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

Demonstration Operations Complete

Participant

Otter Tail Power Company

Additional Team Members

Montana-Dakota Utilities — co-host

NorthWestern Public Service — co-host

W.L. Gore & Associates, Inc. — licensee and filter bag provider

Energy and Environmental Research Center (University of North Dakota) — concept developer

Location

Big Stone City, Grant County, SD (Montana-Dakota Utilities and NorthWestern Public Service's Big Stone Power Plant)

Technology

Advanced Hybrid™ (formerly known as Advanced Hybrid Particulate Collector)

Plant Capacity/ Production

450 MW

Coal

Powder River Basin subbituminous

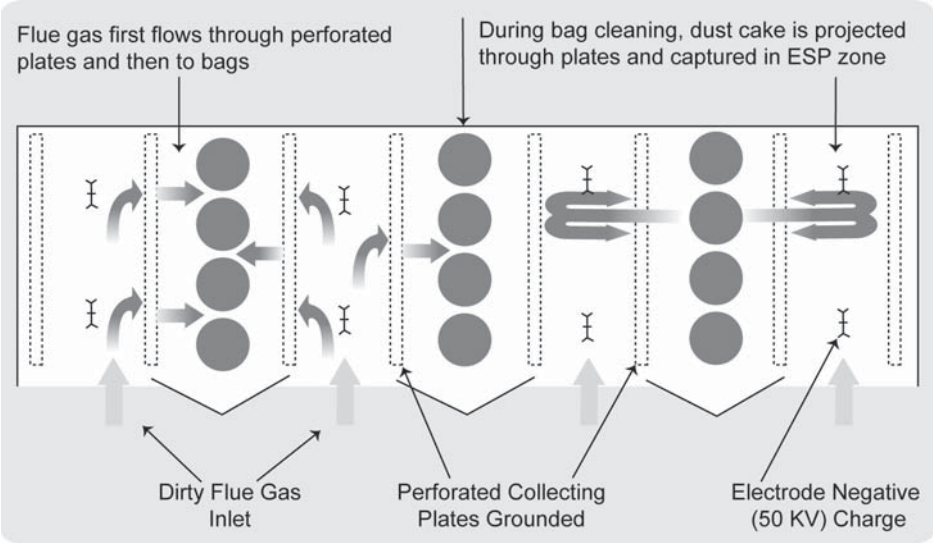
Project Funding

Total	$13,353,288	100%
DOE	6,490,585	49
Participant	6,862,703	51

PPII

Emissions Control

Mercury	☐	NO_x	☐
SO_2	☐	$PM_{2.5}$	■



Objectives

To demonstrate up to 99.99 percent overall particulate matter (PM) capture for all particle sizes greater than 0.01 microns, to demonstrate the ability of the Advanced Hybrid Particulate Collector (AHPC) to achieve low pressure drop (below 10 inches of water column) at an air-to-cloth ratio of 12 feet per minute, and to attain economic viability relative to competing technologies.

Technology/Project Description

The project demonstrates Advanced Hybrid™ technology in controlling PM from a 450-MW cyclone boiler burning Powder River Basin (PRB) coal. The Advanced Hybrid™ system combines electrostatic precipitator (ESP) and fabric filter dust collection (FFDC) technologies in a synergistic manner that leverages the best features of both. ESPs efficiently capture large volumes of PM in size ranges down to 10 microns. FFDCs efficiently capture fine particulates down to 0.1 micron, but at an economic penalty under large volumes. Leveraging these characteristics, the Advanced Hybrid™ uses an ESP to capture approximately 90 percent of the PM from incoming dirty flue gas, and uses an FFDC to capture only the balance of the PM. Perforated ESP plates surround the fabric filter bags and capture PM that is charged by electrodes placed between the plates. Remaining PM, which is predominately fines, passes to fabric filter bags made of highly efficient membrane material for removal. When the fabric filter bags are cleaned by pulsing jets of air from within, the re-entrained PM, not falling to a collection bin, is captured by the ESP.

Benefits

Revised National Ambient Air Quality Standards (NAAQS) for fine PM will require power plants to remove a high percentage of 2.5 microns or less ($PM_{2.5}$) in the 2007 to 2008 timeframe. FFDCs are the current state-of-the-art technology for $PM_{2.5}$ control. The Advanced Hybrid™ integrates an FFDC with an ESP in a synergistic manner that allows the systems to operate at far higher throughputs (2.5 to 4 times) than a stand-alone conventional FFDC. Advanced Hybrid™ fabric filter bag materials offer higher capture efficiency than conventional bags that must sustain full PM loading from incoming dirty flue gas. Stand-alone FFDCs

Project Duration 43 Months	Period of Operation 39 Months	Status/Schedule *Estimated date

also suffer from re-entrainment of PM when the bags are cleaned, a problem nearly eliminated in the Advanced Hybrid™. Testing the Advanced Hybrid™ with PRB coal affords an excellent test of the system since these coals offer high resistivity, which reduces the efficiency of ESPs.

Status/Accomplishments

The cooperative agreement was awarded July 2, 2002. The National Environmental Policy Act (NEPA) requirement was met with an Environmental Assessment (EA) and issuance of a Finding of No Significant Impact (FONSI) on June 11, 2002. Construction commenced in July 2002 and was completed in October 2002.

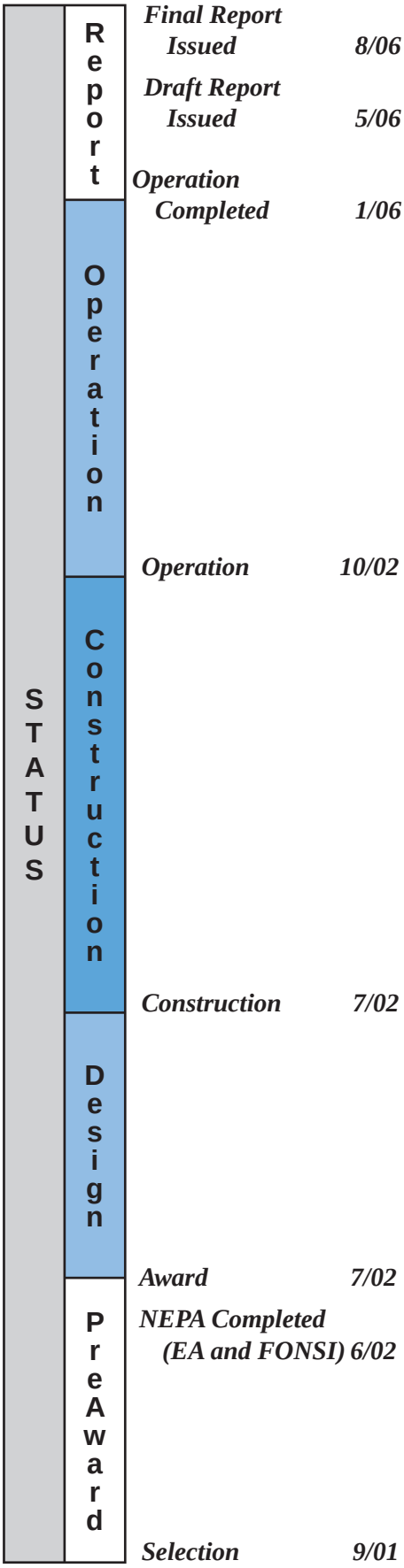
The first 6 months of operation showed very good particulate removal efficiency, but at a higher than anticipated pressure drop. Performance testing has shown that the outlet dust loading is almost two orders of magnitude lower than the guarantee limit of 0.002 grains per actual cubic foot.

While the technology provided high removal efficiency, problem areas included high pressure drop, shorter than expected bag life, and frequent cleaning cycles. In December 2003, operators replaced 3 out of 20 rows of bags in one compartment with the baffles, in an effort to improve flow and pressure drop. Also, one-third of the filter bags were replaced with bags made of a different material to evaluate performance.

In a June 2004 outage, baffles were installed in three compartments and approximately 40 percent of the bags were replaced. Unfortunately, bag life issues persisted and opacity limits were exceeded on several occasions due to bag failures. Additional bags were replaced in an October 2004 outage.

During 2005, pressure drop issues persisted and the ESP components developed problems. Repairs made in July 2005 to the ESP components were not effective and the plant was forced to lower production output on multiple occasions. Following modifications made in December 2005, problems with the particulate collector continued. Changes are needed to enable full load operations. Otter Tail is considering options to achieve acceptable performance.

The period of performance for the project ended on January 31, 2006, and final contract deliverables were received in June 2006. A four-page completed project fact sheet will be provided in the next *Program Update*.



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