MIDWEST

CHP Technical Assistance Partnerships

PROJECT PROFILE (draft 1/23)

Gundersen Health System, La Crosse Wisconsin

Biomass Boiler Project Includes 400kW CHP Backpressure Turbine

Background

Gundersen Health System (Gundersen) has been successfully operating a biomass boiler system, which burns clean organic wood fuel to produce the steam utilized throughout its La Crosse, Wisconsin campus, since 2013. The biomass system incorporates a CHP backpressure steam turbine/generator set to regulate the steam pressure while producing up to 400 kW of electric power.

Prior to the installation of the biomass boiler system, Gundersen was utilizing three natural gas boilers, installed in the early 1970s, to produce the thermal energy (400 psi steam) required on campus. The steam was utilized year round for heating buildings, laundry, kitchen, dehumidification, and sanitization of medical equipment. As these boilers reached the point in time where serious concerns over their refurbishment/ replacement occurred, Gundersen reviewed many options and decided on the installation of an 800 HP biomass boiler system. The new system, which was commissioned in 2013, consumes between 20 tons per day (summer operation) and 60 tons per day (winter operation) of clean wood chips, providing approximately 80% of the annual steam load. The three natural gas boilers now provide back-up and/or supplement the biomass system as needed.

Quick Facts

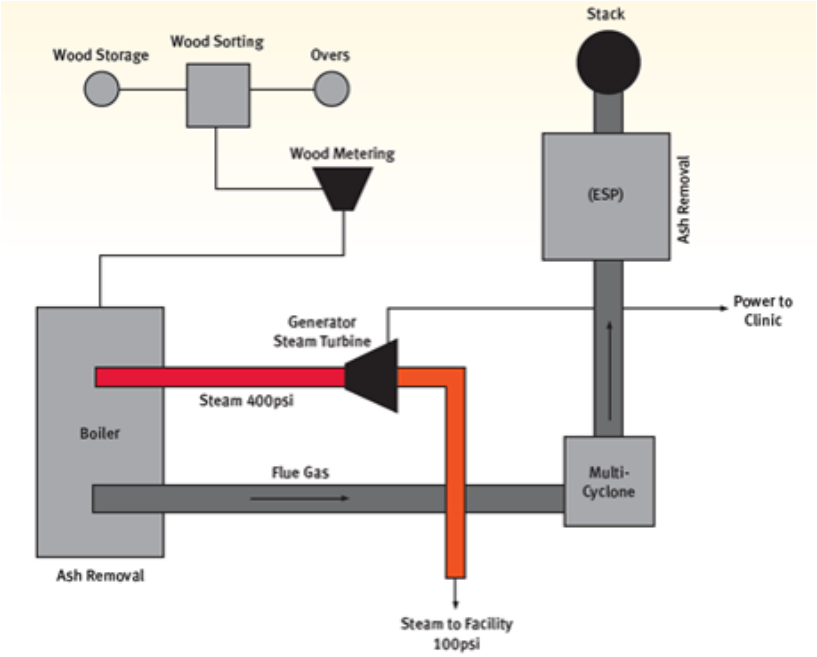
Location: La Crosse, Wisconsin
Market Sector: Healthcare
Type of System: Biomass Boiler (800 HP)
Fuel Type: Wood Chips (milling & forest residue)
Thermal Energy: 400 psi steam
Thermal Energy Use: Space and water heating, laundry, kitchen, dehumidification, and medical equipment sanitization
Prime Mover: Waste heat-to-power backpressure steam turbine/generator set
Steam Pressure Drop: 300 psig
Steam Flow: 12,000lbs/hr to 28,000lbs/hr
CHP Capacity: 400 kW max
Total Project Cost: $6.2M
Sub-Cost (CHP): $3.2M
Wisconsin State Energy Office Grant: $220,000
Est Annual Savings: $450,000/yr.
Began Operation: 2013

Project Overview

Backpressure Steam Turbine/Generator
Photo courtesy of Gundersen Health System

The system is housed on campus in a biomass building that includes a three day wood storage bin, a wood sorting system, a wood fuel metering system, a fuel handling conveyor and pneumatic feed system, an 800 HP boiler with automated combustion and emission controls, a 400 kW backpressure steam turbine/generator set, and a state-of-the-art boiler emission clean up system (multi-cyclonic separator and electrostatic precipitator (ESP) to handle and remove the fly ash). The total system is depicted in the flow diagram on page 2.

While the boiler produces steam at 400 psi, the hospital campus only requires 100 psi pressure for building and equipment use. In most conventional systems, it is customary to utilize mechanical



Biomass/CHP System Flow Diagram
Gundersen Lutheran Med. Center/Gundersen Clinic Ltd/8167-2_0117

pressure reducing valves (PRVs) to reduce the 400 psi steam to the required 100 psi steam. The PRVs are very energy inefficient since the energy contained in the steam during the drop in pressure is not utilized. Gundersen recognized the energy efficiency opportunity of installing a backpressure steam turbine/generator set in parallel with the two PRVs to make use of this otherwise lost energy.

Shaft power is produced in the turbine when a nozzle directs jets of the 400 psi steam against the blades of the turbine's rotor. The rotor is attached to the shaft that is coupled to an electrical generator. The steam turbine does not consume steam, it simply reduces the pressure of the steam, in this case to the 100 psi that is subsequently exhausted into the process steam header.

By paralleling the turbine/generator with the PRVs, Gundersen increased operational flexibility since the steam flow can be automatically diverted through the PRVs when the steam turbine is not operating, allowing the pressure drop to occur and ensuring continuous uninterrupted operation of the system.

Depending on the flow rate of the steam (winter or summer operation), the CHP turbine/generator set can produce up to 400 kW of utility grade electric power. The system produces on average over 2,000,000 kWhs annually, which is utilized onsite by Gundersen, reducing the amount of electricity purchased from the local electric utility and further reducing fossil fuel emissions.

Gundersen Health System Energy Plan

"After some initial start-up issues, the CHP system has met our expectations, operating at over 90% availability and reducing our monthly electric utility bill."

Alan Eber, Facility Operations Director
Gundersen Health Systems

Gundersen is a physician-led, not-for-profit healthcare system headquartered in La Crosse, Wisconsin. Its integrated system serves 21 counties in western Wisconsin, northeastern Iowa, and southeastern Minnesota. In May 2008, with rising energy costs, it established the Envision program that made a commitment to improve the health of the communities they serve and control rising energy costs.

Gundersen would accomplish this through a series of project partnerships aimed at reducing energy consumption throughout its campuses by improving energy efficiency and replacing fossil fuel generated energy, where possible, with clean renewable forms of energy.

In October 2014, through a series of project partnerships, Gundersen reported that it had reached its goal of becoming completely energy independent, the first healthcare system in the U.S. to do so. The La Crosse biomass boiler/CHP project was the single most effective project in meeting the energy independence goal, offsetting 38% of Gundersen's total energy use.

For More Information

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