



CHP
TECHNICAL ASSISTANCE
PARTNERSHIPS

North Carolina State University

17.5-MW CHP with District Energy



NC State's Cates Utility Plant houses 11 MW of the 17.5 MW total Combined Heat and Power now on campus.

Project Overview

In 2012, North Carolina State University, home of the U.S. Department of Energy Southeast Combined Heat and Power (CHP) Technical Assistance Partnership, installed an 11 MW CHP plant as part of the Cates Utility plant. In January 2019, NC State University brought an additional 6.5 MW of combined heat and power online at the Centennial Campus Utility Plant as a \$17 million performance contract. This new plant supplements the Cates Utility plant, increasing the overall CHP capacity at the university to 17.5 MW.

Quick Facts

LOCATION: Raleigh, NC

MARKET SECTOR: University

GENERATING CAPACITY: 17.5 MW

THERMAL OUTPUT: 160,000 lbs/hr steam (125-150 psi)

EQUIPMENT:

(3) 5.5 MW Gas Turbines

(1) 1 MW Steam Turbine Generator

(2) 25,000 lb/hr recovery boilers each w/ 25,000 lb/hr auxiliary burner (100,000 lb/hr)

(1) 30,000 lb/hr recovery boiler w/30,000 lb/hr auxiliary burner (60,000 lb/hr)

(1) 750 kW black start generator

(1) 250 kW black start generator

FUEL: Natural Gas

TOTAL PERFORMANCE CONTRACT: \$78 million

ESTIMATED CHP SYSTEM COST: \$43 million

FIRST YEAR SAVINGS: \$1.7 M - Centennial Campus; \$4.3 M – Cates Utility Plant

ENVIRONMENTAL BENEFITS:

12% GHG reduction for entire campus / 50,000 MT CO₂e reduction

Reasons for CHP

The newest system supports NC State University's Centennial Campus, which is a public-private partnership that provides a connection between industry, government and academia, including the College of Engineering. Companies such as ABB and LexisNexis have research centers located on Centennial Campus, as is the U.S. DOE research partnership PowerAmerica. As an ever-growing campus, NC State University looked to CHP to meet rising energy needs by utilizing this energy efficient technology.

In 2017, NC State University's Energy Management team developed a strategic plan to act as the roadmap for helping to conserve energy and reduce utility costs through a series of 41 methodical and aggressive approaches. Combined heat and power is an application the university deploys to reach multiple goals within that plan including:

- Support of University and state policies for energy consumption, including Governor Roy Cooper's Executive Order 80, which includes a goal of reducing energy consumption per square foot in state-owned buildings by at least 40 percent from fiscal year 2002-2003 levels

- Efficiency gains based on the concurrent electricity and steam generation from the added 6.5 MW include a 5-6% reduction in campus energy per Gross Square Foot (GSF)
- Enhancing the reliability and capacity of the Centennial Campus grid.

The current energy performance contract with DPR Construction is NC State's fourth and brings the total utility costs avoided by energy performance contracts to almost \$10 million each year. Additional energy upgrades planned on Centennial Campus will include efficiency-boosting technologies that will reduce costs while further enhancing reliability and capacity. Energy efficiency gains, coupled with Energy Management's strategic purchasing of natural gas, have contributed to a gradual reduction in utility cost intensity for the university.

Equipment & Configuration

Resilience and reliability are key criteria for the university, which now has the capacity to island from the grid and produce almost 18 MW of their own power in the event of an outage. Since the university also leases space to private tenants, being able to provide power to essential functions is a benefit from an economic development perspective.

The equipment and configuration for both CHP plants is categorized as follows:

Cates Utility Plant

- Two 5.5 MW Solar Taurus 60 combustion gas turbines with heat recovery steam generators (HRSG), each capable of producing 25,000 pounds per hour (pph) of steam (with an additional 50,000 pph of steam provided by two auxiliary burners)
- Each unit will normally utilize natural gas and switch to distillate (No. 2) fuel oil in the event of an interruption
- One high efficiency 2,000-ton steam turbine chiller and a cooling tower that replaced less efficient units
- Plant auxiliary systems and controls to support the combustion turbine and HRSG operation
- 750 kW black start diesel generator

Centennial Campus Utility Plant

- One 5.5 MW Solar Taurus 60 combustion gas turbine with HRSG producing 30,000 pph of steam
- An auxiliary burner of 30,000 pph, for a total steam output of 60,000 pph
- A 1 MW steam turbine generator that utilizes steam from the HRSG to produce electricity during periods of high electric demand and cost.
- Chilled water storage of 3.4 million gallons, for 25,000 ton-hours of cooling capacity
- 250 kW black start diesel generator



Erik Hall (far right), describes the CHP configuration including the combustion turbine at the Centennial Campus Utility Plant.

"The Cates and Centennial Campus CHP plants provide multiple benefits to the university including greenhouse gas reduction, energy cost reduction and increased overall system reliability. Additionally, our campus resiliency to major catastrophic weather events is enhanced by each CHP system's ability to provide service to the campus independently from our utility providers."

– Erik Hall, former Director of Energy Management

For More Information

U.S. DOE Southeast CHP Technical Assistance Partnership (Southeast CHP TAP)

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