Project Title:

Development of Cost-Effective Oxy-Combustion Technology for Retrofitting Coal-Fired Boilers

Technology Area:	**Technology Maturity:**
Oxy-Combustion	Pilot-scale laboratory testing using actual flue gas; equivalent to 13 tons of CO_2/day

Primary Project Goal:

Babcock and Wilcox (B&W) is developing oxy-combustion technology for application to new and existing cyclone and wall-fired boilers. A two-phase research project is being conducted that includes pilot-scale testing and a full-scale engineering and economic analysis.

Technical Goals:

- Conduct pilot-scale testing to evaluate the effect of coal rank (i.e., bituminous, subbituminous, and lignite) on oxy-combustion boiler operation.
- Determine the equipment requirements for the boiler island, flue gas purification, carbon dioxide (CO_2) compression, CO_2 transportation, and CO_2 sequestration for different coal ranks and boiler designs.
- Investigate the potential for multi-pollutant (nitrogen oxides [NO_X], sulfur dioxide [SO_2], and particulate) emissions control.
- Validate an existing three-dimensional computational flow, heat transfer, and combustion model for oxy-combustion scale up to a commercial-size boiler.
- Conduct an engineering and economic assessment of the technology for commercial-scale retrofit and green field application for cyclone and wall-fired boilers.
- Assess CO_2 capture cost reductions via energy integration of the air separation unit (ASU), flue gas purification, and CO_2 compression systems.
- Evaluate the impact of oxy-combustion implementation on net power production and cost of electricity (COE) for cyclone and wall-fired boilers.

Technical Content:

B&W is conducting pilot-scale tests – 14 GJ/hr (6 million Btu/hr) – of oxy-combustion for three coals and two oxy-combustion process configurations at its Barberton, Ohio, test facility. An illustration of the oxy-combustion pilot-scale test facility is shown below (Figure 1). The three types of coal being tested are lignite (North Dakota), sub-bituminous (Decker), and bituminous (Ohio #5). Each of the oxy-combustion tests will run for 100 continuous hours to assess the slagging, fouling, heat transfer, and overall operability characteristics. Data from the pilot-scale testing will be used to validate a computational fluid dynamic (CFD) model of the oxy-combustion process. From the test data, equipment required for flue gas purification, compression, transportation, and sequestration will be determined for the engineering and economic assessment.

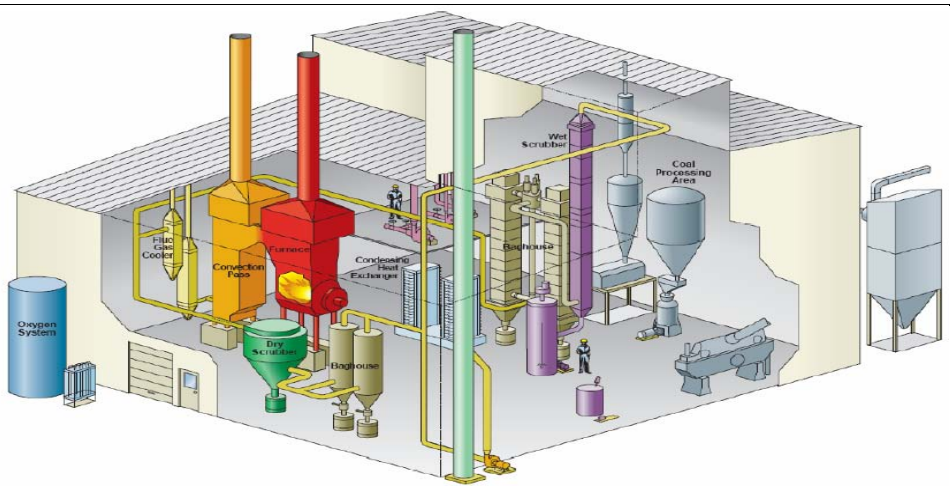

Figure 1: Illustration of B&W's Oxy-Combustion Pilot-Scale Test Facility in Barberton, Ohio

A modeling assessment is being conducted to compare three CO_2 capture purification processes: 1) no purification – only drying to Kinder Morgan pipeline specifications with water (H_2O) at 600 parts per million volume (ppmv); 2) partial condensation at cryogenic conditions (cold box) – 95% CO_2 purity target; and 3) cold box including distillation – 1 ppm oxygen (O_2) target. The purification assessment includes investigation of operating costs, energy requirements, and effects of air infiltration. The following graph (Figure 2) represents a model analysis showing the effect of purification process on CO_2 recovery, purity, and specific energy.

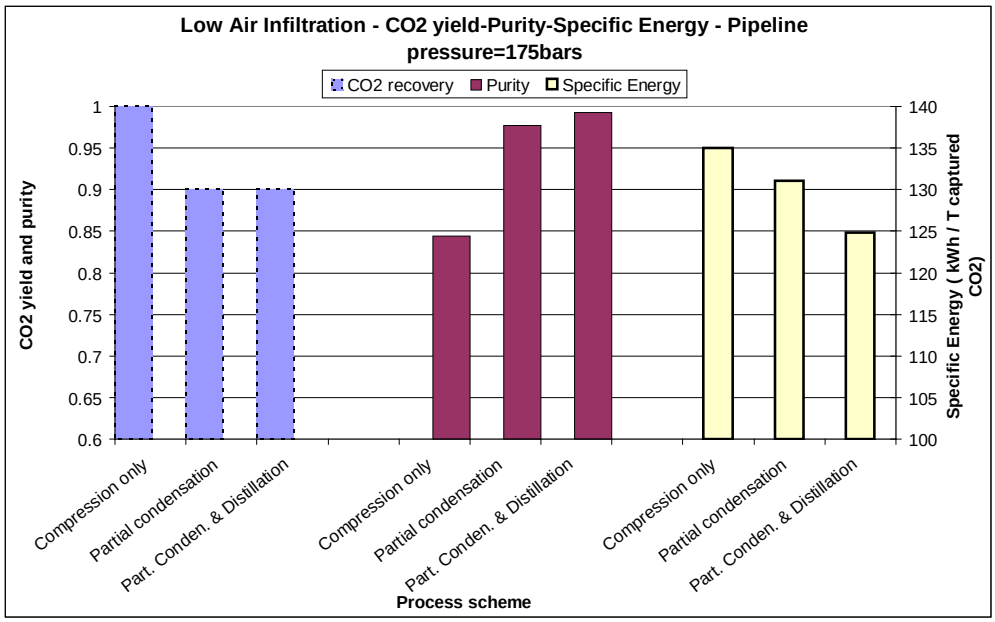

Figure 2: Model Analysis Showing Effect of Purification Process on CO_2 Recovery, Purity, and Specific Energy

Technology Advantages:

- Oxy-combustion has the potential to offer a lower cost solution for CO_2 capture compared to post-combustion CO_2 capture technologies.

R&D Challenges:

The necessary level of flue gas purification remains an issue regarding potential adverse impacts on CO_2

transportation and storage:

- Potential precipitation problems with sulfur dioxide (SO_2) forming sulfate minerals (e.g., anhydrite) if high-sulfur coal is used without scrubbing.
- Non-condensable gases, such as nitrogen (N_2) and O_2, could affect subsurface processes which might require more purification. For example, non-condensable gases could create multi-phase flow which can reduce injectivity or the capacity of the storage site.

Results To Date/Accomplishments:

- Conducted oxy-combustion pilot-scale testing.
- Performed purification and compression studies.
- Determined through sequestration modeling that co-sequestration can be performed with unpurified CO_2 streams (dependent upon geological formations depth, injectivity, and reservoir efficiency).

Next Steps:

- Complete oxy-combustion pilot-scale testing.
- Complete full-scale engineering and economic analysis.
- If the technology is economically viable, a scaleup methodology to full-scale should be determined.

Final test results will not be available until the September 2010 project completion date.

Available Reports/Technical Papers/Presentations:

"Development of Cost Effective Oxy-Combustion for Retrofitting Coal-Fired Boilers," NETL CO_2 Capture Technology for Existing Plants R&D meeting in Pittsburgh, Pennsylvania, March 2009.

"Considerations for Treating Impurities in Oxy-Combustion Flue Gas Prior to Sequestration," 9th International Conference on Greenhouse Gas Control Technologies in Washington, DC, Nov. 2008.

"Developing Oxy-combustion for Retrofitting Coal-fired Boilers," 7th Annual Conference on Carbon Capture and Sequestration in Pittsburgh, Pennsylvania, May 2008.

"Development of Cost Effective Oxy-Combustion Technology for Retrofitting Coal-Fired Boilers," NETL Fact Sheet.

Contract No.:	**NETL Project Manager:**
DE-FC26-06NT42747	José Figueroa Jose.Figueroa@NETL.DOE.GOV
Principal Investigator:	**Partners:**
Hamid Farzan Babcock & Wilcox Co. - Alliance, OH Hamid.Farzan@mcdermott.com	Battelle Air Liquide