

## MEASURING INDIVIDUAL BURNER AIRFLOW

### The Challenge

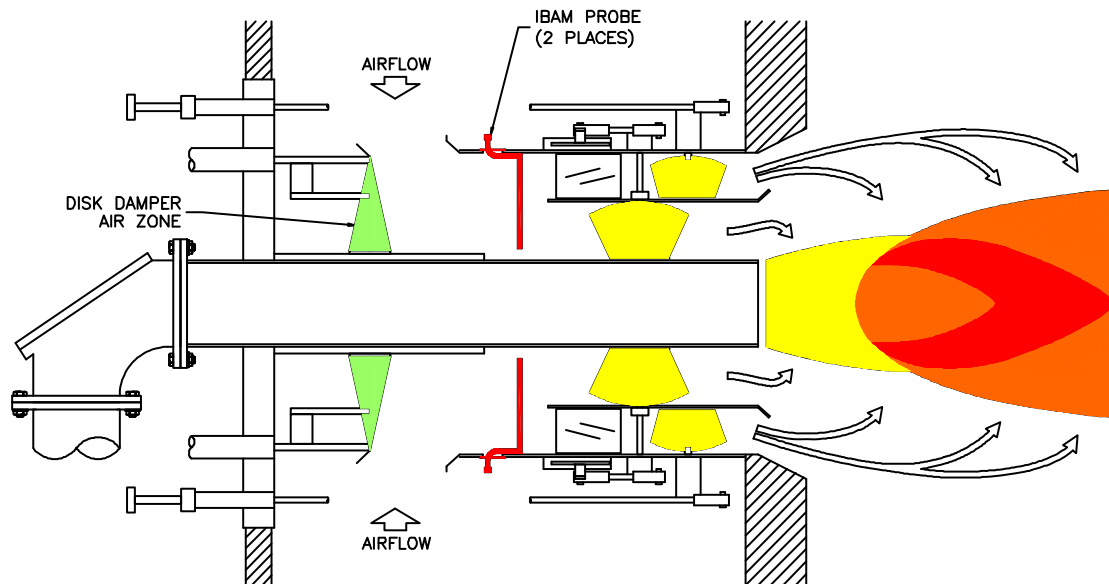
The objectives in the power industry today are twofold; to lower emissions, and increase plant performance. Precise measurement of combustion airflow and fuel rates positively contributes to achieving those objectives by providing the information needed to optimize stoichiometric ratios and facilitate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

Traditional coal fired power plant designs lacked any means to measure and control airflow into individual burners. New burner designs prompted by Clean Air Act attainment levels for NO<sub>x</sub> reduction are typically comprised of inner and outer airflow barrels to introduce secondary air (SA) to the flame ball, adjustable swirl

angles blades in each barrel, a combination of fixed and/or adjustable inlet sleeve/disk dampers, and in most installations the burners were equipped with actuators to facilitate DCS controlled modulation of burner SA airflow corresponding to varying fuel loads. Unfortunately some low NO<sub>x</sub> burners come equipped with a non-calibrated airflow sensing device and most others lack any means to determine how much SA is entering the burner, resulting in the need for extensive burner tuning targeted at meeting the manufacturer's NO<sub>x</sub> and CO emissions guarantees but not repeatable or maintainable long term over varying load conditions.

Just as there are variances in fuel distribution to each burner, multiple

burners served by a common or partitioned wind box can have substantial burner-to-burner imbalances in SA. Accurate and repeatable measurement of individual burner SA requires airflow probes that are economically feasible to retrofit into existing burners and yet able to accommodate a variety of design challenges – the absence of any undisturbed cross section of airflow passage; an installation location typically downstream of a modulating inlet sleeve or disk damper; a broad range of boiler operating conditions; the presence of fly ash particulate; and the broad range of airflow pitch and yaw vectors produced by the adjustable swirl angle blades.



## The Solution

AMC Power's Individual Burner Airflow Measurement (IBAM) probes, a modified version of the VOLU-probe/SS, are designed burner specific to accurately measure burner SA. Based upon the Fechheimer-Pitot measurement technology, each IBAM design draws from a broad array of construction options: Quantity and location of individual TP and SP sensing holes; CW and/or CCW rotation of the individual TP and SP sensing probes; rotation of the entire IBAM assembly; and the use of ultra high temperature alloys and Tungsten Carbide coatings. The configuration of inner and outer airflow barrels, along with the locations of the burner registers and obstructions such as an igniter, typically define the possible IBAM mounting locations. Wind box configuration and burner symmetry guide the quantity of IBAMs needed to obtain desired accuracy and repeatability.

Each IBAM probe is extensively tested and characterized in AMC Power's large scale test duct, installed either in a full size burner mock-up or the actual burner. Testing is conducted over a broad matrix of customer specific sleeve damper or inlet disk positions, swirl angle settings, and boiler operating conditions. The result is a multi-order polynomial equation, with one or two variables, to accurately correlate the total and static pressure signals from the IBAMs into mass flow.

The IBAM signals are routed out of the wind box to the Combustion Airflow Management System (CAMS) enclosure. Within the CAMS enclosure the pressure signals plus airflow temperature are converted by the CAMM using the polynomial equation, into a density compensated lbs/hr mass flow output to the DCS.

The CAMM also manages the AUTO-purge™ system used to keep the IBAM 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

Customized IBAMs characterized in the AMC Power wind tunnel and used in conjunction with a CAMS result in individual burner SA measurement accurate to within  $\pm 5\%$  of actual airflow over the full range of boiler operation.

Statically balanced burner-to-burner airflow is a critical first step in optimizing boiler performance while simultaneously reducing undesirable emissions. In several installations, just balancing the airflow was sufficient to achieve lower  $\text{NO}_x$  emissions levels.

Further reductions in  $\text{NO}_x$  levels are obtained when continuous burner SA measurement is combined with DCS controlled modulation of airflow control to dynamically maintain burner-to-burner airflow balance or a burner bias strategy corresponding to the varying fuel loads.

Incorporating Pf-FLO coal flow measurement for EACH burner permits adjusting SA to reflect the actual fuel being delivered to each burner, thereby achieving the desired fuel / air ratio, safely lowering overall  $\text{NO}_x$  while simultaneously reducing areas of high CO that otherwise produce undesirable slagging and water wall corrosion.

Over-fire Airflow (OFA) measurement is another common  $\text{NO}_x$  reduction technique that alone, or in conjunction with SA measurement and control, requires the accurate measurement capabilities of the IBAM to ensure the proper amount of OFA is used to obtain the best possible  $\text{NO}_x$  solution via staged combustion, while simultaneously minimizing CO and LOI.