CHP Technical Assistance Partnerships

PROJECT PROFILE

University of Oregon
Eugene, Oregon
10.9 MW Gas and Steam Turbine CHP

Interior of the Central Power Station at the University of Oregon

Quick Facts

LOCATION: Eugene, Oregon
MARKET SECTOR: University
FACILITY SIZE: 23,634 Students
FACILITY Total Electrical Energy Use: About 70 million kWh/year
EQUIPMENT: 7,965 kW Solar Taurus gas turbine plus 3,000 kW steam turbine
FUEL: Natural gas
USE OF THERMAL ENERGY: Space, domestic hot water, sterilization, cooking, cage cleaning
CHP TOTAL EFFICIENCY: 77.3% at full-fire
TOTAL PROJECT COST: $15 million to $18 million
CHP IN OPERATION SINCE: 2011

Site Description

The University of Oregon, established in 1876, now has an enrollment of 23,600 students and employs over 4,000 teaching and research faculty. Heating and cooling needs are provided with a centralized power plant that serves 80 buildings and 4.4 million square feet of space on a 295 acre campus. Steam is distributed to end use points at 60 pounds per square inch gauge (psig) through over four miles of steam tunnels.

Reasons for CHP

The original University of Oregon district heating system and central power plant were built in 1921. The power plant was relocated and capacity expanded in 1948 when World War II veterans were released from military duty and returned to school. In 2011, the central power station was modernized to meet expected load growth, improve efficiency, and increase electrical reliability. In particular, adding the ability for the university power system to operate independently in "island mode," supporting critical loads, added resiliency for the campus. This justified more complex interconnections with the grid. One old boiler was upgraded, a new boiler was purchased and a CHP project with a heat recovery steam generator (HRSG) was installed within the old power station footprint. Thermal discharges to the river from condenser cooling were eliminated with the installation of a new air cooling tower system.

The CHP project consists of a dual fuel (natural gas and No. 2 oil) 7,965 kW (ISO) Solar Turbines Taurus 70 and a 3 MW backpressure Dresser-Rand steam turbine. The generating units were included as part of a $110 million central steam plant expansion project that included a new 15,000 ton chilled water plant, three 2.25 MW standby diesel generators, a new switchyard, and a central control system. When cold combustion air is available in the winter, the gas turbine output increases to about 8.2 MW. No gas compression is necessary as the gas turbine can directly use gas from a 400-psig interstate transmission pipeline. Costs for the CHP portion of the central steam plant upgrade project were not broken out but are estimated at about $15 million to $18 million.

CHP Steam Generation

The Rentech HRSG is capable of producing 33,000 lbs./hour of 600-psig steam directly from hot gas turbine exhaust with the capability of increasing steam production up to 65,000 lbs./hour through the use of duct burners. The boilers and the gas turbine can run on natural gas or #2 oil, but HRSG supplemental firing is limited to natural gas. The HRSG steam production, at 600-psig, goes through a backpressure steam turbine for distribution at 60-psig. The possibility of installing two 1500-ton steam absorption chillers was considered, but they weren't included due to cost considerations. Reverse Osmosis is used to treat makeup water.

New switchgear installed at the central power plant. This switchgear allows the CHP project to meet critical loads when switching to island mode operation.

CHP Operating Capabilities

The Solar gas turbine is operated in a steam load-following mode so is not used in the summer. The gas turbine can be used in "Simple Cycle" mode in which the gas turbine is operated independently of the steam plant by diverting exhaust gases directly to exhaust stacks. Simple Cycle electrical power production can be used to meet normal or emergency power requirements. Backup steam boilers are maintained in a hot standby mode through use of a steam blanket and circulating water pumps. Although it has never been required, the CHP project is capable of "island mode" operation with the changeover automated or "hands-off" after being initiated. Island Mode consists of meeting site electrical loads in parallel with three 2.25 MW emergency diesel generators with the gas turbine in either combined cycle or simple cycle operation. Staff indicated that island mode had not been needed or fully tested as of this writing.

Switchyard Upgrade and Other Design Concerns

The university is served by two substations, with an upgraded switchyard located at the central heating plant. The CHP generator provides power at 12.47 kV so it is already at the grid voltage. Electrical energy is provided to the University by the Eugene Water and Electric Board at their Large General Primary Service Rate Schedule price of $0.0485/kWh. No selective catalytic reduction (SCR) is required for exhaust gas NOx treatment as the emissions are below 9 parts per million (ppm).

Maintenance Requirements

The University of Oregon elected not to purchase the Solar "Full Service Agreement" as the gas turbine does not operate continuously. The existing boiler operators were trained to operate the CHP project. Operators were actually involved in writing the CHP operating manuals. During an overhaul, downtime is minimized as Solar simply drops a new gas turbine into place.

"Integrated system functions tied to the chiller plant, such as incorporation of steam-driven or steam absorption chillers, would be required to boost steam loads and fully utilize the generating potential of the CHP project during the summer"

-Tony Hardenbrook, Director of Utilities and Energy

For More Information

U.S. DOE Northwest CHP TECHNICAL ASSISTANCE PARTNERSHIP (CHP TAP)
David Van Holde, PE, Director
(360) 956-2071
VanHoldeD@energy.wsu.edu
More CHP Project Profiles:
http://www.northwestchptap.org/
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University of Oregon
Tony Hardenbrook
Director of Utilities and Energy
(541) 346-9007
Aharden2@uoregon.edu