FY-04-L(50)-126

"Evaluation of MerCAP™ for Power Plant Mercury Control at Stanton Station, Stanton, North Dakota"

Contractor: Great River Energy

Principal Investigator: Dr. Carl Richardson

PARTICIPANTS

Sponsor	Cost Share
Great River Energy – In-kind costs for MerCap	$ 62,112
Great River Energy Payment to EPRI	$ 140,000
EPRI	$ 140,000
DOE-NETL	$1,113,216
NDIC	$ 150,000
Total Cost	$1,605,328

Project Schedule - 12 Months

Contract Date – 2/16/04
Start Date – 2/16/04
Completion Date – 3/31/06

Project Deliverables

Contract Signed: 2/16/04 (✓)
Qrtly Reports: 12/03 (✓); 3/04 (✓); 6/04 (✓); 9/04 (✓);12/04 (✓); 3/05 (✓); 6/05 (✓); 9/05 (✓)
Final Report: 3/31/06 (✓)

OBJECTIVE / STATEMENT OF WORK:

Test a scaled-up version of the EPRI MerCAP ™ concept, previously tested at the GRE Stanton Station at small scale and various configurations. The concept will employ a fixed structure coated with a thin film of gold, which absorbs mercury from flue gas. Results at small scale suggest that up to 90% of elemental mercury can be achieved. The fixed structure will be inserted into the outlet plenum of one Stanton Station baghouse compartment. Since the structure will be located downstream of a spray dryer, acid gases, particulate matter and other trace gas constitutes that could reduce the efficiency of the proposed concept are minimized. A separate companion project evaluating the MerCAP ™ concept will be conducted Yates Station, where the MerCAP ™ structure will be located in a wet flue gas scrubber, downstream of a demister.

STATUS

Oct – Dec, 2003 Quarterly Report. Initial project planning was conducted. Preliminary planning at the Stanton Station was completed. Additional small scale parametric testing will be conducted to evaluate how substrate surface area and gold coating thickness affects performance.

Jan – Mar, 2004 Quarterly Report. This was the first full technical progress reporting period for the project. Efforts focused on tasks associated with initiating and planning the test program. Specific activities included initial planning and scheduling for Site 1, a host site

survey, design of the MerCAP™ installation and instrumentation, and beginning the electroplating effort.

Apr – June & Jul - Sept, 2004. Efforts during the two reporting periods include defining scrubber slurry feed rates and scrubber outlet temperature, installing the MerCAP sections into the baghouse compartment, and testing a chemical wash as a means of regenerating the MerCAP plates. The full-scale MerCAP array was in service for 915 hours and was operating at nominally 30%-40% mercury removal efficiency. Initial removal rates were nominally 90%, but degraded over the first 48 hours of operation before stabilizing at 30% - 40% mercury removal.

Oct – Dec, 2004. The MerCap array has operated for 1,700 hours on ND lignite and over 1,400 hours on subbituminous without performance degradation. Removal has ranged from 30 to 35%. Plate spacing and acid pre-treatment has an effect (reduced capture) on performance, as does an increase in duct temperatures.

Jan – March, 2005. The MerCap technology has been in continuous operation for over 5,300 hours at a spray dryer baghouse unit. The first 1,700 hours used lignite coals, the remaining hours with a subbituminous coal. Mercury capture averaged 30 to 35%. Poor removal was correlation to spray dryer operational parameters, with some conditions achieving removal efficiencies up to 65%.

Apr – June, 2005. The implementation of MerCap at site 2 downstream of a FGD demister was delayed at the request of the host site.

Final Report (January 2008). The Mercury Capture by Amalgamation Process (MerCap^{TM}) technology was tested. The technology uses fixed sorbent structures placed in flue-gas streams to passively remove vapor-phase mercury compounds. A significant benefit of the MerCap^{TM} system is that it does not negatively impact the ability to sell fly ash for re-use. A full-scale MerCap^{TM} was installed to treat 1/10th of the flue gas flow of the Great River Energy Stanton Station Unit 10. The technology was installed in the clean-air plenum of a single full-scale compartment of the unit's baghouse. Mercury removal performance was documented over a period of nine months where the system operated continuously. Studies were continued beyond the initial scope with additional funding provided by EPRI and GRE.

A single continuous mercury monitor was installed to monitor mercury removal performance. Parametric testing of different plant operation variables was conducted to evaluate the effects of temperature, small-scale thermal regeneration, and spray dryer absorber (SDA) operation on the mercury removal performance. In addition, small-scale testing of samples of the sorbent substrates was conducted to investigate the effect of gas composition, physical installation parameters, and temperature on the mercury removal performance. The technology is capable of achieving mercury removal of 30-50% over extended time periods when operated downstream of a spray-dryer fabric filter. A single set of substrates operated for 23 months continuously over the course of this program.

Variation of plate spacing and active length did not demonstrate a direct correlation to mercury removal, indicating that a mechanism other than mass transfer dominates the mercury capture performance of the gold substrates. Evaluation of SDA operation versus mercury capture indicates that temperature and acid gas constituents are most likely limiting factors. Both thermal and chemical regeneration of slipstream-scale substrates demonstrated that six regeneration cycles had no adverse impact to mercury capture performance.

During the course of this project the cost of commodity gold increased from approximately $280/ounce to over $900/ounce. Original cost estimates to install the MerCap™ technology to the entire baghouse of Stanton Unit 10 (60 MWe) were roughly 2.0 – 2.5 million dollars. The increased cost of gold used as the substrate for the technology increased the cost of installation dramatically. This makes MerCap™ based on gold substrates economically unattractive compared to other options such as activated carbon injection for applications at Stanton. Alternative substrate materials were tested in the laboratory to determine the possibility of identifying more economical alternatives to electroplated gold substrates. The carbon cloth substrate showed promise in laboratory testing, but proved to be mechanically unsuitable to this application. Granulated carbon beds are one of the most promising alternatives. The use of granulated fixed carbon beds at the backend of particulate controls (MercScreen) is currently being actively evaluated as a lower cost alternative to gold-based MerCap™.