MIDWEST CHP APPLICATION CENTER

In Partnership with the US DOE

combined heat & power in ethanol plants

East Kansas Agri-Energy, LLC

1.6 MW CHP Application

Project Profile

Quick Facts

Location:
Garnett, Kansas

Facility Type:
Ethanol plant

Annual Plant Capacity:
35 million gallons of ethanol
68,000 tons of DDGS
110,000 tons of WDGS
92,000 tons of CO2

Boiler Fuel Type:
Natural Gas

Prime Mover Type:
Dresser-Rand KD2 Steam Turbine Generator Set

Electric Generating Capacity:
1,600 kilowatts

Inlet / Outlet Steam Turbine Pressure:
120 psig / Atmospheric pressure

Steam Turbine Nominal Flow Rate:
40,000 – 50,000 lb/hr

Estimated Annual Electric Savings:
$180,000 per year

Began Operation:
June 2005

Project Overview

East Kansas Agri-Energy (EKAE), LLC, a 35 million gallon per year dry ethanol plant located in Garnett, Kansas, is the first ethanol plant in the U.S. to incorporate a combined heat and power steam turbine to generate electricity as part of its daily operation. The 1.6 MW Dresser-Rand KD2 steam turbine intakes 120 psig steam, produced by natural gas-fired boilers, and exhausts the steam at atmospheric pressure, producing one-third of the plant's required electricity. The 120 psig steam is utilized in the distillation process while the steam at atmospheric pressure is used in the evaporators. The steam turbine, integrated into the initial design of the EKAE facility and installed in June 2005, provides an estimated $15,000 in monthly electric savings.

Plant Background

EKAE is a farmer cooperative with more than 600 owner-members. The ethanol plant began operation in June 2005 following an industry record of only eight months of construction. The grain supply for the ethanol plant is supplied from a 150 mile radius including 10 counties in Kansas and four in Missouri.

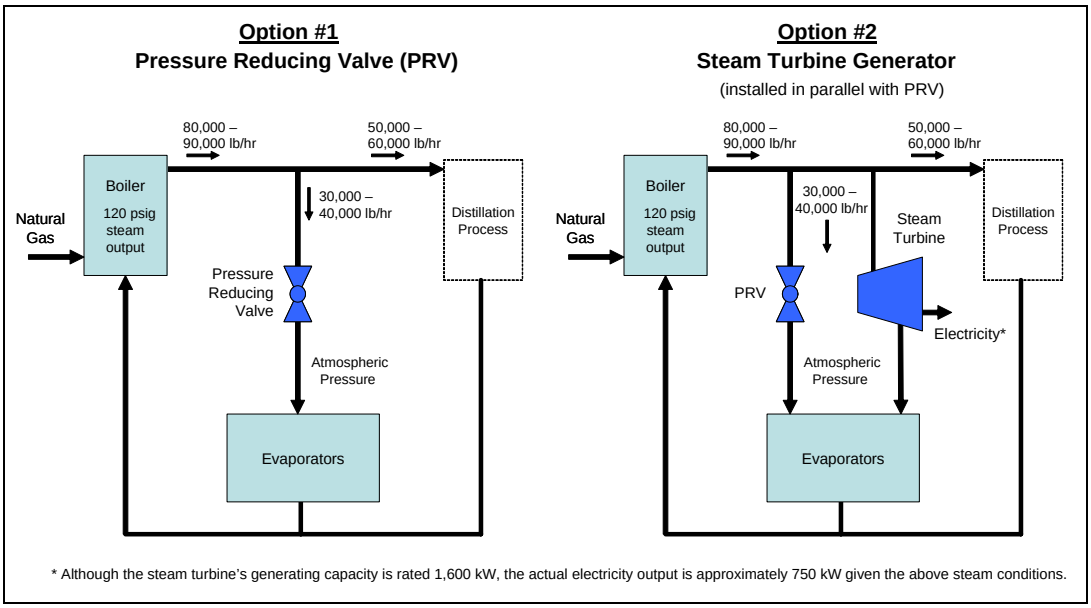
East Kansas Agri-Energy (EKAE) Ethanol Plant – Garnett, Kansas
Source: Insights – A Publication of the Dresser Rand Company, Volume 10 No. 2.

Replacing PRVs with Backpressure Steam Turbines

Many industrial facilities produce steam at a pressure higher than that demanded by process requirements. Steam passes through pressure-reducing valves (PRVs, also known as letdown valves) at various locations in the steam distribution system to let down or reduce its pressure. A non-condensing or backpressure steam turbine can perform the same pressure-reducing function as a PRV while converting steam energy into electrical energy.

In a backpressure steam turbine, shaft power is produced when a nozzle directs jets of high-pressure steam against the blades of the turbine's rotor. The rotor is attached to a shaft that is coupled to an electrical generator. The steam turbine does not consume steam. It simply reduces the pressure of the steam that is subsequently exhausted into the process header.

Source: U.S. DOE – Industrial Technologies Program – Steam Tip Sheet #20 – January 2006



* Although the steam turbine's generating capacity is rated 1,600 kW, the actual electricity output is approximately 750 kW given the above steam conditions.

Integrating a Steam Turbine into the EKAE Ethanol Plant

Many ethanol plants present excellent CHP opportunities due to the continuous and coincidental thermal and electric loads of the ethanol producing process. The thermal and electric loads are such that they meet the size ranges of many commercially available CHP technologies. As a result, CHP systems have been installed and operating in a number of ethanol plants across the U.S. providing operational, economical and environmental benefits.

Although steam turbines have been in application for a number of years, it took some time before this concept was accepted into the design of ethanol plants. According to Ken Ulrich, Sales Manager for ICM, Inc., a design engineering firm of ethanol facilities, "We had been recommending this to clients for several years." The initial response from the ethanol producers included little interest of entering into the electric industry stating they wanted to maintain their focus on the core business of producing ethanol. Ulrich noted many of the responses citing, "I just want to make ethanol. Why should I buy a turbine and generator when I can put in a control valve?"

This was the industry reaction until EKAE realized the opportunity identified by the engineering design team of ICM, Hughes Machinery and Dresser Rand to install the first steam turbine in a U.S. ethanol plant. "They have to drop the steam pressure anyway, why not make electricity," noted Kent Calvert, Sales Manager for Hughes Machinery Company. The steam turbine would provide a mechanism to provide electric savings and to be environmentally conscious.

Source: Insights – A Publication of the Dresser Rand Corporation, Volume 10 No. 2.

For further information contact:

Midwest CHP Application Center
851 S. Morgan Street
Chicago, IL 60607-7054

Phone: (312) 413-3835
Fax: (312) 996-5620
www.CHPCenterMW.org

"I have to make the steam for the production process. This is a classic cogeneration application that's been around forever. It's nearly a perfect conversion of heat to work when you have an application where you use low-pressure exhaust steam."

Ken Ulrich
Design Engineer
ICM, Inc.

"They have to drop the steam pressure anyway, why not make electricity."

"The fact that it's integrating a steam turbine generator set into such an industry that's trying to be environmentally responsible is indicative of their forward thinking."

Kent Calvert
Sales Manager
Hughes Machinery Company

Revised 121707