Flexible CHP System with Low NO_x, CO and VOC Emissions

Utilizing Supplemental Ultra-Low-NO_x Burner Technology to Meet Emissions Standards and Improve System Efficiency

Developed FlexCHP-65 system incorporates new burner technology into a 65 kW microturbine and 100 HP heat recovery boiler.

Introduction

A combined heat and power (CHP) system can be a financially attractive energy option for many industrial and commercial facilities. This is particularly the case in areas of the country with high electricity rates. However, regions with air quality concerns often have strict limits on criteria pollutants, such as nitrogen oxide (NO_x), carbon monoxide (CO), and volatile organic compounds (VOCs). In order to meet these emissions standards, additional control systems often need to be incorporated into CHP systems that are installed. Such systems, however, make CHP installations more expensive and often decrease system efficiency, making installation of a CHP system less attractive financially.

The CHP system being developed by Gas Technology Institute (GTI) and its project partners aims to address this challenge by incorporating a supplemental Ultra-Low-NO_x (ULN) burner into a 65 kW microturbine and a heat recovery boiler. The ULN burner is expected to help the CHP system meet stringent emissions criteria and improve overall system efficiency in a cost-effective manner.

Benefits for Our Industry and Our Nation

The FlexCHP-65 system being developed is expected to yield the following energy, economic, and environmental benefits:

- NO_x emissions below 10 parts per million by volume (ppmv), or approximately 50 percent reduction compared to a turbine and a conventional boiler operating separately
- CO emissions at or below 0.10 lb/MWh
- VOC emissions at or below 0.02 lb/MWh
- Seven percent fuel savings for heat recovery boiler
- Seven percent reduction in greenhouse gas (GHG) emissions for heat recovery boiler

The FlexCHP-65 system consists of Johnston Boiler Company 100-horsepower firetube boiler, GTI-developed supplemental Ultra-Low-NO_x burner, and Capstone C65 microturbine.

Photo courtesy of Gas Technology Institute (GTI).

- Decreased CHP system cost due to avoided emissions control equipment

Applications in Our Nation's Industry

The FlexCHP-65 system can be utilized by a wide range of industrial as well as commercial facilities that use boilers for heat or steam production and are interested to generate electricity onsite. The system will be particularly well suited for geographic areas with high electricity rates and stringent air quality standards, such as California and the Northeastern states.

Project Description

The project team will develop a Flexible Combined Heat and Power (FlexCHP) system to deliver power and steam keeping criteria pollutant emissions below the 2007 Fossil Fuel Emissions Standard targets for microturbines. The FlexCHP-65 system incorporates Gas Technology Institute's (GTI) supplemental ULN burner technology into a Capstone C65 (65 kW) microturbine and a 100-horsepower heat recovery boiler by Johnston Boiler Company.

Barriers

The project seeks to overcome the following barriers to successful implementation of the proposed FlexCHP concept:

- Reaching ULN emissions targets without the use of additional emissions control technologies, such as Selective Catalytic Reduction
- Scaling up of a laboratory-tested ULN burner to a commercial prototype
- Keeping costs of the new supplemental burner on par with conventional duct burner models and designs
- Integrating different system components into a packaged design

Pathways

GTI has already tested its ULN burner design in a laboratory. For this project, GTI will develop a commercial-scale prototype of the new supplemental burner, which will be integrated into a CHP system that consists of Capstone Turbine Corporation's C65 microturbine and Johnston Boiler Company's 100-horsepower heat recovery boiler. Cannon Boiler Works (CBW) and Integrated CHP Systems Corp. (ICHPS) will be responsible for the system integration.

The integrated commercial prototype will be first tested at GTI's laboratory to verify that it meets the emissions and performance requirements. After testing, a host site demonstration will be conducted at a food processing facility in Riverside, California.

Milestones

The project started in summer 2010 and is expected to last two years.

Project year one key milestones include:

- Laboratory validation of FlexCHP-65 system
- Field unit installation, data collection, and analysis

Project year two key milestones:

- Completion of engineering designs for production units
- Preparation of commercialization readiness plan

Commercialization

Based on a market study conducted by GTI, the new technology will have greatest potential in the replacement boiler market in regions with high electricity costs and stringent emissions standards, such as California and the Northeastern states.

Once the host site demonstration has been carried out, the new ULN burner design will be incorporated into project partners' product lineups. CBW has a strong presence in the boiler market, and Capstone Turbine Corporation is an established vendor in the power generation market. These two companies will be the primary conduits for the technology to enter the market. In the first three years of commercialization, GTI, CBW, and ICHPS will actively assist the market channel partners in identifying sales opportunities. In addition, project partners will conduct a market outreach program through appropriate industry associations. Full market potential for the new technology is estimated to be 60 units per year.

Project Partners

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