FY05-LII(52)-135

"Assessment of Mercury Control Options & Ash Behavior in FBC"

Contractor: Energy & Environmental Research Center; Duration: 24 months
Principal Investigator: Dr. Steve Benson

PARTICIPANTS

Sponsor	Cost Share
Montana Dakota Utilities	$ 50,000
SaskPower	$ 50,000
Babcock &Wilcox	$ 50,000
ALSTOM Power	$ 50,000
Foster Wheeler	$ 50,000
EPRI	$ 50,000
Twin Oaks Power	$ 50,000
U.S. DOE	$296,153
NDIC	$200,000
Total Cost	$846,153

Project Schedule - 24 Months

Contract Date – 2/11/05
Start Date – 2/11/05
Completion Date – ~~9/30/06~~
Revised to – ~~3/31/07~~
Extended to – 9/30/07

Project Deliverables

Contract Signed: ✓
Quarterly Reports:
3/31/05 (✓); 6/30/05(✓);
9/30/05(✓); 12/31/05(✓)
3/31/06(✓); 6/30/06(✓);
Final Report ~~3/31/07( );~~
9/30/07 (✓)

OBJECTIVE / STATEMENT OF WORK:

Evaluate mercury speciation in CFBC flue gas and identify effective control options and the potential impacts of the control options on system performance, such as bed agglomeration, corrosion, and ash deposition.

STATUS

January 1 – March 31, 2005. Following a project kickoff meeting, defining project teams and test matrix with project sponsors. Follow-on activities addressed equipment preparation, analytical chemical preparation, coal collection and preparation for future testing periods.

April 1 – June 30, 2005. Two CFBC test runs using lignite coal was completed during this quarter with two emission control configurations and several mercury control options. One test used lignite from the Dakota Westmoreland Beulah mine and another test used Texas lignite. Baseline mercury emission levels were characterized, with preliminary tests conducted using various oxidation chemicals and activated char.

July1 – September 30, 2005. The CFBC test results from the Texas lignite tests conducted June 6-10 were presented and discussed. The system was configured to include two emission streams: a fabric filter baghouse and a spray dryer absorber upstream of the fabric filter. Baseline mercury emission levels were characterized, with preliminary tests conducted using various oxidation chemicals and activated char.

October 1 – December 31, 2005. Project activities involved synthesis of the mercury data from the Texas lignite test run and the Beulah lignite test run into a paper entitled "Mercury Speciation and Control During Combustion of U.S. Lignites in a 1-MWth Circulating Fluidized-Bed Combustor," which will be presented at the Electric Utilities Environmental Conference in Tucson, AZ, January 25, 2006.

January 1 – March 31, 2006. Project activities involved presentation of the Texas lignite results to the project sponsors, determination of trace metal partitioning during the Texas lignite test run, and preparation of an abstract for the Mega Symposium. Also, the mercury balance of the system during the baseline and mercury control test conditions was determined.

April 1 – June 30, 2006. Attempts (which were unsuccessful) were made to secure additional project sponsors and developing potential test plans.

July 1 – September 30, 2006. Attempts were made to secure additional project sponsors and development of a modified scope of work to complete the project. A poster describing the results of two CFBC tests was presented at the Mega Symposium in Baltimore, MD, August 28-31, 2006.

October 1 – December 31, 2006. A test plan was developed which includes two test runs in the pressurized fluidized-bed reactor (PFBR). The PFBR can feed fuel at a rate of 2-4 lbs/hr. The two tests will each be three-day runs, which will begin in January. A test matrix has been completed.

January 1 – March 31, 2007. Mercury control testing with two different fuels using the pressurized fluidized-be reactor was attempted in January without success. Mercury measurements were unreliable. The only remaining activity for the project is preparation of the draft final report and final report. A no-cost extension from March 31, 2007 to September 30, 2007 was requested and approved.

Final Report. A North Dakota lignite, a Texas lignite, and a Wyoming subbituminous coal were burned in the pilot-scale CFBC in three separate mercury (Hg) control test runs. The tests included simultaneous monitoring of Hg control effectiveness through a fabric filter (FF)-only stack and a spray dryer absorber – FF (SDA–FF) slipstream. Inherent Hg control and performance data were collected during baseline testing. The Hg control efficiency and effects on system performance were measured during activated carbon injection (ACI) and fuel additive tests.

Hg concentrations of the three coals differed significantly. The Texas lignite had a Hg concentration that was about three times higher than the Hg concentration for the North Dakota lignite. Coal chlorine concentrations were low, which is generally representative of other western U.S. lignite and subbituminous coals.

The CFBC performed very well while using the three coals. The majority of the flue gas Hg was present as elemental Hg (>90% for the North Dakota lignite and Wyoming subbituminous coals and >70% for the Texas lignite). The FF and SDA–FF captured 26% of the Hg present in the North Dakota lignite combustion flue gas. During all tests, >90% Hg capture was obtained through one or

more forms of Hg control strategies, although the best strategy depended on the coal and pollution control device (PCD) configuration.

Trace element removals in the CFBC system, calculated from coal to FF outlet, were excellent for all coals and trace elements, except Selenium. For most of the trace elements, the total emissions did not vary significantly among the three coals.

Economic evaluations of Hg control for a generic North Dakota lignite-, Texas lignite-, and Wyoming subbituminous coal-fired 450-MW FBC equipped with a FF or SDA–FF were performed using the test conditions (DARCO FGD and/or FA2 injection rates) and corresponding Hg removal efficiencies observed during the CFBC testing.

This project provided information on Hg control options and their potential impacts on system performance, including bed agglomeration, corrosion, and ash deposition. The results of mercury control combustion tests using low-rank fuels such as North Dakota lignite indicate that mercury control in a CFBC system firing these fuels is more easily achievable than in pulverized coal-fired systems using similar fuels. The research provides useful information for coal producers, energy utilities, and industrial users who are using or considering circulating fluidized-bed technologies.