SOUTHCENTRAL

CHP TECHNICAL ASSISTANCE PARTNERSHIPS

PROJECT PROFILE

Rice University

District Energy System

7.4 MW Combined Heat & Power

Rice University Campus – Houston, Texas

SOURCE: RICE UNIVERSITY

Site Description

Rice University is a private research university located in Houston, Texas, with total enrollment of 7,124 in 2018. Established in 1912, Rice has become one of the top research and undergraduate universities in the United States with $125 million in externally funded research.

With the goal of becoming a Zero Carbon Campus, Rice has undertaken a robust energy strategy that focuses on energy savings, efficiency and resilience. CHP originally installed to conserve energy has evolved and continues to fill an important role as part Rice University's Integrated Climate & Energy Master Plan (RICEMaP). The plan currently includes 100 kW of rooftop solar photovoltaics, with more renewable energy sources to be added in the coming years. The positive impact of CHP on Carbon Footprint supports the university's Zero Carbon Campus goal. The CHP system can operate in island mode in the event of a power outage for reliability and resilience

District Energy System

During the 1980s a campus district energy system was developed for efficiency and reliability. Rice University has two utility plants on campus. The Central and South Plants collectively house two natural gas turbines (CHP in the Central Plant) two heat recovery steam generators (HRSG), six boilers,

Quick Facts

LOCATION: Houston, Texas

MARKET SECTOR: Higher Education

FACILITY SIZE: Serves 50 campus buildings

DISTRICT PEAK LOAD: 7.4 megawatts (MW), 170,000 lb/hr steam, 13,188 tons chilled water

EQUIPMENT: Central Plant - Solar Taurus 40 gas turbine, Ruston GTG gas turbine, 2 HRSGs, 2 Cooling Towers, 6 Chillers

FUEL: Natural gas, dual fuel capability

USE OF THERMAL ENERGY: Steam Generation and Chilled Water

TOTAL EFFICIENCY: 80-84%, evaluated yearly

ENVIRONMENTAL BENEFITS: NO_X emissions reduced by two thirds. Positive impact on Carbon Footprint supports goal of Zero Carbon Campus. Key component of Integrated Climate & Energy Master Plan.

YEARLY ENERGY SAVINGS: Campus estimated Total Annual Energy Savings $725,000, plus $450,000 per year estimated revenues from curtailment and other savings possible by CHP

CHP IN OPERATION SINCE: 1980s, ongoing upgrades, new turbine engine in 2018

six chillers, two cooling towers, and one domestic water well. The two gas turbines with CHP provide a combined 7.4 MW of power. The district system meets almost all thermal energy needs for the campus, The Solar Taurus 40 operates 24 hours/day, 7 days/week. The Raston turbine operates only during specific high price market conditions enabling Rice to participate in load shedding and peak power management initiatives.

These facilities generate 25% of Rice's electricity, 98% of heating and cooling, and 20% of the campus domestic water. These utility services are provided through three miles of tunnels and hundreds of miles of pipe, both buried and in tunnels throughout the campus. The plants also serve as distribution points for the remaining 75% of Rice's electricity and another 80% of domestic water.

District Energy System Capacity

Central Plant CHP System

- Former 'Power House' 26,911 sq ft
- 7.4 MW Total
  - Solar Taurus 40 Gas Turbine
  - Ruston GTG Dual Fuel Turbine
- 8,000 tons chilled water
- 130,000 lb/hr steam

South Plant No CHP

- 17,380 sq ft
- 5,000 tons chilled water
- 40,000 lb/hr steam

Best Practices

Central Plant
SOURCE: RICE UNIVERSITY

Added measures, such as retro-commissioning, LED lighting, and tighter building HVAC schedules improve energy efficiency campus-wide. These measures will reduce thermal demand by 30%-50% and electric power consumption by 20%-30%. In addition, during the winter break, many areas of the campus are put into a setback mode to conserve energy while the university is closed. The combination of reduced campus energy consumption and improved plant efficiency will dramatically reduce future utility infrastructure capacity requirements.

In a story that spans a quarter-century, Rice began implementing CHP and other efficiency measures in the 1980s. Today the focus on efficiency and environmental performance drives ongoing efforts to innovate for optimization. Students got involved in optimizing the chilled water system by modeling coordinated operation of the chillers, for a monthly savings of $15,000. Similar efforts are in progress to optimize other aspects of system operation including steam distribution.

"Through the years we have seen the value of our CHP system shift from being an isolated physical campus asset to a shared virtual asset by participating in electrical grid curtailment programs."

- Mark Gardner,
Manager of Energy Strategy, Rice University

For More Information

U.S. DOE SOUTHCENTRAL CHP TECHNICAL ASSISTANCE PARTNERSHIP (CHP TAP)
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