the ENERGY lab

PROJECT FACTS

Existing Plants, Emissions & Capture

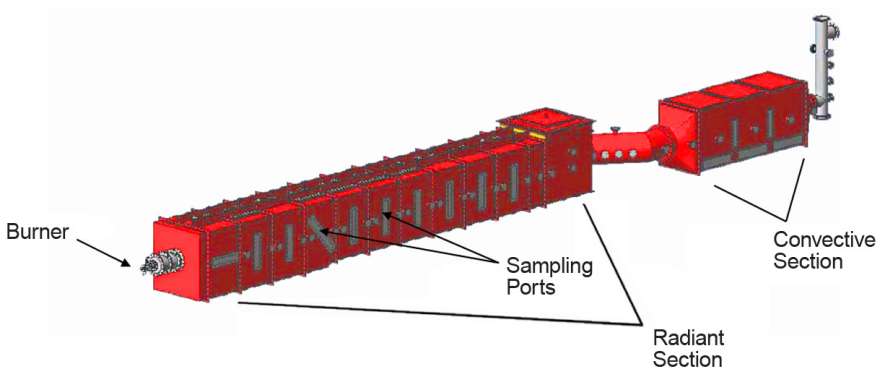
Characterization of Oxy-combustion Impacts in Existing Coal-fired Boilers

Background

Technology and policy options are being investigated for mitigating CO_2 emissions. Electric power generation represents one of the largest CO_2 contributors in the United States and is expected to grow with fossil fuels continuing to be the dominant fuel source. Oxy-combustion is a developing technology that could become part of a national carbon capture effort to mitigate climate change. At a pulverized coal (PC)-fired power plant, this process involves burning coal in a nearly pure (~95%) oxygen environment instead of the ambient air. The resulting flue gas is composed of highly concentrated CO_2 that is nearly ready for compression, pipeline transport, and permanent underground storage.

Description

Reaction Engineering International (REI) will work, along with its partners, to gather fundamental data that can be incorporated into computational fluid dynamic (CFD) models that describe how oxy-combustion retrofit of PC power plants will affect performance and operational impacts such as flame characteristics and waterwall corrosion. Data will be gathered from 0.1 kW bench-scale, 100 kW laboratory-scale, and 1.2 MW pilot-scale (see figure) coal-fired combustors. The modeling work will culminate in the design of a conceptual commercial-scale, retrofit firing system for existing utility boilers.



1.2 MW Pilot-Scale Furnace at the University of Utah

CONTACTS

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PARTNERS

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Brigham Young University
Corrosion Management
PacifiCorp
Southern Company

COST

Total Project Value
$1,079,654

DOE/Non-DOE Share
$863,723 / $215,931

Primary Project Goal

The primary objective of this program is to develop data and tools to characterize and predict impacts of CO_2 flue gas recycle and burner feed design on flame characteristics (char burnout, nitrogen oxides (NO_x), sulfur oxide (SO_x) and fine particle emissions, heat transfer, fouling, slagging, and corrosion, inherent in the retrofit of existing coal-fired boilers for oxy-coal combustion.

Benefits

A number of studies have shown that fitting new and existing PC plants with the current amine-based wet scrubbing technology to capture CO_2 will increase the cost of electricity (COE) by approximately 85% and decrease the power plant net efficiency by 30%. However, the development of oxycombustion technology has the potential to simplify carbon capture in PC-fired power plants by minimizing the volume of flue gas produced and vastly increasing the CO_2 concentration, thereby significantly reducing the CO_2 capture cost. Another advantage is that the potential exists for many of the exhaust effluents to be captured and permanently stored underground along with the CO_2.

Upon completion, this project will benefit the Existing Plants Program oxycombustion technology development by:

- Providing experimental data for the design of future oxyfuel burners and boilers.
- Demonstrating the oxyfuel burner and boiler retrofit technology to enable cost effective and efficient retrofit of existing coal fired boilers.
- Developing more accurate, predictive CFD modeling tools for assessing potential barriers to oxyfuel retrofits such as slagging, corrosion, and air infiltration.
- Using test results and modeling tools to optimize retrofit oxyfuel applications such as:
  - reducing the CO_2 recycle rate
  - enhancing boiler heat transfer
  - ensuring complete combustion to limit excess oxygen
  - promoting multi-pollutant capture

Accomplishments

A project kick-off meeting was held in Salt Lake City, Utah, on November 20-21, 2008.

Planned Activities

Phase 1:

- Conduct initial bench-scale tests for char burnout characterization
- Conduct initial laboratory-scale tests for ash characterization
- Develop and install an oxy-fired burner in the University of Utah's pilot-scale furnace (see figure)
- Choose development strategies for sooting, slagging, fouling, and corrosion mechanisms