PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Environmental and Water Resources

11/2006

SORBENT INJECTION FOR SMALL ESP MERCURY CONTROL IN LOW SULFUR EASTERN BITUMINOUS COAL FLUE GAS

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Background

Full-scale field testing has demonstrated the effectiveness of activated carbon injection (ACI) as a mercury-specific control technology for certain coal-fired power plants, depending on the plant's coal feedstock and existing air pollution control device configuration. In a typical configuration, powdered activated carbon (PAC) is injected downstream of the plant's air heater and upstream of the existing particulate control device – either an electrostatic precipitator (ESP) or a fabric filter (FF). The PAC adsorbs the mercury from the combustion flue gas and is subsequently captured along with the fly ash in the ESP or FF. ACI can have some negative side effects. Even a slight increase in primary particulate emissions resulting from PAC passing through the particulate control device could trigger New Source Review (NSR) requirements, potentially exposing the plant to costly equipment upgrades. In addition, ACI results in commingling of PAC and the fly ash, which can impact fly ash marketability due to carbon contamination and the perceived health hazards associated with mercury.

Primary Project Goal

Field tests are being conducted to: (1) evaluate the ability of various PACs to remove mercury from full-scale units configured with small specific collection area (SCA) ESPs; (2) document the impact of ACI on small-SCA ESP and wet flue gas desulfurization (FGD) scrubber operations; and (3) assess the impact of ACI on coal utilization byproducts. Full-scale ACI field tests have been completed at Georgia Power's Plant Yates Unit 1 and Unit 2 in Newnan, GA. Both Units 1 and 2 fire a low-sulfur Eastern bituminous coal. Unit 1 is equipped with a small-SCA ESP and a downstream jet bubbler reactor wet FGD system, while Unit 2 is outfitted with a dual flue gas conditioning system to enhance ESP performance. Additional ACI field testing will be conducted at Reliant Energy's Shawville Station Unit 3 in Shawville, PA during Summer 2006. This bituminous coal-fired unit is equipped with two ESPs in series.

Objectives

- Conduct short-term parametric tests to: (1) gain a better understanding of the plant-specific factors that influence mercury capture; (2) determine the best PAC for long-term testing; and (3) establish the optimal operating conditions for long-term continuous ACI tests.
- Conduct long-term (30-day) ACI trials to: (1) evaluate mercury removal efficiency over time; (2) examine the impacts of unit load and ACI concentration on small-SCA ESP and wet FGD operations; (3) quantify the effect of continuous ACI on primary particulate matter emissions; and (4) develop cost estimates for full-scale implementation of ACI for mercury control.

PARTNER

URS Group
Austin, TX

PERIOD OF PERFORMANCE

09/26/2003 to 07/31/2006

COST

Total Project Value
$1,183,656

DOE/Non-DOE Share
$858,004 / $325,652

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Accomplishments

Parametric tests have been conducted at Plant Yates Unit 1 using two conventional (untreated) sorbents and one chemically-treated sorbent. The conventional sorbents were NORIT Americas' DARCO® Hg and RWE Rhinebraun's Super HOK, and the treated sorbent was an iodine-impregnated NH Carbon from Ningxia Huahui. Test results indicated similar performance for the three sorbents, with maximum total mercury removal of approximately 60 percent across the ESP using an ACI concentration of 6 pounds per million actual cubic feet (lb/MMacf) of flue gas. Because of its lower delivered cost, Super HOK was selected for the 30-day long-term continuous injection trial. Additional parametric tests performed on Unit 2 with DARCO® Hg revealed that the dual flue gas conditioning system had no impact on mercury removal efficiency.

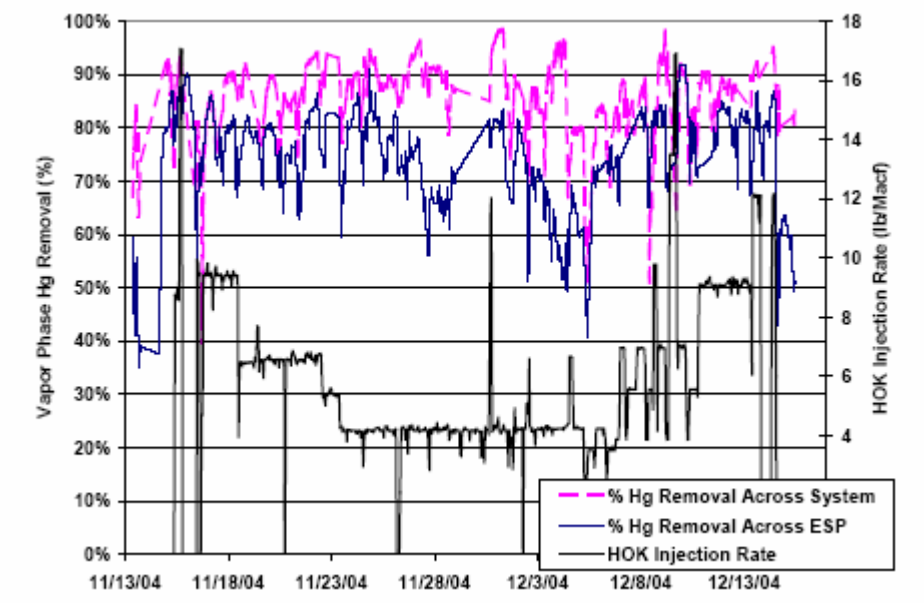
During the 30-day long-term test, Plant Yates Unit 1 operated at low load (50-60 MW) and high load (95-107 MW) conditions, while the Super HOK injection concentration varied from 0-16 lb/MMacf. Super HOK injection concentrations of 4.5 lb/MMacf, 6.5 lb/MMacf, and 9.5 lb/MMacf were required to achieve average total mercury removals of approximately 68 percent, 75 percent, and 76 percent across the ESP, respectively.

Approximately 70 percent of the long-term ACI data fell within or below the range of ESP outlet particulate matter concentrations measured during baseline testing.

The following observations were made after monitoring the Unit 1 ESP arcing rate for three months: (1) ESP arcing rate increased during ACI; (2) ESP arcing rate was higher during high load versus low load; (3) ESP arcing rate appeared to be independent of the ACI concentration at low load; (4) ESP arcing rate may increase with ACI concentration at high load; and (5) the long-term continuous ACI trial caused no physical damage to the ESP.

Planned Activities

URS will be completing overall data analysis, economic analysis, and the final report. In addition, URS will conduct full-scale field testing at Reliant Energy's Shawville Station Unit 3 during Summer 2006.



Long-Term Field Testing Results at Plant Yates Unit 1