INTRODUCTION
This paper is the second in a series that discusses Combustion Management Solutions. This installment discusses Parallel Positioning Control.

The benefits of parallel positioning control are:
◊ Provides improved boiler efficiency by compensating electronically and mechanically for variations in fuel and combustion airflows
◊ Provides improved boiler safety by maintaining airflow even at low firing rate demand

BACKGROUND
The primary function of the combustion control system is to provide air and fuel to the burner at a rate that satisfies the firing rate demand while optimizing the combustion mixture. The control system design, configuration, and daily operation must provide for the safety of operating personnel and for economy of operation.

Maintaining an optimum combustion mixture is critical in meeting the requirement for safety and economy. Insufficient air results in incomplete combustion and poses a health and safety hazard. Incomplete combustion forms carbon monoxide, which is a health hazard if combustion gases escape into the plant area. In extreme cases, unburned fuel remains in the combustion gases. This is a severe safety hazard because fuel rich combustion gases can auto-ignite when they mix with a stream of fresh air. Of course, poor mixing of air and fuel at the burner can also result in incomplete combustion. From an economic standpoint, incomplete combustion reduces boiler efficiency and results in higher fuel cost.

Too much air also results in higher fuel costs because energy is wasted heating excess air. However, the combustion control system should operate with a slight amount of excess air to insure complete combustion and minimize formation of carbon monoxide.

The parallel positioning control system uses a similar strategy as single point positioning (see AD353-101) for combustion control. The main difference is that the fuel valve actuator and the forced draft fan damper are controlled separately. This permits optimization of the air/fuel ratio across the full range of firing rate demand. The result is higher boiler efficiency.

MEASUREMENT
The parallel positioning control strategy uses a single measured variable: steam header pressure for a steam boiler, hot water outlet temperature for a hot water boiler. Both the fuel valve actuator and the forced draft fan damper are positioned based on this variable.

Steam Header Pressure
The steam header pressure measurement can be made using a gauge pressure transmitter. Select a transmitter with significant over-pressure protection to avoid damage from pressure spikes.

Hot Water Outlet Temperature
Temperature measurement can be made using a smart transmitter with either a thermocouple or resistance temperature detector. Select a
transmitter that has a universal input and can accept many different types of T/Cs and RTDs.

**CONTROL**

Parallel positioning control is commonly used on package boilers. The SAMA\(^1\) diagram at right illustrates the control strategy. The process variable is either steam header pressure (shown in the diagram) or hot water outlet temperature. The PID function block maintains the process variable at setpoint by manipulating firing rate demand.

There are two controlled variables. One modulates the fuel valve actuator and the other modulates the forced draft fan damper. Typically, the fuel valve is mechanically characterized such that fuel flow is linear with the firing rate demand. Airflow is characterized electronically such that the air/fuel ratio is optimum across the full range of firing rate demand. For safety reasons, a minimum airflow is maintained at low fuel flow rates even though it exceeds required airflow.

**APPLICATION SUPPORT**

The next publication in this series is AD353-103, Full-Metered, Cross-Limited Control. User manuals for controllers and transmitters, addresses of Siemens sales representatives, and more application data sheets can be found at www.usa.siemens.com/ia. To reach the process controller page, click Process Instrumentation and then Process Controllers and Recorders. To select the type of assistance desired, click Support (in the right-hand column).

The control concepts in this publication can be developed into a controller configuration using the Siemens i|config™ Graphical Configuration Utility.

Combustion management configurations can be created and run in the following Siemens controllers:

- Model 353 Process Automation Controller
- Model 353R Rack Mount Process Automation Controller*
- ipac™ Internet Control System*
- Model 352Plus™ Single-Loop Digital Controller*

* Discontinued model

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\(^1\) SAMA – Scientific Apparatus Makers Association