FY03-XLIX(49) – 118

"Mercury Control Technologies for Electric Utilities Burning Lignite Coals – Phase II, Field Testing of Slipstream Technology"

CONTRACTOR: Energy & Environmental Research Center
PRINCIPAL INVESTIGATOR: John Pavlish

PARTICIPANTS

Sponsor	Cost Share
Basin Electric Power Cooperative	$57,100
Great River Energy	$59,400
Minnkota Power Cooperative	$37,600
Ottertail Power Company	$28,050
Montana Dakota Power Company	$17,850
SaskPower	$200,000
EPRI	$60,000
DOE-NETL	$440,000
NDIC	$200,000
Total Cost	**$1,100,000**

Project Schedule - 24 Months

Contract Date – 6/24/03

Start Date – 6/24/03

Completion Date – ~~3/31/05~~

Contract Extension – ~~3/31/2006~~

Contract Extension – 3/31/2007

Project Deliverables

Contract Execution – 6/25/03 ✓

Quarterly Reports: 10/3/03(✓)
1/31/04 (✓); 4/30/03 (✓),
7/31/04(✓); 10/31/04 (✓),
1/31/05 (✓); 4/30/05 (✓); 7/31/05 (✓)
10/31/05 (✓)

Draft Report: 2/28/07 (✓)

Final Report: ~~3/31/07 ( )~~
4/30/07 (✓)

OBJECTIVE / STATEMENT OF WORK

The project goal is to demonstrate cost-effective mercury control for lignite-fired power plants. A Phase I pilot plant effort that has identified a fabric filter baghouse-activated char sorbent-based approach to mercury capture has been completed. The promising technology will be further tested in a Phase II project at SaskPower's Popular River power plant. SaskPower will design and install and operate a slip-stream baghouse (nominal size up to 10 MW). The EERC proposed Phase II program will support activities that demonstrate and quantify the effectiveness, performance and operational cost of the technology for capture of elemental mercury.

STATUS

July – September, 2003. The effectiveness of NF lignite derived char was evaluated in a previous project. Based on the results of that project, the present activity will evaluate mercury capture at the SaskPower's Popular River plant. Design of the slipstream baghouse is on-going.

October – December, 2003. Design and construction activities are continuing.

January – March, 2004. Carbon sorbents from Luscar, Center and the Beulah-Zap mines were steam activiated at two temperatures. Additional bench-scale tests were conducted that demonstrated activation of the chars is necessary for effective mercury uptake. Pilot plant tests indicate that injection of activated carbon between an ESP and baghouse was most effective at capturing mercury, as compared to other technology configurations that were tested.

April – June, 2004. Construction of the test facility at Popular River was completed. Interior equipment and test apparatus is being installed. Additional bench- and pilot scale tests were conducted on additional sorbents provided by Luscar. Planning for the field test is continuing.

July – September, 2004. Luscar has begun production of its lignite-based activated carbon for the large-scale facility at Poplar River. Baseline and screening tests were conducted at the large-scale facility. Data is being reduced and analyzed. Parametric tests are scheduled for November, 2004.

September – December, 2004. Parametric tests are on-going. Issues being addressed include baghouse cleaning frequency, flue gas flow rates and concern about baghouse filter life. Tests are continuing.

January – March, 2005. Parametric and screening tests have been conducted as sorbents became available. Up to 50% mercury capture was observed at injection rates of 2 lb/Mcf.

April – June, 2005. Most tests to date have shown mercury removal rates of >50%. Limited test data reflect removal approaching 90% at high AC injection rates; however, the data will undergo QA/QC and should be considered as preliminary.

July – September, 2005. A long-term test was conducted that indicated pressure drop and cleaning frequency are gradually increasing, even at low dust loadings, over entire test duration. The residual drag is a concern for the operation and the life of the baghouse filters.

October – December, 2005. Phase II activities continue. Ontario Hydro method testing was performed in October during baseline testing at the Emission Control Research Facility.

QA/QC standards were applied to the data generated during the Long Term Test #1 (August 2 – September 9). Delays have pushed back testing.

January – March, 2006. The 2nd long-term low-ash condition test series was completed in January 2006. Data analysis and reduction were completed during the quarter. Interpretation of the data has not been completed. Select ash samples are still ongoing analysis for LOI and mercury.

April – June 2006. QA/QC of all data generated during Long Term Test #2 completed. A third long term test series at the Poplar River ECRF was initiated and the data from this test will be made available for inclusion in the final analysis and report. Parts of the final report are being written.

July – September 2006. Task 3: Ash material samples were tested for a number of parameters including moisture content, LOI, pH, mercury and air toxic element concentrations, 60-day leaching tests, elevated-temperature mercury release tests, ambient-temperature mercury release tests, microbial mercury release tests and ash utilization characterization. Task 4: a draft final report has been written. Task 5: Management of data reduction and reporting is ongoing. A draft version of this report is being written.

October – December 2006. Work this quarter consisted of preparation of the final report.

Final Report. Phase I pilot-scale activities, completed in 2003, led to the design of a slipstream Emission Control Research Facility (ECRF) test unit that was built at SaskPower's Poplar River Power Station. Phase II testing was conducted at this facility to screen and evaluate nine sorbent-based technologies on a system utilizing sorbent injection between an electrostatic precipitator and a fabric filter baghouse (otherwise known as a TOXECON™ configuration) for their mercury capture ability based on injection rates; many showed removals greater than 80%. Parametric evaluations were also conducted that evaluated the effect of operational changes on mercury removal; these parameters included temperature, baghouse-cleaning cycle, pressure drop, and air-to-cloth ratio. Three separate longer-term tests were conducted that evaluated activated carbon injection (ACI) for 1–2 months.

While mercury removals were good, this project showed that balance-of-plant impacts negatively affected the ECRF, including pressure drop increases that were not sustainable, increased filter blinding and, subsequently, shortened bag life. The results of this project, which included some evaluation of coal by-products, were used to perform a preliminary economic analysis of the sensitivity of various factors when using ACI as a mercury control strategy for a TOXECON system.

This project evaluated several sorbent-based technologies, both carbon and noncarbon, to achieve performance curves at different injection rates. The TOXECON arrangement has been proposed as one of the means of achieving the best mercury capture, especially since most of the fly ash is not affected by the AC, and so can still be sold. However, this project has shown that additional concerns exist for TOXECON systems, especially concerning issues with the fabric filter, which will directly affect the economics.