the ENERGY lab

PROJECT FACTS

Clean Coal Power Initiative (CCPI 2)

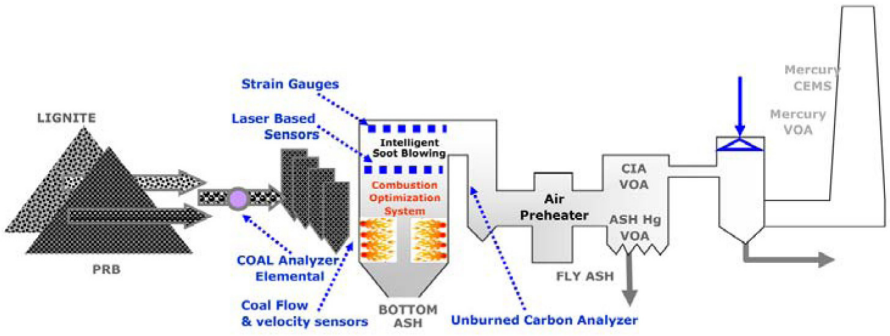
Mercury Specie and Multi-Pollutant Control Project *(Completed May 31, 2010)*

Description

NeuCo, Inc. (which acquired original participant Pegasus Technologies), a developer of power plant control and optimization technologies, demonstrated the capability to optimize mercury speciation and control of emissions from an existing power plant. This demonstration took place at an 890 megawatt (MW) utility boiler in Jewett, Texas owned by NRG Energy.

This project was selected in Round 2 of the Department of Energy (DOE) Clean Coal Power Initiative to demonstrate advanced mercury control technologies. Although coal-fired power plants contribute only a small part of the total worldwide emissions of mercury, the estimated 48 tons of mercury they emit annually is about one-third of the total amount of mercury released annually by human activities in the United States. Mercury emissions can take a number of chemical forms – or species – including as a pure element, as part of a gaseous compound, or bound to particulates in the flue gas. Certain mercury species, such as mercury that is adsorbed onto fly-ash particles, are relatively easy to remove from the flue gas. Adjustment of certain parameters during combustion can optimize the speciation process, maximizing the mercury captured in particle bonds. This results in greater capture of mercury and a reduction of uncontrolled releases.

NeuCo utilized state-of-the-art sensors and neural network-based optimization and control technologies to maximize the proportion of mercury species which are easy to remove from the boiler flue. Artificial intelligence and simulation technologies were used to control and optimize all the major facets of the power plant. During this project, critical sensing devices were added to the unit to monitor inputs and emissions from



Schematic of Sensors and Control Systems

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PARTICIPANT

NeuCo, Inc. (acquired original participant, Pegasus Technologies)
Boston, MA

PARTNERS

NRG Energy
Princeton, NJ

PERFORMANCE PERIOD

Start Date	End Date
04/12/2006	05/31/2010

COST

Total Project Value
$15,560,811

DOE/Non-DOE Share
$6,079,479 / $9,481,332

the plant. Data from these sensors was analyzed by the neural network to optimize the use of raw materials, while simultaneously minimizing emissions. This project demonstrated how integrating sensors, controls, and advanced analysis techniques into multiple facets of plant operation can lead to improved economics and environmental compliance.

The demonstration power plant is equipped with a tangentially-fired boiler rated to supply steam to power a turbine generator and fueled with a blend of 70 percent lignite and 30 percent Powder River Basin sub-bituminous coal, which was eventually transitioned to a ratio closer to 50/50 by project end. The unit is equipped with a cold-side electrostatic precipitator with 99.8 percent nominal removal efficiency for particulates and originally a wet limestone flue gas desulfurization system with 90 percent SO_2 nominal removal efficiency. The desulfurization system was modified during the project to produce gypsum instead of calcium sulfite. Both of the devices are capable of removing specie-optimized mercury from the unit's flue gas.

Sensor installation, software system design and baseline operating metric testing were achieved during performance period 1. Instruments or instrument technology packages installed included a coal elemental analyzer (part of the fuel management system), mercury sensors, coal flow sensors, laser-based furnace gas speciation sensors, on-line carbon in ash sensor (located in the electrostatic precipitator), installation of related communications links for data acquisition and control, related computers, controllers, and NeuCo optimization products. After installation, baseline testing was performed to establish comparative data for follow-on operational testing in Phase 3. After baseline testing, parametric testing was performed to exercise various combinations of control variables to determine their effect on mercury speciation and byproduct generation as well as overall plant performance. These data were used in phase 2 to design/ construct the neural network for optimization control. Performance period 1 ran from April 12, 2006 through December 14, 2007. Software installation, data communications modification and DCS modification were achieved during performance period 2, from December 15, 2007 through December 31, 2008. System validation and demonstration operation was performed in performance period 3, from January 1, 2009 through May 31, 2010.

Benefits

This project demonstrated plant-wide advanced control and optimization systems on a coal-fired steam electric power plant that could minimize emissions of mercury and other pollutants into the atmosphere.

The improved control and knowledge of plant conditions also provided the capability to maximize plant efficiency for electricity production. This technology is expected to have widespread application since it can be directly retrofitted to existing coal power plants or integrated into future new plant designs.

The NeuCo project is part of the DOE's plan to meet the nation's growing demand for electricity, provide a secure and low-cost coal-based energy source, and protect the environment. This project and others will provide the technical foundation to build the zero-emissions, coal-based power and hydrogen production plants of the future.

Host Site Power Plant Looking West