MIDWEST

U.S. DOE

CHP Technical Assistance Partnerships

PROJECT PROFILE

Saint Mary's Hospital

7.75 MW CHP System

Project Overview

Saint Mary's Hospital of Rochester, Minnesota, has long embraced combined heat and power (CHP). It first began operating a CHP system in 1912 with a 350 kW steam turbine system and today operates a CHP system that includes a 4.75 MW combustion turbine and 3.0 MW back pressure steam turbine. The facility upgraded the initial system based on expanding facility needs, while retiring aging equipment. For the most recent addition to the CHP system, the 4.75 MW combustion turbine installed in 1996, the hospital experienced a 3.5 year payback on their $5 million investment. The hospital can now meet approximately 75% of its peak electric demand.

The CHP system utilizes a 4.75 MW Solar Taurus 60 natural gas combustion turbine with a heat recovery boiler that recycles the exhaust gas from the turbine into approximately 24,000 lb/hr of 250 psig high pressure steam. To supplement the thermal energy provided by the Solar Taurus turbine Saint Mary's utilizes three Nebraska 80,000 lb/hr high pressure boilers. The high pressure steam produced from the combined system is then either utilized in building heating or cooling, in medical equipment sterilization or sent to a 3.0 MW backpressure steam turbine that reduces the 250 psig steam to 8 psig. The 8 psig steam is then utilized for either heating or cooling throughout the hospital.

Quick Facts

LOCATION: Rochester, Minnesota

MARKET SECTOR: Healthcare

FACILITY SIZE:

3 Million Square Feet, 960 Licensed Beds

FACILITY PEAK LOADS:

Electric: 12.0 Megawatts

Heating: 130,000 lb/hr Steam

Cooling: 7,500 Tons

TOTAL CHP GENERATING CAPACITY: 7.75 Megawatts

HEAT RECOVERY RATE: 24,000 lb/hr of 250 psig Steam

HEAT RECOVERY UTILIZATION: Building heating or cooling, medical equipment sterilization, additional electricity generation

PRIME MOVERS:

(1) 3.0 MW Dresser-Rand Back Pressure Steam Turbine (installed 1971)

(1) 4.75 MW Solar Taurus 60 Gas Combustion Turbine (installed 1996)

FUEL TYPE: Natural Gas

TOTAL PROJECT COST: $5 Million*

EXPECTED PAYBACK: 5 Years*

ACTUAL PAYBACK: 3.5 Years*

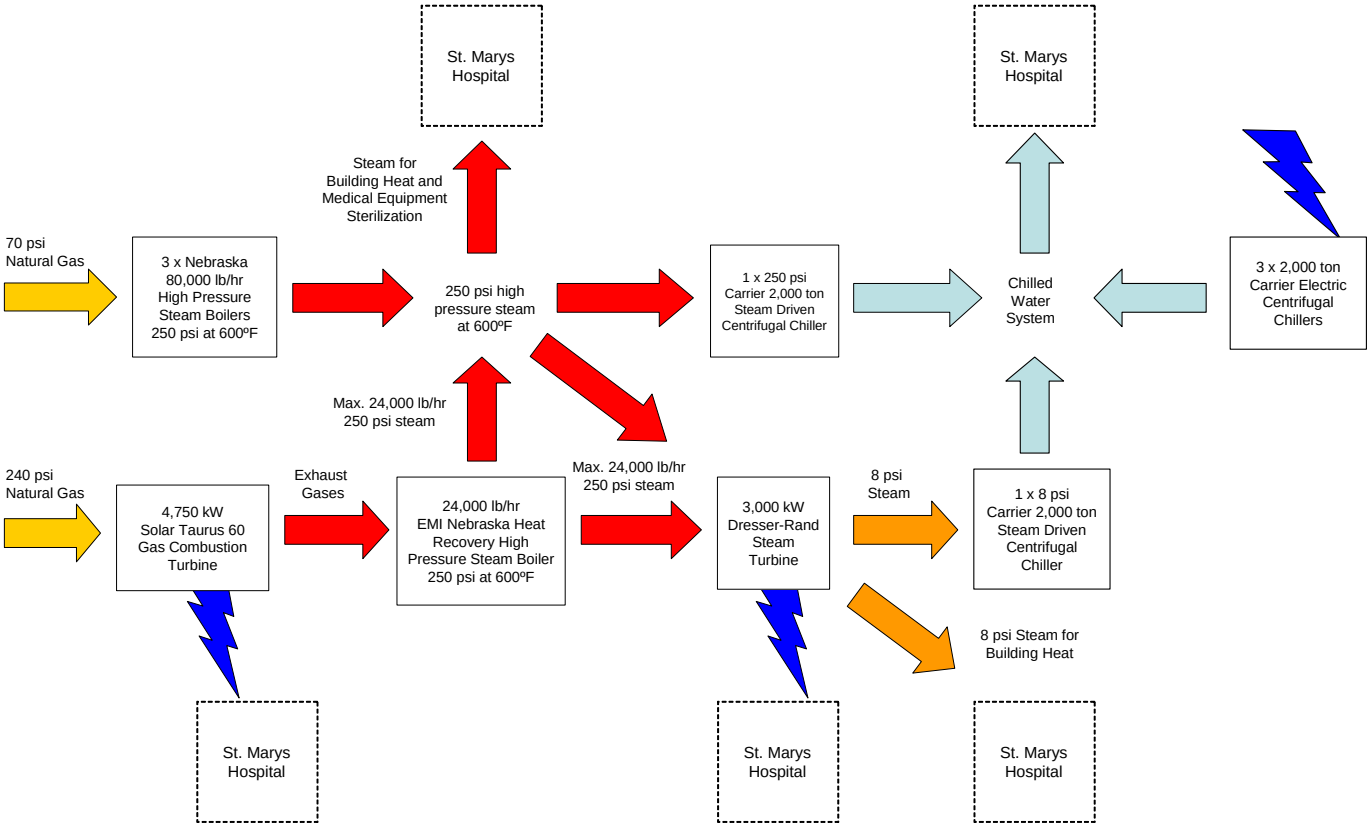
BEGAN OPERATION: 1996*

** Data for 4.75 MW Combustion Turbine Installation Only*

History of CHP at Saint Mary's Hospital

The first two 350 kW steam turbines were installed in 1912 and 1919, respectively. In 1942 the hospital installed two 750 kW Westinghouse steam turbines to replace the original turbines, and in the 1950s added a 1,500 kW steam turbine to meet increased electrical needs. The current 3,000 kW Dresser-Rand steam turbine was added in 1967. Aging boilers and equipment were replaced in 1992 with a new plant and the retirement of the 3 oldest Westinghouse turbines. More recently in 1996, Saint Mary's hospital installed a 4.75 MW Solar Taurus 60 natural gas combustion turbine that would supply high pressure steam to the 3.0 MW backpressure steam turbine or supplement building heating and cooling loads and medical equipment sterilization.

Solar Taurus Turbine at Saint Marys Hospital



CHP Flow Diagram of Saint Marys Hospital

Design and Operation

During the warmer months, generally between March and November, the CHP system is able to generate nearly two-thirds of Saint Mary's Hospital's maximum electric demand of 12,000 kW. Over half of the hospital's total 7,500 ton cooling demand is supplied by utilizing the exhaust steam from the gas turbine heat recovery steam boiler and steam turbine to operate steam driven chillers. The steam driven chillers represent 4,000 tons of the 10,000 ton cooling capacity at the hospital. The chillers are shut down during the winter months and the hospital utilizes the cooler outside air through shell-and-tube heat exchangers to meet any required cooling. During the cooler months, generally November through March, the CHP system is able to meet over 75% of the hospital's 10,000 kW maximum winter electric demand and nearly 20% of the 130,000 lb/hr maximum high pressure steam demand. If the CHP system cannot meet the hospital's entire electric demand, the hospital purchases the required electricity from Rochester Public Utilities. The hospital also has three 2.5 MW standby diesel engine generators for emergency power. The CHP system, in parallel to the utility grid and the emergency generators, provides the hospital with high electric reliability.

Lessons Learned:

- To generate 3,000 kW of electricity at full capacity, the Dresser-Rand steam turbine requires 66,000 lb/hr of high pressure steam. The Solar combustion turbine can provide over one-third of the turbine's maximum high pressure steam requirements through the EMI boiler.
- Maintenance of the Solar turbine is provided by staff employees; no additional staffing was required to support the addition of this system.
- Excess electricity generated is shared to a common substation for use at the Franklin Heating Station of Rochester, Minnesota.

For More Information

U.S. DOE MIDWEST CHP TECHNICAL ASSISTANCE PARTNERSHIP

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