PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Carbon Sequestration

08/2007

DEVELOPMENT OF COST EFFECTIVE OXY-COMBUSTION TECHNOLOGY FOR RETROFITTING COAL-FIRED BOILERS

CONTACTS

Sean Plasynski
Sequestration Technology Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236
412-386-4867
sean.plasynski@netl.doe.gov

José D. Figueroa
Project Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4966
jose.figueroa@netl.doe.gov

Hamid Farzan
Principal Investigator
The Babcock & Wilcox Company
180 South Van Buren Avenue
Barberton, OH 44203-0622
330-860-6628
HFarzan@Babcock.com

Background

Electric power generation from fossil fuels represents one of the largest contributors to greenhouse gas emissions, not just in the United States, but throughout the world. Various technologies and concepts are being investigated as means to mitigate carbon dioxide (CO_2) emissions. The concept of pulverized coal (PC) oxy-combustion is one potential economical solution, whereby coal is combusted in an enriched oxygen environment using pure oxygen diluted with recycled flue gas. In this manner, the flue gas is composed primarily of CO_2 and H_2O, so that a concentrated stream of CO_2 is produced by simply condensing the water in the exhaust stream. An advantage of oxy-combustion over air-fired combustion is that it provides a high potential for a step-change reduction in both CO_2 separation and capture costs because virtually all of the exhaust effluents can be captured and sequestered (co-sequestration).

Description

This project entails pilot-scale develop-ment of oxy-combustion technology for both wall-fired and cyclone boiler configurations. For the wall-fired mode, tests will include lignite firing, while cyclone boiler combustion tests will investigate different coal ranks. Parametric and 100-hour continuous tests will optimize the oxy-combustion process and assess the slagging, fouling, heat transfer, and overall operability characteristics. Specifications for flue gas purification, compression, transportation, and sequestration will be developed to help design the environmental equipment required (e.g. scrubber, selective catalytic reduction (SCR), etc). An engineering feasibility and economic evaluation will also be performed on a full-size cyclone boiler and a full-size wall-fired boiler. An ASPEN model will be developed to optimize the integration of the air separation unit (ASU), flue gas purification, CO_2 compression train, CO_2 transportation, and sequestration. Net power production will be calculated and the cost of electric production will be estimated using an economic model.

Primary Project Goal

The primary project goal is to further develop the oxy-combustion technology for commercial retrofit in existing wall-fired and cyclone boilers by 2012. To meet this goal, a two-phase research project is proposed that includes pilot-scale testing and a full-scale engineering and economic analysis.

PARTNERS

Babcock & Wilcox Company

AirLiquide

Battelle

PROJECT DURATION

3/31/2006 to 3/31/2008

COST

Total Project Value
$3,453,287

DOE/Non-DOE Share
$2,762,643 / $690,644

ADDRESS

National Energy Technology Laboratory
1450 Queen Avenue SW
Albany, OR 97321-2198
541-967-5892

2175 University Avenue South
Suite 201
Fairbanks, AK 99709
907-452-2559

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4764

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4687

One West Third Street,
Suite 1400
Tulsa, OK 74103-3519
918-699-2000

CUSTOMER SERVICE

1-800-553-7681

WEBSITE

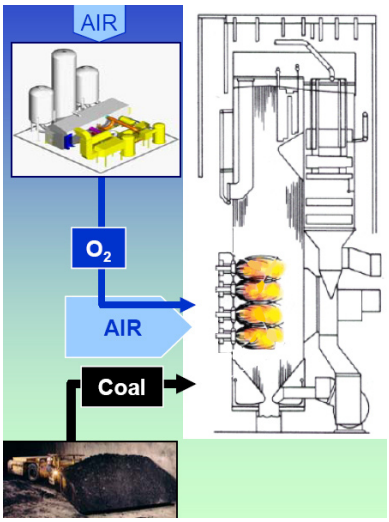
www.netl.doe.gov

Objectives

Objectives for this project are separated into two phases.

Phase I objectives include:

- Evaluate the effect of coal rank that is currently used in existing boilers in an oxy-combustion design.
- Determine the equipment requirements for the boiler island for different coals and combustion systems.
- Investigate the potential for multi-pollutant (NO_x, SO_2, Hg, and particulate) reduction.
- Validate an existing 3-dimensional computational flow, heat transfer, and combustion model for oxy-combustion scale-up to a commercial size boiler.



Schematic for typical oxy-combustion process.

Phase II objectives are as follows:

- Conduct an engineering and economic assessment of the technology for commercial-scale retrofit application.
- Assess CO_2 control cost reductions via the integration of ASU flue gas purification, CO_2 compression train, CO_2 transportation, and sequestration.
- Evaluate the impact of oxy-combustion implementation on net power production and cost of electricity.
- Determine the boiler population with close proximity between stationary CO_2 sources and candidate geologic sink.

Benefits

This technology will play a part in moving the United States toward cleaner, more efficient power generation from coal and will help reduce costs of existing CO_2 capture systems. Through this project, Babcock & Wilcox expects to demonstrate a cost-effective approach for CO_2 capture, coupled with much lower nitrogen oxide emissions than normal coal combustion with air.

Accomplishments

- Process specifications, including CO_2 transportations & sequestration, flue gas purifications and storage were determined.
- A draft pilot plan has been submitted for testing of the oxyfuel system at a 6 MMBTU scale.

Planned Activities

- Test facility will be modified to a wall-fired configuration to determine the performance of the oxy-combustion process for this configuration.
- Test facility will be modified to a cyclone configuration to determine the performance of the oxy-combustion process for this configuration.