

COGENERATION AND TRIGENERATION SYSTEMS IN HOSPITALS

In hospitals, which offer 24/7 services and have an essential place in our lives, the service quality provided to patients, employees and visitors go parallel with their energy consumption. It is considerably important for hospitals to maintain uninterrupted supply of heating, cooling and electrical energy. In this scope, cogeneration and trigeneration systems bring significant advantages for hospitals.

Cogeneration and Trigeneration Systems

Cogeneration means converting a form of energy into a combined form of heat and electrical energy and producing them at the same place. Two of the most important advantages of producing heat and electrical energy in the same location instead of producing them in separate locations, are highly efficiency and economy. Natural gas, biogas, propane gas, coke-oven gas etc. can be used as energy input at these plants. While a gas turbine or gas engine producing only electricity transforms approximately 30-40 percent of the energy input into electricity, the efficiency in cogeneration systems go as high as 80-90 percent with heat production.

Trigeneration means adding a cooling property to cogeneration system which generates heat. In addition to supplying electricity and heat energy to the plant, trigeneration system also supplies cold water to the cooling line. This supply of cooling is ensured via an absorption chiller cooling unit. Absorption chiller unit containing lithium bromide supports 12-7°C line of the hospital by absorbing hot water from the engine. 12°C water line is covered by the absorption chiller group and this water is cooled in the unit and supplied back to the hospital at 7°C.



Since the use of natural gas has become widespread in our country and the government has facilitated the means for generating your own electricity, cogeneration and trigeneration applications have gained popularity. At Teksan, we have produced the first local cogeneration system in Turkey. With our know-how, we have been developed suitable solutions to respond to the needs.

Cogeneration and trigeneration facilities have carbon emission-reducing features in accordance with the Kyoto Protocol. Due to low emission values of gas engines used in these systems, environmental damage caused by the facility is minimized.

Why Should Hospitals Have Cogeneration or Trigeneration Systems?

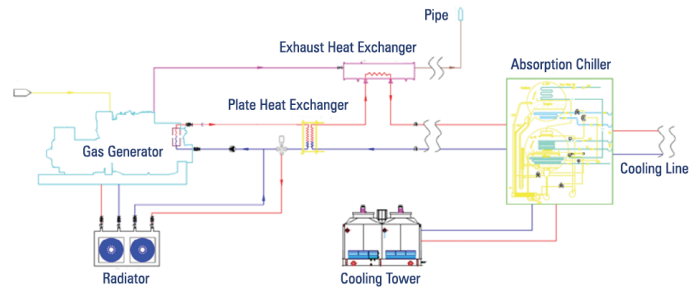
Hospitals need uninterrupted supply of electrical, heating and cooling energy for 24 hours. It is extremely important for hospitals to use cogeneration and trigeneration installations to heat the rooms, to sustain the operation of central heating boiler, to supply hot utility water, to ensure interrupted supply of vapor used in certain locations in hospitals, to operate the cooling line in designated locations in hospitals during summer and to maintain desired level of temperature in the rooms.

The advantages of cogeneration and trigeneration systems can be listed as follows;

- High efficiency above 90%
- Low energy costs
- Uninterrupted energy
- Depreciating the investment in a short time
- Environment-friendly features
- Less burden on the national grid due to generating its own energy in the facility, minimizing losses in transmission and distribution.

Trigeneration System Applications in Hospitals

A single trigeneration circuit is indicated below.



Electric energy is produced by a gas engine running on natural gas and a coupled alternator. In addition, influent water of the hospital first absorbs the heat of the engine jacket water through a plate heat exchanger, and then the water goes to the exhaust heat exchangers to absorb the exhaust heat in order to use the heat of the jacket water and exhaust heat of the engine. Thus, it returns back to the hospital with a higher temperature. In addition, absorption chiller cooling unit supports the 12- 7°C cooling line by absorbing the hot water received from the engine through chemical reactions in order to support the cooling line of the hospital during summer.

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An Example of Feasibility of Trigeneration in Numbers

Assume that a 2x400 kW natural gas trigeneration installation in a hospital has the following values.

Electric Production	:2 x 400 kWe
Heat Production	:2 x 539 kWt
Abs Chiller Cooling Capacity	:675 kWt

This trigeneration facility supplies 800 kW electrical energy and 1078 kW thermal energy per hour to the hospital, as well as supplying 675 kW cooling to the cooling line of the hospital in summer. While conducting a feasibility study and choosing a trigeneration installation, it is highly important to determine operating hours and to operate during targeted times. In general, trigeneration installations provide energy during most of the year, except for the maintenance periods, supplying energy for approximately 7-8 months of the year and supporting the cooling system for 3-4 months in summer. These periods may vary depending on the geographic location of the facility.

Without a trigeneration facility installation;

- Electrical energy would be purchased from national grid on unit price of electricity,
- Thermal energy would be purchased on unit price for natural gas to operate boilers,
- Cooling energy would be purchased on unit price for electricity to operate air-conditioners, electrical chillers and air-cooled cooling groups.

If we make a calculation, assuming that unit price for electricity is 0.34 TRY/kWh, and unit price for natural gas unit is 0,85 TRY/m³;

Without a trigeneration installation;

- Costs of production of electrical energy would be 2.176.000,000 ₺
- Costs of production of thermal energy would be 557.281,00 ₺
- Costs of production of electricity for cooling water supply would be 160.550,000 ₺ in a facility with the same capacity as the trigeneration.

If we add these values, the sum is 2.893.831,00 ₺, which would be the total amount to be paid for electricity, heating and cooling production per year in the absence of a trigeneration installation in a hospital. In addition, the hospital would operate heat boilers, electrical cooling groups etc. in order to reach these energy values, which would be subject to maintenance costs. With a trigeneration installation, only natural gas costs for operation of gas engines and operation expenses would have to be paid. Natural gas consumption values of natural gas generator group may vary depending on gas engine used in the trigeneration installation.

When there is a trigeneration installation, the natural gas expenses of the hospital with the facility values and operation hours specified above would be 1.468.800,00 ₺.

In addition, when we add maintenance costs, internal electricity consumption, spare parts and oil consumption to the management

expenses, the annual cost of the facility amounts to 1.8000.00,00 ₺. Annual profit by trigeneration installation for the hospital can be calculated by subtracting the amount to be paid for electricity, heating and cooling in the absence of a trigeneration installation from the total annual cost of trigeneration facility. When we calculate the difference, the approximate amount is 1.093.831 ₺, which means that this 2x400 system will generate approximately 1.000.000 ₺ annual net profit for the hospital. Thus, the hospital will ensure savings on natural gas by operating heating boilers less when trigeneration system is functional, and as well as savings on electricity by disabling electrical chiller group when absorption chiller group operates during summer.

Electricity Cost
Heating Cost
Cooling Cost



In conclusion, cogeneration and trigeneration systems contribute to energy efficiency of hospitals and reduce energy costs considerably. Using the energy efficiently is valuable for facilities which require uninterrupted supply of energy. Cogeneration and trigeneration facilities can also be preferred in hospitals due to increasing energy demand, reduced external dependence in terms of electric energy, environment-friendly system and user-friendliness.



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