R & D facts

U.S. Department of Energy
National Energy Technology Laboratory

Combustion Technologies

08/2002

Combustion and Environmental Research Facility

CONTACT POINTS

Mark C. Freeman
Chemical Engineer
412-386-6094
mark.freeman@netl.doe.gov

Diane (DeeDee) Newlon
Technology Transfer Manager
304-285-4086
r diane.newlon@netl.doe.gov

ADDRESS

National Energy Technology Laboratory

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4604 fax

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4469 fax

WEBSITE

www.netl.doe.gov/products/r&d

Capabilities

The National Energy Technology Laboratory conducts pilot-scale evaluations in the Combustion and Environmental Research Facility (CERF) to enhance fuel, emissions, and/or efficiency performance in pulverized-coal combustors. Technical issues include fuel handling, combustibility, ash deposition, and flue gas emissions. Commissioned in 1989, the basic CERF design criteria (150 kW_t; 500,000 Btu/hr) achieves similarity with utility boilers to replicate typical specification ranges for burner relative-mass-flow, temperature distribution, gas residence time, and convective-section gas velocity. Although pilot-scale combustors cannot exactly duplicate conditions in utility boilers, they are useful to examine the integrated effects of various interdependent design/operating variables. The CERF operates round-the-clock for continuous periods of one to five weeks, and is equipped to evaluate the following:

- Fuel transport, handling, and storage.
- Combustibility, including flame stability and carbon conversion efficiency.
- Ash deposition, slagging/fouling behavior, and removal characteristics (e.g., soot-blowing requirements).
- Flue gas emissions, such as SO_2, NO_X, CO, Hg, and particulates.

Over 20 coals have been tested in the CERF, including run-of-mine, conventionally washed, and deep-cleaned coals, as well as coal blends. The flexible design of the CERF has facilitated the development/testing of various systems and concepts to improve combustion and reduce pollution. Projects have included evaluation of:

- Emissions control technologies, including low-NO_x burner, multi-fuel reburn, SNCR, and novel concepts.
- Air toxics and fine particulate (e.g., $PM_{2.5}$) studies.
- Development and applications of 3-Dimensional computational fluid dynamics (CFD) modeling.

Current CERF testing involves evaluating biomass cofiring and reburning, including various wastes (e.g., sawdust, treated wood, feedlot manure) and energy crops, such as switchgrass and hybrid willow, and novel fuels including lignin. Ceramic and advanced alloy materials and novel coatings are also being evaluated to determine practical upper temperature limits for applications such as ultracritical steam cycles, high-temperature air-based heat exchangers, and slag screens to support Vision 21. The CERF allows materials scientists to expose well-characterized samples under realistic combustion conditions to study corrosion behavior.

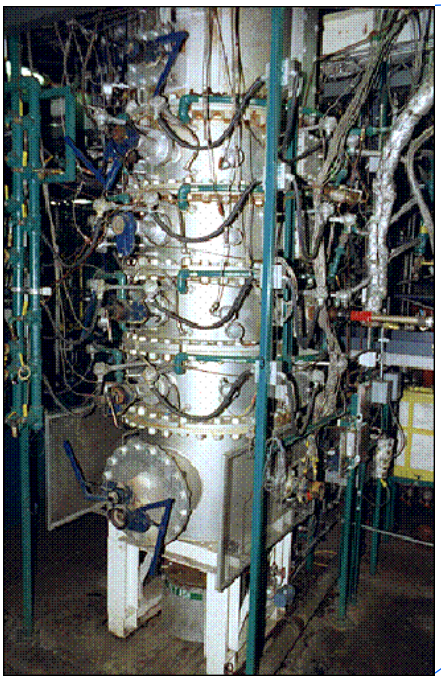
Combustion and Environmental Research Facility

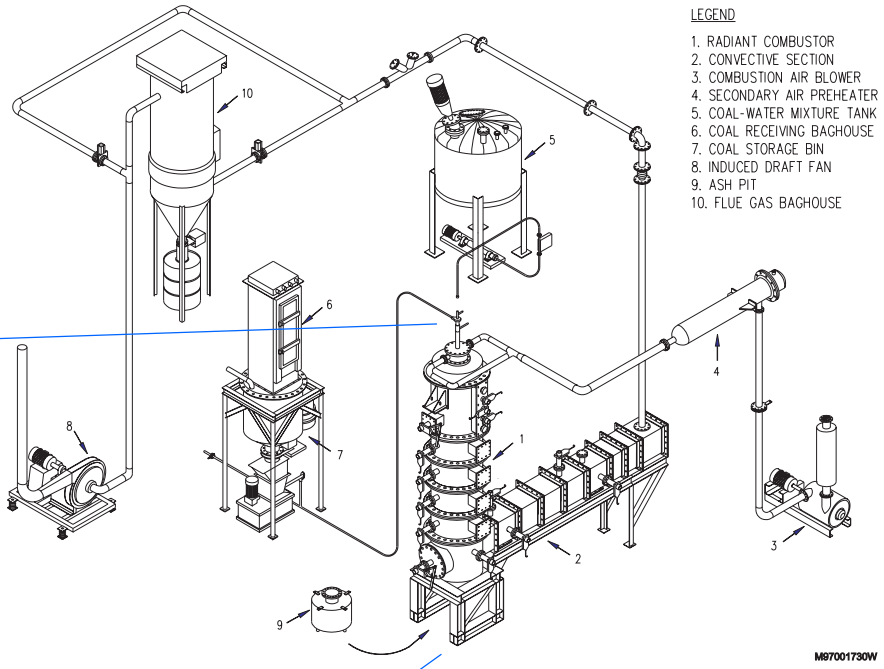
Opportunities

The CERF has been used in six CRADAs, which allow industry to access federal research facilities through in-kind and other arrangements. These CRADAs have involved coal quality studies and in-furnace NO_x reduction processes.

Activities have also been funded by other government agencies. For example, a U.S. Agency for International Development (USAID) study for the Ukraine, India, and Indonesia included combustion tests on foreign run-of-mine and cleaned coals (using U.S. technology) as well as providing engineering design, review work, and training for visiting scientists and engineers.

Much of the CERF activities involve interaction with outside parties that bring their fuels, concepts, equipment, and/or high-temperature materials for evaluation under realistic coal-combustion conditions. Typically, the CERF objective is to provide a test bed for ideas that are at laboratory scale, and to obtain basic information that could support large-scale proof-of-concept testing or a full-scale utility test burn.





The pilot-scale CERF is designed to test solid, liquid, and gaseous fuels used in utility power plants.