PROJECT facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Power Plant Improvement Initiative (PPII)

10/2008

Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector (Advanced Hybrid™) Technology (completed)

CONTACTS

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PARTNER

Otter Tail Power Company
Big Stone City, SD

ADDITIONAL TEAM MEMBERS

Montana-Dakota Utilities and NorthWestern Public Service

University of North Dakota Energy and Environmental Research Center

Background

This project demonstrated the Advanced Hybrid™ technology originally developed and tested by UND/EERC on a 2.5 MWe slipstream at Otter Tail's Big Stone Plant near Milbank, SD. The research was initially supported by the Innovations for Existing Plants component of the DOE Fossil Energy Coal R&D Program and then demonstrated under the Power Plant Improvement Initiative.

A full-scale demonstration of the Advanced Hybrid™ was performed at the 450 MW Big Stone Plant from October 2002 through December 2005. The technology consists of fabric filter bags interspersed with perforated electrostatic precipitator (ESP) plates and electrodes in the same housing. The filter bags can achieve greater collection of very fine particles than can the ESP plates, while the ESP plates can capture dust that is re-entrained due to back-pulsing of the fabric filter bags. The combination of these two technologies (ESP and filtration) in the patented Advanced Hybrid™ uses the ESP portion to capture the bulk (as much as 90%) of the particles and allows the filter bags to be made out of highly efficient membrane materials because of a reduction in filtration surface required as compared to conventional pulse-jet type fabric filters. As such, it is anticipated that the particulate control device can operate at 2.5 - 4 times

Full Scale Advanced Hybrid™ Retrofit at Big Stone

450 MW Big Stone Power Plant

LOCATION

Otter Tail Power's Big Stone Power Plant
Big Stone City, SD

COST

Total Project Value
$21,359,336

DOE/Non-DOE Share
$6,490,585 / $14,868,751

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the throughput of conventional fabric filters. This technology offers the potential to increase fine particle (PM 2.5) collection efficiency by one or two orders of magnitude (i.e., 99.99% to 99.999% removal) at a cost that is roughly comparable to conventional particulate control technology.

Description

The demonstration was conducted on a cyclone boiler firing coal from Wyoming's Powder River Basin (PRB). PRB coal produces fly ash that is among the most difficult to collect with ESPs. Challenging PRB coals, which are often less expensive and contain significantly lower amounts of sulfur, in many cases cannot be burned because existing ESPs cannot effectively capture the high-resistivity dust that is generated. Seventy-five percent of the existing ESPs on U.S. coal-fired utilities are over 20 years old, and many are operating with marginal performance. A growing number of power plant deratings occur because the existing ESP cannot operate efficiently and effectively at peak load. The present performance of these ESPs limits the type of fuel that can be burned in the boiler. The Advanced Hybrid™ technology, with its superior collection of fine particulate in a cost-effective, compact-sized device, can potentially capture a portion of the ESP upgrade market. Detailed project information and the final project report can be found on the NETL website at **http://www.netl.doe.gov/technologies/coalpower/cctc/PPII/bibliography/demonstration/environmental/bib_otter.html**.

In addition (although not part of this demonstration project), the Advanced Hybrid™ technology can provide the control of heavy metals. Generally, heavy metals are directly condensed or adsorbed onto particles in the power plant gas stream. Since fine particles have a much greater surface area than larger particles, for the same amount of mass they adsorb a greater percentage of these heavy metals. The Advanced Hybrid™ technology's superior capture of fine particles will effectively control emissions of heavy metals that are not substantially in the vapor phase. Those elements in the vapor phase (e.g., mercury and selenium) will require sorbents. It is expected that the Advanced Hybrid™ system will be compatible with any of the proposed sorbents for mercury control.