Boiler) for steam production per example. After that this steam drives a steam turbine for power generation.

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The place of the combined heat and power systems is growing up more and more over the world particularly in America, European and Asian countries.

The main prime movers used today for the CHP system are: Gas and Steam Turbines, Engines, Fuel cells and Organic Rankine Cycles. These prime movers operate with fossil resources as: Natural gas, Coal or Diesel for electricity production. In general, the thermal power of the conventional fuel is used by a medium as air (transformed to power by a Gas Turbine) or by steam (transformed to power by a steam Turbine) [1, 2, 3, 4, 5, 6, 7, 8]. The available exhaust heat as mentioned in the topping cycles paragraph is used for steam generation or hot and chilled water productions.

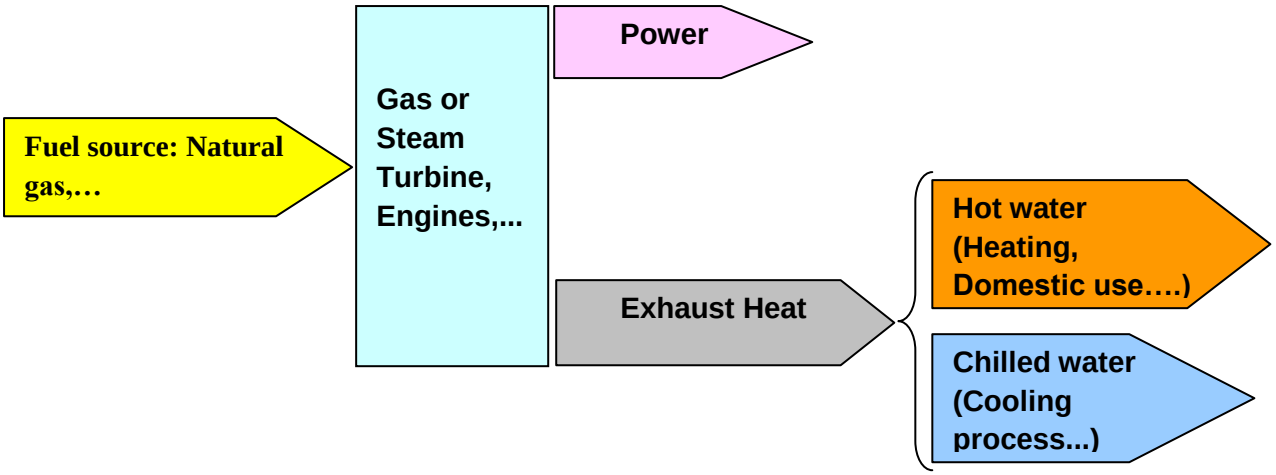

Fig. 1 General configuration of a Combined Heat and Power system

II. COMBINED HEAT AND POWER PROJECT PROPOSAL

The combined heat and power project that we propose is multi generation system for the university site. The combined heat and power system is a topping cycle. The prime mover of this system is a Gas Turbine class 6 MW. First of all the gas turbine uses a certain fuel amount (natural gas) for power production. In the second step the exhaust heat available at outlet of the gas turbine drives a waste heat recovery unit (boiler) for saturated steam production at 5 bara. In the winter time, the whole steam drives a heat exchanger for hot water production at 125 or 130°C. This hot water is used for heating or for the domestic purposes. During the summer time, the whole steam amount at 5 bara drives an absorption chiller double effect (Lithium bromide / water) for chilled water production at 5 or 7°C. The chilled water is used for air conditioning purposes in the different offices and institutes of the university. The system is described in the figure 2. This system can operate 8000 hours per year. It requires a standard maintenance and service for few weeks. During the service period the power can be bought temporarily from the public grid in one hand. On the other hand the boiler of the CHP system is able to operate in a conventional way in order to supply steam at5 bara and to keep the heat processes (heating or cooling) in function. This CHP system is flexible, it can operate at full load or part load load if the power demand is less than 6 MW. At the same time the heat processes (heating and cooling) demands can follow the fluctuations of the power generation. The overall combined heat and power efficiency is in general very interesting. It is between 80 and 90%.

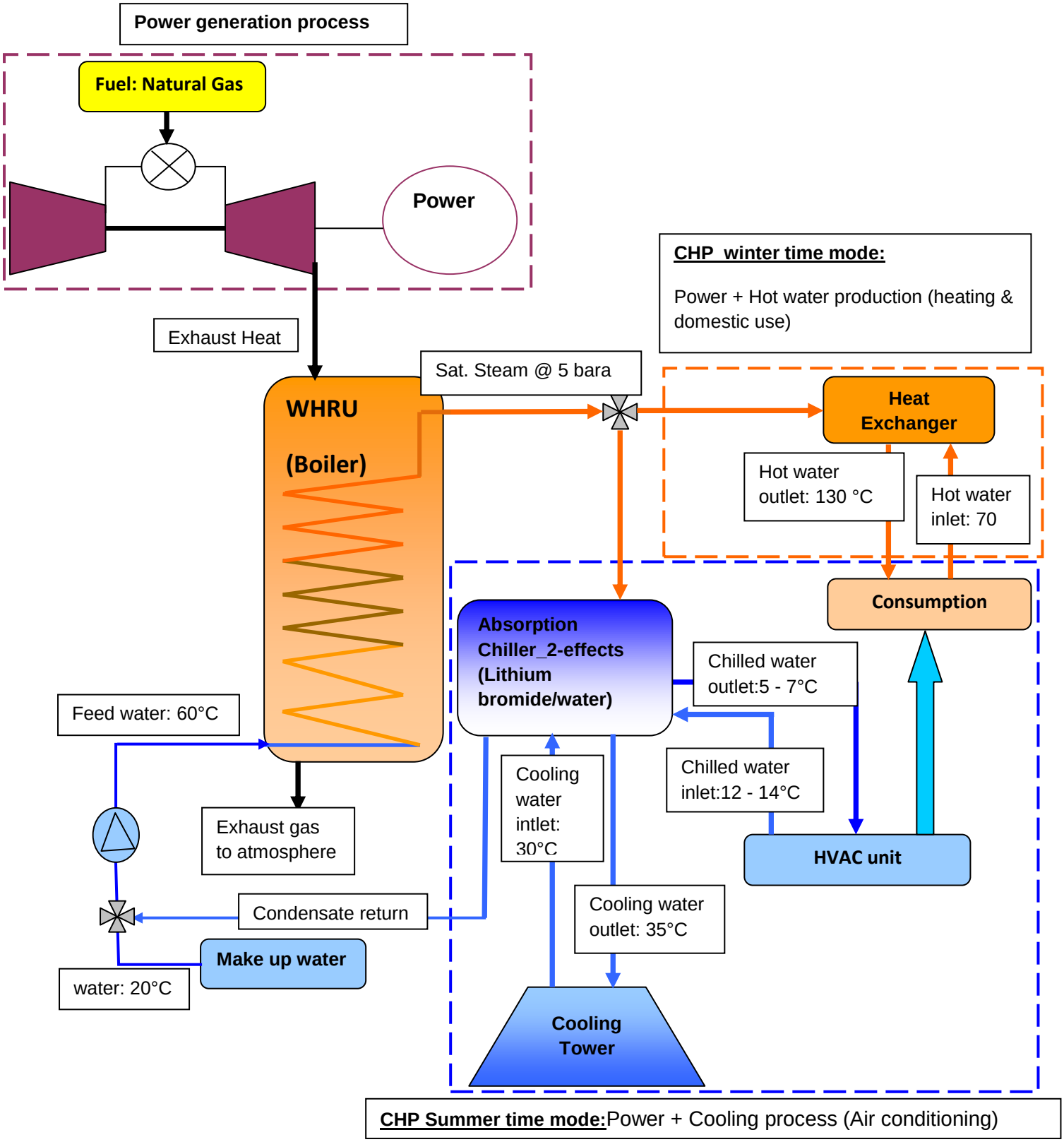

Fig. 2 Configuration of the proposed Combined Heat and Power system (Power, heating and cooling)

III. CONCLUSIONS

Economically, this system provides high savings and the payback time of such combined heat and power system is between 3 and 5 years. It is very attractive [4, 7, 8, 9, 10, 11]. This parameter depends on the generated savings, the investment, the maintenance costs and the local energy costs (electricity and natural gas). The main advantage also of such CHP system, it provides a full autonomy to the university site.

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