PROJECT facts

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

Combustion Technologies

06/2005

ESTABLISHMENT OF AN ENVIRONMENTAL CONTROL TECHNOLOGY LABORATORY WITH A CIRCULATING FLUIDIZED-BED COMBUSTION SYSTEM

CONTACTS

Robert R. Romanosky
Advanced Research
Technology Manager
National Energy Technology
Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507
304-285-4721
robert.romanosky@netl.doe.gov

Robert M. Kornosky
Project Manager
National Energy Technology
Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236
412-386-4521
robert.kornosky@netl.doe.gov

Wei-Ping Pan
Director
Institute for Combustion Science
and Environmental Technology
Western Kentucky University
One Big Red Way
Bowling Green, KY 42101
270-780-2532
wei-ping.pan@wku.edu

Background

On February 14, 2002, President Bush proposed the Clear Skies Initiative, a legislative proposal to control the emissions of nitrogen oxides (NO_x), sulfur dioxide (SO_2), and mercury from power plants. In response to this initiative, the National Energy Technology Laboratory organized a Combustion Technology University Alliance and hosted a Solid Fuel Combustion Technology Alliance Workshop. The workshop identified multi-pollutant control, improved sorbents and catalysts, mercury monitoring and capture, and improved the understanding of the underlying reaction chemistry occurring during combustion as the most pressing research needs related to controlling environmental emissions from fossil-fueled power plants. The Environmental Control Technology Laboratory will help meet these challenges and offer solutions for problems associated with emissions from fossil-fueled power plants.

Goals

Develop the capability and technology database needed to support municipal, regional, and national electric power generating facilities in improving the efficiency of operation and solving operational and environmental problems. In order to effectively provide the scientific data and the methodologies required to address these issues, the project will include the following aspects:

- Establish an Environmental Control Technology Laboratory using a laboratory-scale, simulated fluidized-bed combustion (FBC) system;
- Design, construct, and operate a bench-scale (0.6 MW_{th}), circulating fluidized-bed combustion (CFBC) system as the main component of the Environmental Control Technology Laboratory;
- Develop a combustion technology for co-firing municipal solid waste (MSW), agricultural waste, and refuse-derived fuel (RDF) with high sulfur coals;
- Develop a control strategy for gaseous emissions, including NO_x, SO_2, organic compounds, and heavy metals; and
- Develop new mercury capturing sorbents and new particulate filtration technologies.

ADDRESS

National Energy Technology Laboratory

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4687

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4764

One West Third Street, Suite 1400
Tulsa, OK 74103-3519
918-699-2000

P.O. Box 750172
539 Duckering Bldg./UAF Campus
Fairbanks, AK 99775-0172
907-452-2559

CUSTOMER SERVICE

1-800-553-7681

WEBSITE

www.netl.doe.gov

PROJECT DURATION

Start Date
9/15/2003

End Date
9/14/2006

Accomplishments:

- Completed detailed design of the bench-scale CFBC system;
- Contacted potential bidders for fabrication of the component parts;
- Conducted pretests in the laboratory-scale simulated FBC system; and
- Resolved problems identified during pretests.

Benefits

- Performs a wide variety of combustion tests using a wide range of fuels (high-sulfur coals, low-rank coals, MSW, agricultural waste, and RDF) under varying conditions to analyze and monitor air pollutant emissions.

- Provides scientific data for atmospheric pollutants and the methodologies required to reduce pollutant emissions. Integration with a selective catalytic reduction (SCR) slipstream unit will allow the effect of flue gas composition, including trace metals, on the performance of the SCR catalyst to be investigated. A quick cooling section will permit the effect of cooling rate on the speciation of mercury to be studied.

- Modification of the bench-scale CFBC system will allow advanced combustion technologies such as "chemical looping" and "oxygen-enhanced" combustion to be investigated.

  - Chemical looping is a process by which the combustion of a hydrocarbon occurs in two stages. In the first stage, air is used to oxidize a "metal carrier" to a "metal oxide carrier," and in the second stage, the "metal oxide carrier" is used to oxidize a fuel as it is reduced to its original "metal carrier" form.

  - "Oxygen-enhanced" combustion occurs in a gas mixture of oxygen and recycled carbon dioxide. The carbon dioxide functions as a heat sink for combustion, much like the nitrogen in air, but produces a flue gas that is made up of carbon dioxide and water vapor. Removal of the water vapor results in a sequestration-ready, concentrated carbon dioxide stream.