APPLICATION BULLETIN
ICA-02

MEASURING BULK SECONDARY AIRFLOW

The Challenge

The objectives in the power industry today are twofold; to lower emissions, and increase plant performance. Precise measurement of combustion airflow and fuel rates positively contributes to achieving those objectives by providing the information needed to optimize stoichiometric ratios and facilitate more complete, stable combustion.

Traditional coal fired power plant design utilized airfoils or venturis for measurement of bulk primary and secondary airflow for the purpose of maintaining the correct boiler air to fuel ratio at varying load conditions. Although airfoils and venturis have provided adequate airflow measurement in the past, achieving current emission reduction mandates and performance objectives require a more accurate and cost effective means of airflow measurement.

Venturis and airfoils have known limitations: 1) Significant non-recoverable pressure loss that wastes power and can limit generated output; 2) Decreased accuracy and noisy signals at high turndown operating conditions associated with low NO_x retrofits; 3) The need for five to eight straight lengths of duct runs at the point of installation to obtain true accuracy and repeatability, 4) Cannot achieve a linear mass flow output over a broad operating range with a single K-factor.

The Solution

A Florida utility was engineering a low NO_x burner retrofit on their 300MW gas/oil wall fired boiler. In order to gain needed fan capacity and obtain a more accurate measurement of airflow over a higher range of turndown, Air Monitor Power's Application Engineering Department suggested the total air venturi be removed and replaced with a VOLU-probe/SS array. See Figure 1.

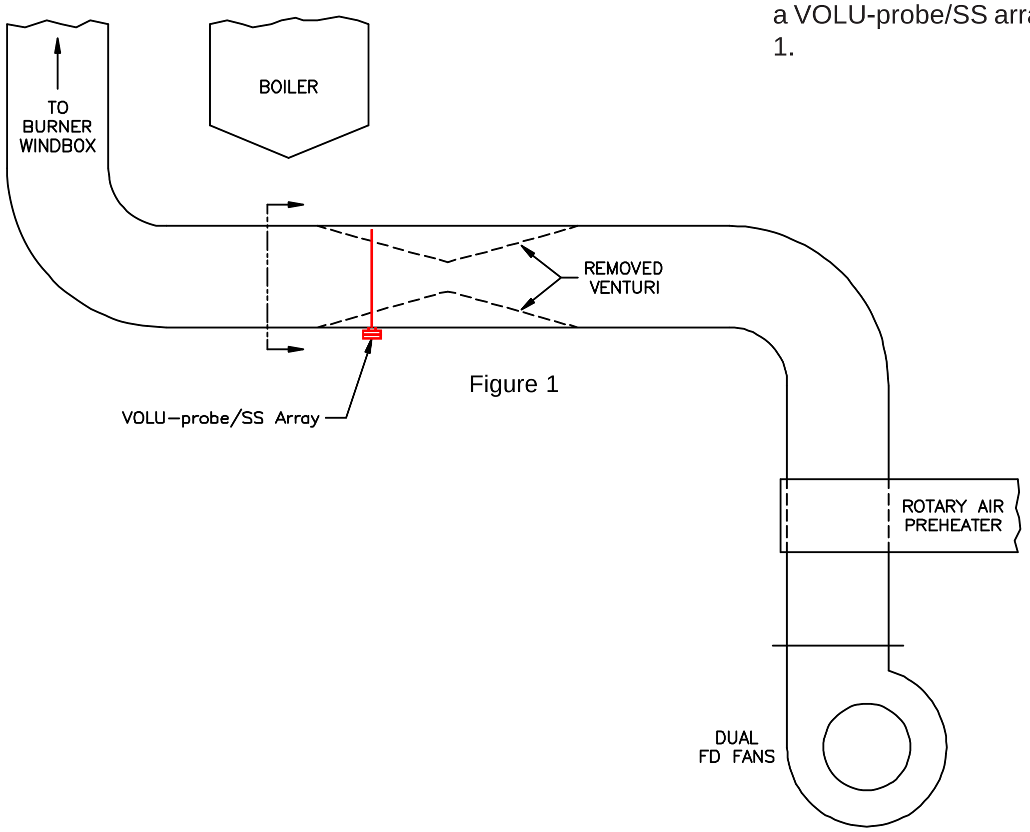

Figure 1

4/09, Rev.1

The Solution

The measuring location was a 40' long section of duct downstream of twin forced draft (FD) fans and a rotary air pre-heater. The two fans joined into a common 5' x 75' duct upstream of the pre-heater, and it was believed that the flow rates on either side of the duct would vary depending on the load changes on either fan.

Two side-by-side measurement arrays, each having seven Fechheimer-Pitot VOLU-probe/SS measuring 60" in length, were installed. For each array the VOLU-probe/SS total and static pressure signal connections were manifolded together and routed to their own Combustion Airflow Management System (CAMS) enclosure. Within the CAMS enclosure the pressure signals plus airflow temperature are converted by the CAMM into a density compensated lbs/hr mass flow output to the DCS. The two mass flow inputs, one from each CAMM, were summed in the DCS to arrive at a total bulk airflow.See Figure 2.

The CAMM also manages the AUTO-purge™ system used to keep the VOLU-probe/SS sensing ports and signal lines clear of accumulating fly ash. The purge cycle can be configured to operate on a programmable interval or initiated via a dry contact from the DCS. During the purge cycle the CAMM maintains a locked signal output to the DCS while providing a dry contact notification of purge cycle start and finish.

Result

The removal of the venturi provided the needed additional fan capacity, while saving an estimated $10,000 in reduced power consumed by each FD fan. The installed VOLU-probe/SS arrays achieved the desired ±3% measurement accuracy over the full 4:1 range of turndown. Due to the CAMS sensitivity to small changes in airflow, a cyclic drop in airflow was detected and traced back to one of the pre-heater's twelve sections being plugged.

Subsequent to the initial installation, Air Monitor Power assisted the customer in reconfiguring the manifolding of the two VOLU-probe/SS arrays as in Figure 3. The revised arrangement resulted in two fully redundant systems, each measuring the total bulk airflow without any summing in the DCS. When one system was performing a purge cycle, the other system continued to provide dynamic flow measurement.

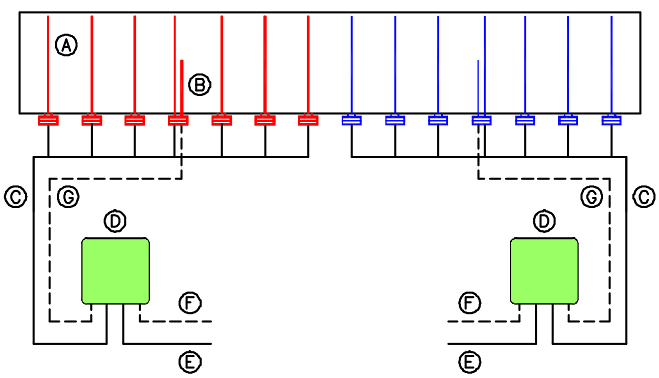

Figure 2

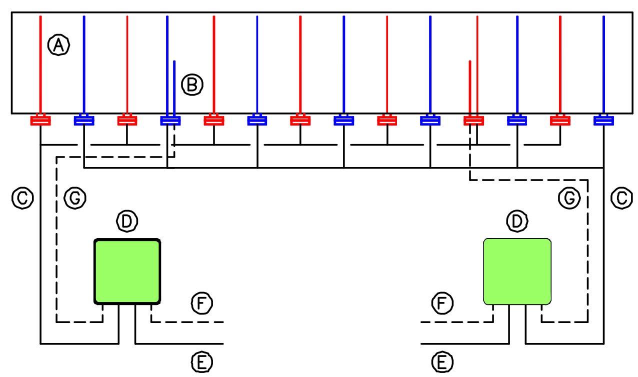

Figure 3

Ⓐ VOLU-probe/SS Array
Ⓑ Thermocouple Probe w/Temperature Transmitter
Ⓒ T.P. and S.P. Signal Tubing
Ⓓ CAMS Purge and Transmitter
Ⓔ 100 psi Plant Air
Ⓕ 4-20mADC Flow Signal to DCS (lbs/hr)
Ⓖ 4-20mADC from Temperature Sensor