Summary:

The installation is in the Hospital Universitario Severo Ochoa (HUSO) in Leganés (Madrid). Madrid has its highest cooling demand in summer but during the winter, cooling is needed for surgery rooms and other areas with special air requirements.

Furthermore, heating demands are high, not only for space heating in the winter, but also for domestic hot water production as well as for process heat (e.g. sterilization and cleaning) over the whole year.

The installation recovers low temperature heat from the condensation circuit of the water-water electric chillers. Previously, this heat was dissipated through the cooling towers. The heat is upgraded to 50–55 °C and injected into the local DHN to partially satisfy its thermal energy needs. The booster heat pump captures the heat from the outlet water of the chillers' condensing circuit (25–35 °C), which is used to generate hot water at a satisfactory temperature and varies depending on the control system but can be up to 50–55 °C, which can be injected into the local DHN. Through the booster HP, water from the chillers' condensing circuit is cooled, minimising the use of the cooling towers and saving energy.

The project has been developed and executed by ASIME, responsible for maintenance of the hospital's cooling and heating systems. The installation was part of the EU project ReUseHeat.

1. System History

As a result of strong policy towards energy efficiency in public buildings in Spain, the hospital engaged ASIME to ensure an efficient energy transition of its premises. A 13-year contract is established between the parties and it is built around the concept of win-win and the savings of energy are split between the partners.

ASIME found that waste heat from the cooling towers of the hospital was being dissipated into the ambient air. It was identified that a recovery of it could replace the use of gas fired boilers. Trough a booster heat pump, water from the chillers' cooling circuit is cooled, minimizing the usage of the cooling towers and, if the heating demand is not enough to absorb this heat production, it will be addressed to the DHN tanks (50-55ºC), reducing the need to produce hot water with the natural gas boilers. A new, advanced control system further improved the operation of the heating production system. To optimize efficiency and energy savings, parameters such as temperatures in the chillers' cooling circuit and local DH&C, instantaneous boiler efficiencies and energy prices need to be taken into account; one of the main innovations in the project. The heat pump installation was undertaken within the Innovation Action ReUseHeat (H2020) and was combined with an installation of photovoltaics on the rooftops of the hospital buildings to ensure that the heat pump could run on locally generated electricity.

2. Configuration of production units

The demonstrator recovers low temperature heat from the cooling circuit of the water-water electric chillers. Before the installation, the heat was dissipated through the cooling towers. The booster heat pump captures the heat from the outlet water of the chiller cooling circuit and upgrades it to supply it to the district heating system. By using the booster heat pump, the water from the chillers' cooling circuit is cooled, minimising the usage of the cooling towers. The conceptual design is illustrated below. A comparison is shown between the ReUseHeat solution (new) and the baseline before the demonstrator implementation (old).

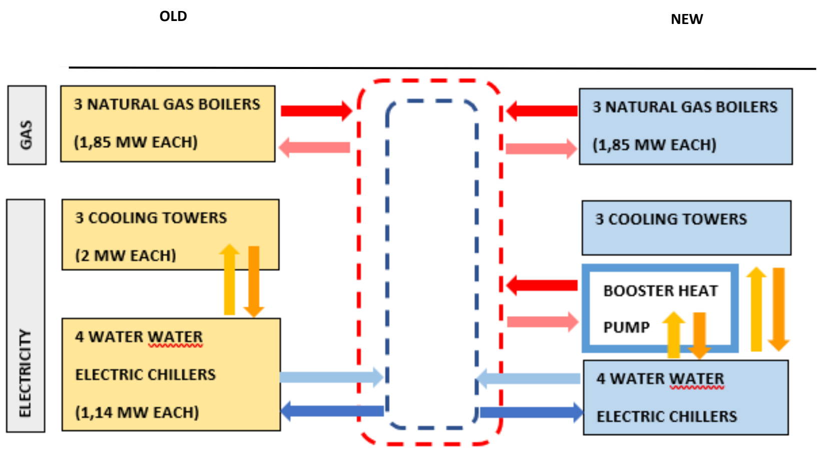

Figure 1. Booster heat pump for waste heat recovery from hospital

The schematics of the implementation are illustrated further in figures 2 and 3 where figure 3 shows the inclusion of the heat pump into the current system.

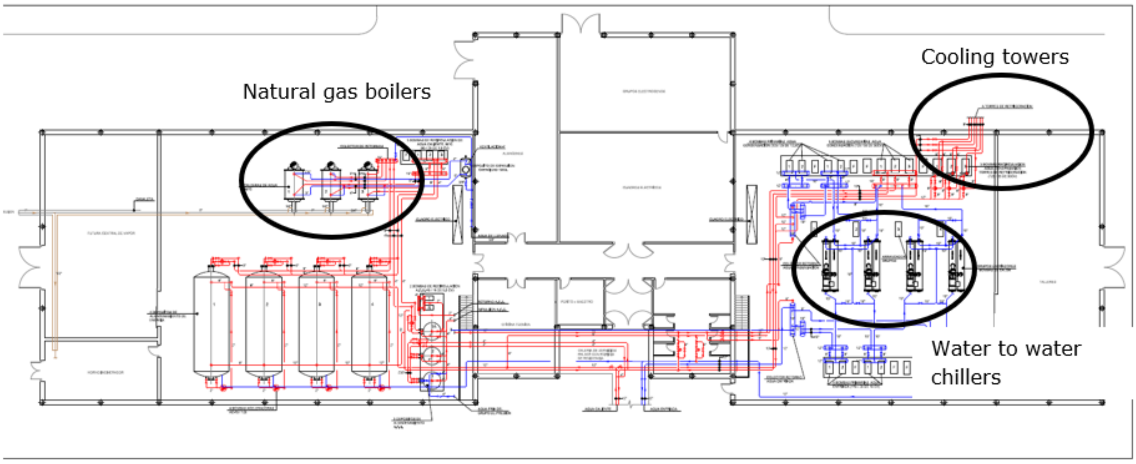

Figure 2. The system before the intervention

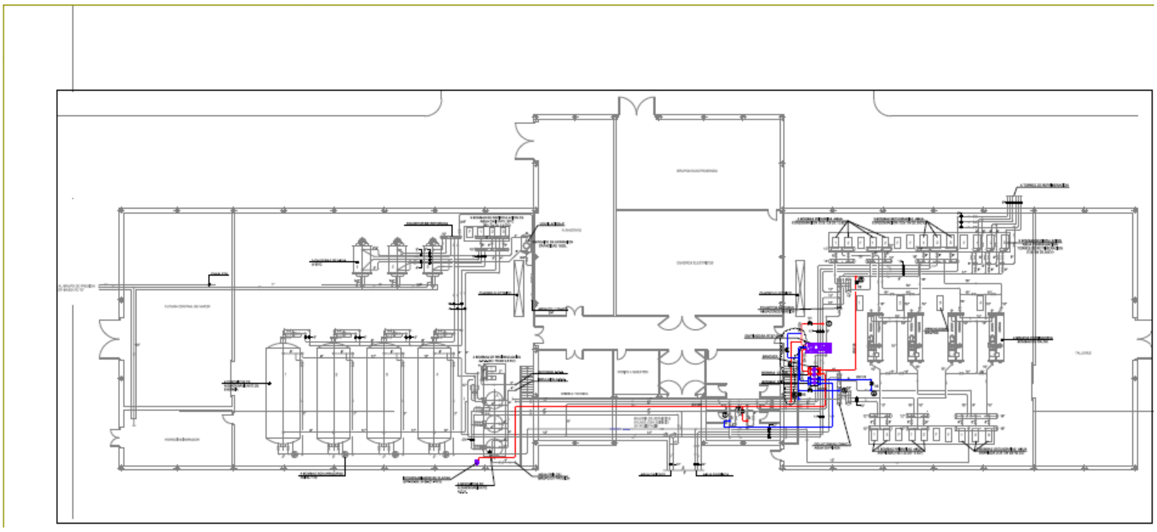

Figure 3. The system with heat pump included

3. Distribution network

The operating mode to implement the new water-water heat pump equipment has two modes:
- Mode 1: Supporting the cooling towers and boilers in summer. (from June to September)
- Mode 2: Supporting chillers and boilers in winter and between seasons. (The rest of the year)

The operating mode will be selected according to the date and will be carried out according to the outside temperature operating motorized valves.

Supply of hot and cold water to the air treatment units is carried out through 4 tubes with low temperature in the heating water circuit at 47ºC.

For the system to operate properly, an energy accumulation has been planned, with water tanks, capable of storing up to 10000 kW of thermal power, which operate as true regulators of the system, both to release heat and to collect the excess heat production.

All the central air treatment units are located in 18 machine rooms, located on the roof of the building and are controlled by peripheral microcomputers connected to the central unit, which allows programming their operation according to schedules and controlling it from the central dash board, where the working temperatures can be programmed and energetically optimized. This dash board also permits to know the current operating situation and any service alarms that may occur.

Finally, and as additional security, knew the importance that a breakdown of heating could implies in a hospital, conventional 90ºC water boilers have been provided with diesel and gas mixed burners, which would fully operate in case of an emergency or a failure of the refrigeration groups.

In figures 4 and 5 the managements systems of the chillers and the booster heat pump are shown

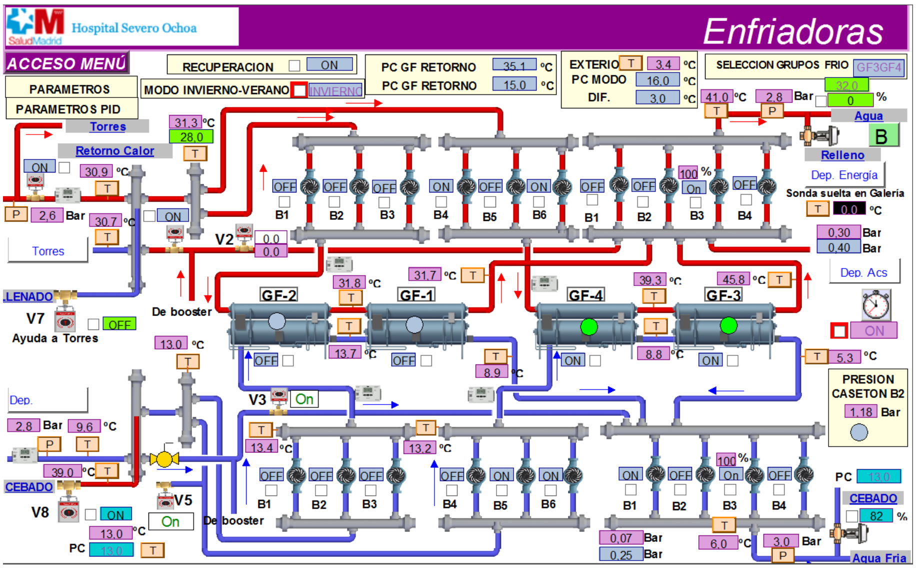

Figure 4. The chillers management system

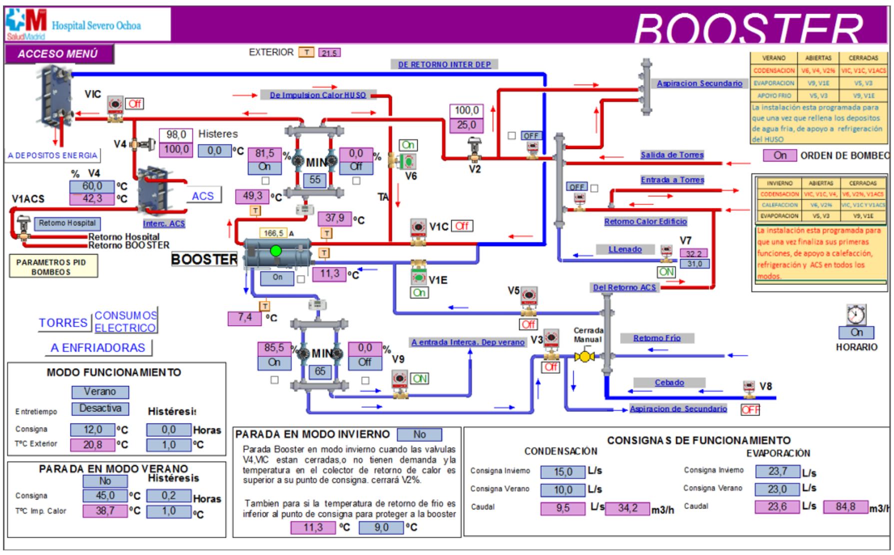

Figure 5. The Booster Heat Pump management system

4. Number of square footage of buildings/ customer facilities served

There are seven different buildings served, including the facilities warehouse, a nursery and the main hospital building. There are 61.134m^2 served in total.

5. Average age of production and distribution system facilities

The original facilities dates from 1987, and in 2009 an expansion and ampliation of the distribution network.