FY10-LXVIII(68)-169

"Oxy-Combustion Boiler Development for Tangential Firing of Dried Lignite"

Submitted by: Alstom Power, Inc.
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PARTICIPANTS

Sponsor		Cost Share
Alstom Power, Inc.		$ 2,169,117
NDIC		$ 490,000
GRE		$ 50,000
DOE		$ 5,000,000
ICCI		$ 480,767
Industrial Advisory Group		$ 500,000
EERC (through JSRP)		$ 26,639
	Total Cost	$ 8,716,523

Project Schedule – 10 Months
Contract Date – 3/22/09
Start Date – 03/22/10

Completion Date – 2/28/11

Project Deliverables
Status Reports:
7/1/10 (✓);
10/1/10 (✓); 1/1/11 (✓);
Final Report: 3/31/11 ( )

OBJECTIVE / STATEMENT OF WORK

The objective of this current project with NDIC is to include the evaluation of dried North Dakota lignite under a broader Department of Energy funded oxy-combustion program with focus on testing at the 15 MW_{th} scale T-fired combustion facility. This will allow for development of design and operational data necessary to move to a commercial scale demonstration.

STATUS

April – June 30, 2010:
Alstom has delayed the testing of the dried ND lignite coal as shipment from GRE has been delayed. The new schedule for testing will be determined as soon as the coal has been received at the Alstom facility. Scheduling will be based on availability of the test facility. Work on the other fuels included in the DOE program is continuing.

July 1-September 30, 2010:

Oxy-combustion is a promising near-term technology for CO_2 capture and sequestration from coal-fired power plants. Alstom Power Inc, in cooperation with the U.S. Department of Energy and a utility advisory group, is conducting a multi-year program to develop oxyfuel tangentially-fired technology for utility and industrial boilers. The purpose of this program is to provide the information needed to take the next step of full-scale demonstration and to accelerate commercialization of the technology. The objective of this current project with NDIC is to include the evaluation of dried North Dakota lignite under this broader oxy-combustion program with focus on testing at the 15 MW_{th} scale.

During this reporting period project planning and preparations for the 15 MW_{th} test campaign firing dried North Dakota lignite coal were performed. The test matrix was refined and reviewed with the Lignite Energy Council Director and the Utility Advisory Group. The primary test parameters addressed include:
- Gas recycle rate and take-off location
- Distribution of gas recycle into the furnace
- Excess oxygen
- Oxygen injection location, distribution and concentration

The test campaign is scheduled to be conducted in early October 2010. Facility preparations and shakedown testing have been completed. More than 350 tons of test lignite were received from GRE Coal Creek Station and initial pulverizer setup completed. An additional focus of this test campaign is the behavior of mercury during oxy combustion, and the gaseous mercury concentrations that may build up due to recycle of flue gas according to the level of mercury capture. Continuous Mercury Monitors have been installed at the boiler outlet and in the flue gas recycle stream to determine a mercury balance around the boiler.

October 1-December 31, 2010:

Testing with dried North Dakota lignite from Great River Energy's (GRE) Coal Creek Station was successfully completed in October 2010 at Alstom's 15 MW_{th} Boiler Simulation Facility in Windsor, CT. More than 350 tons of test lignite, provided by GRE, were fired during 11 air-fired and 15 oxy-fired test conditions. The primary test parameters evaluated included:
- Gas recycle rate and take-off location
- Distribution of gas recycle into the furnace
- Excess oxygen
- Oxygen injection location, distribution and concentration

Test measurements focused on combustion, boiler thermal performance, and emissions. Trace metals in the flue gas were measured by TRC Environmental Corporation. More detailed measurements of mercury were done by the Energy & Environmental Research Center to assess the behavior of mercury during different oxy combustion configurations.

Combustion results from the North Dakota lignite test campaign are very promising and consistent with results from the previous three test campaigns. Oxy-fired operating conditions could be controlled to achieve combustion performance and heat release patterns similar to those during air firing. It was possible to operate at low excess oxygen levels (less than 2% oxygen in flue gas exiting the boiler) with minimum CO emissions and low carbon in fly ash. NO_x emissions from the boiler were generally on the order of 50% lower during oxy-firing as compared to baseline air firing.

Overall results from the program have not revealed any technical barriers that would restrict the continued development and commercialization of oxy-combustion technology for CO_2 capture. Test results indicate that development of an oxy-combustion tangentially-fired boiler should not require major changes to current boiler design. For oxy-combustion retrofit, boiler size and pressure part surfaces should only require minor, if any, design modifications. For oxy-combustion, the low sulfur content of the North Dakota lignite can be even greater benefit than for air-firing because the flue gas recycle for an oxy-firing system could be taken from before the sulfur control equipment, thus reducing the size of downstream equipment and cost.