COMBUSTION TEST STAND

CAPABILITIES STATEMENT

OCTOBER 2000

HIGH TEMPERATURE PROCESS SIMULATION

DIAL's combustion test stand (CTS) is a versatile platform for testing high-temperature instrumentation and systems. Built to simulate the very harsh coal combustion environment, the CTS was initially used to study the effects of high-temperature particle-laden gas streams on boiler materials. DIAL's engineers quickly recognized the value of a general facility that could be rapidly configured to provide a specific set of conditions, e.g., temperatures, particle concentrations, and redox states, and set out to provide such a platform for testing. As a result of that effort, DIAL's combustion test stand has evolved into a system that is capable of accurately controlled and repeatable simulation of a wide variety of combustion and other high-temperature processes.

The CTS can be configured to represent a variety of real-world conditions. Air flow rates between 300 and 800 lb/hr are normally achieved through the eight inch nominal diameter pipe sections. Six, sixteen and twenty-two inch sections are also available. Pipe sections can be one, two or four feet in length, and can be readily changed out, or can have custom access ports installed. The CTS is set up for the combustion of either fuel or natural gas. Coal slurries can also be fed. The relative variability in the fuel feed rate is less than 3%. Combustion air can be preheated electrically up to 850°C. Temperatures as high as 2000°C can be obtained.

Both solids and slurries can be injected at several locations via peristaltic pump; injection rates typically are stable within 2% of the nominal feed rate.

Off-gas from the combustion test stand is processed through an air pollution control system (APCS). The first stage of the APCS consists of a quencher section followed by a venturi scrubber. The second stage is a packed column followed by a gas re-heater and HEPA filters. Spacing between the various components provides the required number of pipe diameters, both before and after measurement locations, to provide defensible EPA reference measurements, optical instrument and intrusive probe measurements.

The control system for the CTS is a network-based system which requires connection to only two wires for control and two for monitoring. This allows the addition or removal of components from the test train with required minimal rewiring. A distributed control system is used which takes advantage of PID controllers for control of fuel flow, main air flow, secondary air flow, and air/fuel ratio. The main CPU is capable of data collection, monitoring, and graphic presentation of system data, while only sending set points to the remote controller units. All CTS sensors are calibrated, using NIST traceable standards at regular intervals, as part of DIAL's quality assurance program. The CTS allows both intrusive probe and optical access to the gas stream.

Operation and maintenance of the combustion test stand is supported by system operators and operations technicians. The entire combustion test stand, as well as the air pollution control system, was constructed "in-house" by DIAL's mechanical shops. Modifications to the system as well as repairs are also handled in-house. In the event system upsets occur, this in-house capability helps to minimize down time.

■
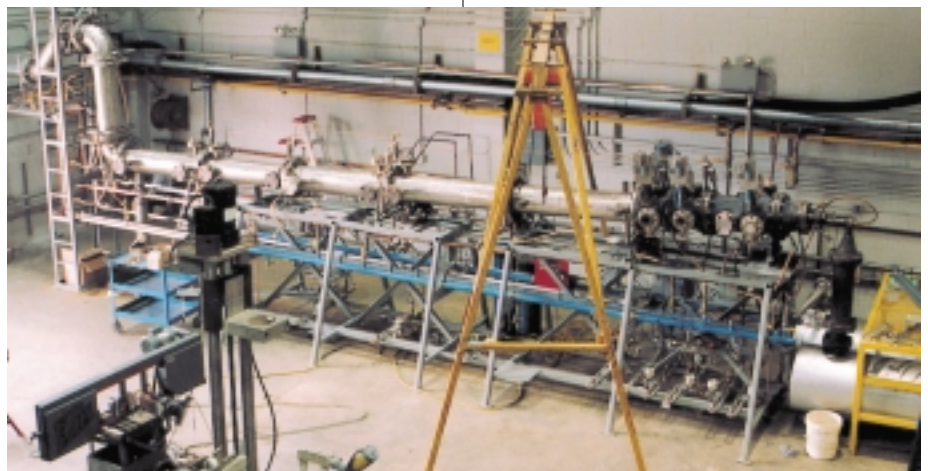
A wide variety of non-intrusive, extractive sampling, or probe systems can be used to elicit engineering data about the gas stream. These include instruments to accurately determine gas stream velocities, particle size information, the concentration of solids in the stream, the temperature of the gas stream, its redox state, and the concentration of volatile and semi-volatile species in the gas stream. All of these can be measured at virtually any position in the CTS. DIAL also operates an analytical laboratory with a wide range of capabilities for organic and inorganic solid analysis. DIAL also has a gas analysis group which supports testing with both standard gas analyzers and using EPA reference measurements. When combined with DIAL's measurement capabilities, the testing and simulation provided by the combustion test stand are a unique combination of attributes for the testing of a variety of thermal components and systems, process characteristics, and air pollution control systems.

The combustion test stand has been a invaluable aid in the development and testing of optical and probe-based diagnostic systems. The capability of simulating a wide variety of thermal processes has provided a basis for testing instrumentation before it is used in the field to make important measurements. The ability to test a measurement system in an environment which is very similar to the environment at a remote facility where measurements are required, allows instrument developers/operators to be better prepared and significantly improves success.

DIAL's combustion test stand is also being used for testing of off-gas systems, APCS components, and instrumentation that was developed at other DOE facilities. Currently the CTS is being used to simulate a municipal solid waste incinerator in order to provide information on the mechanisms of generation of dioxins/furans and PCBs in incinerator off-gas.

Since the late 1970's, DIAL's combustion test stand has been continually improved in order to keep up with the ever increasing need for a broader spectrum of simulation capabilities, improved accuracy, better control, and better repeatability of results. This capability makes the system a unique test bed for instrumentation development and testing, process testing and evaluation, air pollution control system testing/evaluation, control system development, and for the evaluation of chemical species generation/destruction in combustion processes.

Additional information about this and other research and testing capabilities at DIAL can be obtained from:

Dr. M. J. Plodinec, Director
205 Research Blvd.
Starkville, MS 39759-9734
Telephone 662-325-2105
dial@dial.msstate.edu
www.msstate.edu/Dept/DIAL

■