Pilot-Scale Research Boiler — *Facilities Description*

The CANMET Energy Technology Centre's pilot-scale research boiler (PSRB) is illustrated schematically in Figure A.1. The furnace is U-shaped and consists of a vertical refractory-lined shaft and vertical steam boiler connected at the bottom through a horizontal refractory-lined tunnel. It is fired by opposing twin burners which can be located in three basic positions, known as the I, J, or U configuration. Solid, liquid or gaseous fuels can be fired in this furnace, using a variety of burners.

The more reactive fuels will burn efficiently when fired in the I configuration. However, for fuels that are difficult to burn, combustion residence times can be increased by locating the burners in the U configuration. Intermediate residence times can be obtained by locating the burners in the J configuration. It is estimated that, at full-firing load and with the burners located in the I configuration, the combustion chamber residence time will be about one second. This time will increase to about three seconds when the burners are located in the U configuration. Gas velocities within the furnace range from 2 to about 6 m/s and up to 20 m/s in the flue duct, depending on the gas temperature, feed rate and excess combustion air. The combustion chamber heat release rate is estimated to be about 0.35 MJ/s/m^3.

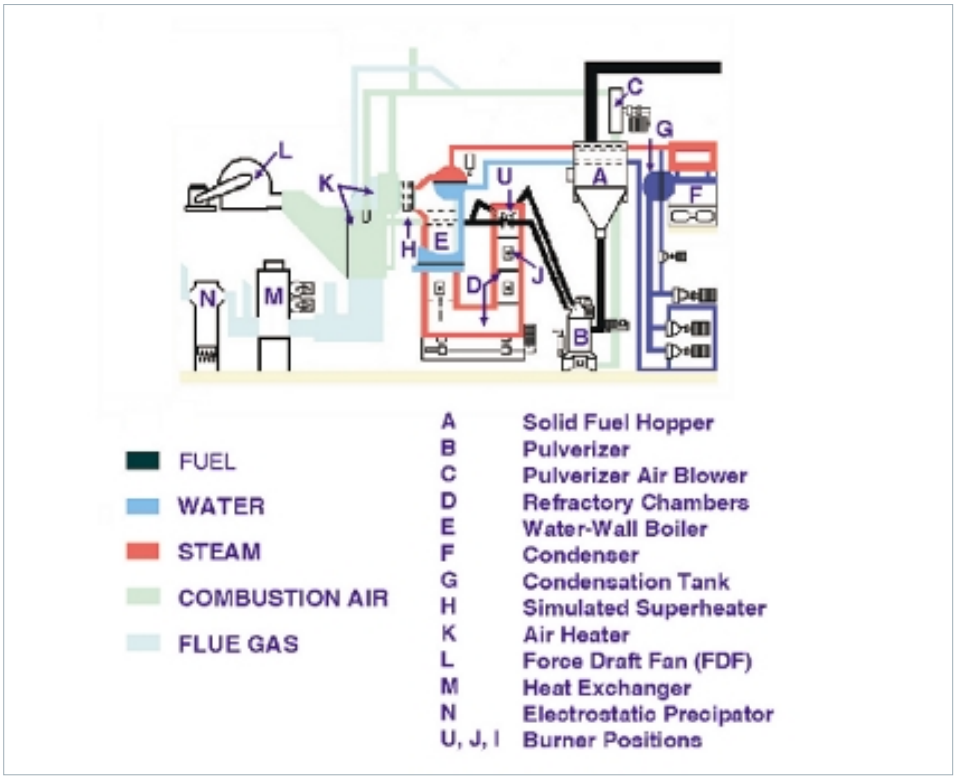

Fig. A.1 Schematic of the Pilot-Scale Research Boiler

The three sections of the furnace are designed to operate at pressures up to 2.5 kPa. At the fully loaded firing rate of 2.5 GJ/h (0.7 MW), the boiler generates about 730 kg/h of steam at 690 kPa. The furnace is normally operated at about 1.5 GJ/h, in order to reduce the overall fuel consumption requirement for each test. Crushed coal, for example, can be supplied to the furnace from a 4500 kg coal bin, mounted on an electronic weigh scale and fed through a variable-speed worm screw feeder to a ring-roller type pulverizer which is swept and pressurized with a mixture of air and flue gas (maximum temperature of 400°C). The pulverizer contains a motor-driven air classifier to control fuel fineness and a riffle at the pulverizer outlet that proportions the fuel to each burner. Secondary air can be supplied to the burners at temperatures up to 250°C.

Combustion gases leave the furnace at temperatures between 700°C and 1300°C and pass through air-cooled superheater tubes, a transition section, a test-air heater and a conventional three-pass air heater, before entering a long horizontal sampling duct. At the end of the sampling duct, gases can either be passed entirely into the stack or be diverted into an electrostatic precipitator for sampling. A bypass from the air heater to the stack and an additional heat exchanger in the sampling duct permit the temperature of the flue gas sample

Side View of the Pilot Scale Research Boiler

to be varied from 150°C to 300°C. A forced-draft fan supplies air to the air heater at 7 kPa (71 cm water-column).

When leaving the heater, the air is divided into three systems: primary air to the pulverizer, secondary air to the burners and cooling air to the test air heater. The last stream, after leaving the test-air heater, can either be exhausted to the atmosphere or be blended with the primary air supply to the pulverizer.

The following parameters are generally measured during the coal combustion trials, at their appropriate stations:

- fuel quality from a composite sample at pulverizer inlet
- moisture and sieve analyses at pulverizer outlet
- oxygen content of flue gas by dynatron and paramagnetic monitors
- NO_x content of flue gas by chemiluminescent monitor
- CO and CO_2 contents of flue gas by infrared monitor
- SO_2 content of flue gas by ultra-violet monitor
- carbon content of fly ash particulates
- fly ash loadings by isokinetic sampling system
- size distribution of flue gas particulates
- fouling of heat-transfer surfaces by visual examination and samples
- slagging propensity by visual examination and samples
- in-situ electrical resistivities of fly ash

R&D Facilities

CETC's R&D facilities are available for use on a "fee-for-service" basis.

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