FY07-LXI (61)-158

"Demonstration of WRI's Pre-Combustion Mercury Removal Process for Lignite-Fired Power Plants"

Submitted by: Western Research Institute

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PARTICIPANTS

Sponsor	Cost Share
Basin Electric Power Cooperative	$ 44,000
MDU	$ 44,000
SaskPower	$ 44,000
U.S. DOE	$275,000
NDIC	$188,000
Total Cost	$595,000

Project Schedule – 2 years
Contract Date – 9/14/07
Start Date – 7/1/07
Completion Date – 6/30/09

Project Deliverables:
Status Reports:
1/31/08 (✓); 4/1/08 (✓);
10/1/08 (✓); 4/1/09 (✓);
Draft Final Report: 5/31/09 (✓)
Final Report: 6/30/09 (✓)

OBJECTIVE / STATEMENT OF WORK:

Develop and demonstrate pre-combustion mercury removal of raw coal by thermal treatment. A mercury removal efficiency improvement of at least 50% in the incoming coal will be achieved at less than $30,000/lb of mercury removed. Conduct an economic analysis of the commercial-scale application of the WRI process.

FINAL REPORT SUMMARY

Western Research Institute (WRI) has teamed with Energy and Environmental Research Center (EERC), Etaa Energy, Inc. (EEI), Foster Wheeler North America (FWNA) and Washington Division URS to undertake a research and development effort that addresses WRI's patented WRITECoal upgrading process with North Dakota lignite associated with deploying the technology at a power plant by increasing boiler efficiency, recovery of water, and reducing trace metals emissions such as mercury, while maintaining ash sales. Funding was provided by North Dakota Industrial Commission (NDIC), U.S. Department of Energy, Electric Power Research Institute (EPRI), Montana-Dakota Utilities, Basin Electric Power Cooperative, Detroit Edison, Southern Company, SaskPower, and Etaa Energy, Inc. The project objectives were to evaluate the effectiveness of the WRITECoal process in order to achieve >50% mercury removal in the pre-combustion process, achieve 90% mercury removal with minor combustion process additions, and at a cost of <$30,000/lb of Hg removed. Key findings include the following:

WRITECoal Process PDU Testing. Testing of WRITECoal-treated North Dakota lignite confirmed reduction of Hg and As in bench-scale and pilot-scale tests of 63% and 38%. Recovered condensate quality allows for replacing raw water consumption.

Combined Mercury Removal Using Air-Jigging and WRITECoal Process. The potential to increase the total removal of mercury from coal by combined dry physical cleaning (e.g., air jigging) with WRI's WRITECoal process indicated air-jigging Hg removal of 25% and the WRITECoal process removed another 55% for a total mercury removal of 68%.

Pilot-Scale PC Combustor Testing of Raw and WRITECoal-Treated Lignite. Combustion tests conducted at EERC with WRITECoal-treated North Dakota lignite with a small amount of activated carbon and/or RLP was able to achieve 89-92% Hg removal. Reduction of 28-41% NO_x in the WRITECoal-treated lignite flue gas was observed.

Power Plant Integration and Commercial Configuration Development. WRI, FWNA and EEI simulation/modeling study used ASPEN Plus® and FWNA's FW-FIRE software and revealed WRITECoal integration can result in one of three integration cases: (1) a 3% reduction in raw lignite consumption, or (b) a net power increase of 30 MWe (5.2%) with 2.2% increase in coal use, or (c) a net power increase of 17 MW (3.0%) with the original lignite consumption.

Estimation of Cost of WRITECoal Integrated System. WRI contracted the Washington Division of URS to conduct an economic assessment of the capital and O&M costs of a 600MWe lignite-fired power plant ACI and TOXECON reference cases. Based on January 2009 costs the bare bones capital cost was estimated at $28.9M and total installed capital of $122M, including process (10%) and project (15%) contingencies and 1.3 retrofit cost factor. Present Worth of Revenue Requirements (PWRR) calculations showed a 20% and 14% advantage for the WRITECoal process compared to the ACI and TOXECON reference cases.

In summary, the WRITECoal pre-combustion coal upgrading process has been shown to meet or exceed each of DOE's goals and the economics indicate that it has the potential for being retrofitted into existing plants as part of various plant efficiency and CO_2 capture strategies.