

Combined Heat and Power Integrated with Burners for Packaged Boilers

Providing Clean, Low-Cost, Onsite Distributed Generation at Very High Fuel Efficiency

This project will seamlessly integrate a gas-fired, simple-cycle 100 kilowatt (kW) microturbine with a new ultra-low nitrogen oxide (NO_x) gas-fired burner to develop a combined heat and power (CHP) assembly called the Boiler Burner Energy System Technology.

Introduction

CHP systems can achieve significant gains in fuel efficiency for power generation and reductions in greenhouse gas emissions. While large CHP systems have been installed and used for many years, small CHP systems (especially less than 250 kW in generating capacity) have seen limited market acceptance.

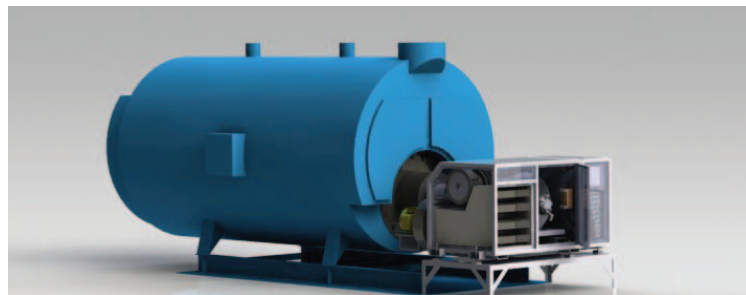
This project will develop the Boiler Burner Energy System Technology (BBEST), a CHP assembly of a gas-fired, simple-cycle 100 kW microturbine (SCMT) and a new ultra-low NO_x gas-fired burner (ULNB), to increase acceptance of small CHP systems. This technology will improve reliability while reducing costs and the need for maintenance.

The project's BBEST system will achieve an overall CHP fuel efficiency of 80%–82% and a power conversion efficiency of 3,800 British thermal units (Btu)/kilowatt hour. The CHP product will be used in new installations and as a retrofit for existing industrial and commercial boilers in place of conventional burners.

Benefits for Our Industry and Our Nation

The BBEST system will meet the industry's vital demands for reliability, low investment cost, attractive return on investment, and emission compliance. The incremental cost for power generation is expected to be \$700/kW, compared to \$2,000/kW for conventional CHP. Maximum system efficiency is expected to be over 80%, compared to 70% for conventional systems.

Increased efficiency will benefit industry through energy savings and associated cost reductions, as well as decreased greenhouse gas emissions. The system will also reduce NO_x emissions to meet stringent air quality regulations.



Boiler Burner Electrical System Technology (BBEST)
for packaged boilers

Photo courtesy of CMCE, Inc.

Applications in Our Nation's Industry

This project will target a large retrofit CHP market consisting of about 130,000 industrial and commercial boilers operating in the United States, each with heat input design capacities of <100 million Btu/hour. The BBEST CHP assembly will be applicable to all major packaged boiler designs (A-Type Watertube, D-Type Watertube, O-Type Watertube, and Firetube). Sectors that will most likely benefit are small industrial plants, schools, and health care facilities.

Project Description

The objective of this project is to engineer, design, fabricate, and field validate BBEST CHP assembly that integrates a low-cost, clean-burning, gas-fired 100 kW SCMT with a new ULNB. The compact BBEST CHP product can be used in new installations or in retrofits of existing industrial and commercial boilers.

The first part of the project includes hardware development, assembly, and preliminary testing. Each key CHP system component (ULNB, SCMT, assembly BBEST CHP package, and integrated controls) will be engineered, designed, fabricated, tested, and optimized.

The second part of this project includes field installation and demonstration testing. The field verification tests will document performance of the BBEST CHP technology and its attainment of energy and emission targets, and objectives under parametric and normal boiler operation.

Barriers

- Developing a new ULNB that considers the optimum integration of the SCMT equipment and exhaust gas properties
- Improving the SCMT premix combustor to provide greater CHP operational flexibility
- Creating an integrated, user-friendly control assembly for electronics and software

- Fabricating the CHP assembly in a compact, small-footprint package applicable to a broad range of packaged boiler designs
- Increasing market acceptance of small CHP systems

Pathways

CMCE, Inc. (CMCE) and its subcontractor, Altex Technologies Corporation (ATC), are the key partners for this project. CMCE will purchase all necessary equipment and lead the SCMT optimization, integrated controls installation, and field testing. ATC will lead the ULNB development, assembly design, and preliminary testing of individual components, as well as support the field testing.

The initial steps of this project will be to develop the ULNB and SCMT. Once these are complete, they can be assembled into an integrated BBEST CHP package. A burner management system (BMS) will be designed and fabricated for the ULNB. The BMS control will be integrated with the SCMT power electronics.

After preliminary testing is completed in the ATC combustion laboratory, CMCE will outsource the field installation of the BBEST system to a local burner/boiler retrofit company. The BBEST CHP technology will then be tested for its performance.

Milestones

- Development of a new ULNB
- Development of a new SCMT
- Assembly of the ULNB and SCMT into an integrated BBEST CHP package
- Integration of the BMS control with the SCMT power electronics
- Completion of preliminary testing
- Completion of field installation and performance testing

Commercialization

Since August 2008, CMCE and ATC have had an agreement in place to develop and commercialize BBEST integrated CHP products for packaged boilers.

About 40,000 units of the target industrial and commercial boiler population are located in strict air permit areas of the country. These units require burner upgrades for emission compliance. CMCE and ATC recognize this as a near-term opportunity for the BBEST CHP technology.

The team aims to grow installations exponentially, with the goal of 3,500 BBEST CHP units installed in year 7 of sales and 15,000 units in year 10. An estimated cumulative 39,000 units (nearly one-third of the available industrial and commercial boiler population in the United States) could be installed in the first 10 years of commercialization.

Project Partners

CMCE, Inc.
Santa Clara, CA
Principal Investigator: Carlo Castaldini
E-mail: carlo@cmc-engineering.com

Altex Technologies Corporation
Silicon Valley, CA

For additional information, please contact

Bob Gemmer
Technology Manager
U.S. Department of Energy
Industrial Technologies Program
Phone: (202) 586-5885
E-mail: Bob.Gemmer@ee.doe.gov