ACTIVE CONTROL OF CARBON IN ASH

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Summary

The initial and in some cases second generation of low NOx burner modifications are behind most US Power Generators. In many cases the result of these Clean Air Act (CAA) compliance measures is a major loss in revenue, due to the inability to sell flyash that contains higher carbon levels. This is in addition to the heat rate loss from incomplete use of the heating value of the coal.

In order to recoup the loss of revenue as stated above, utilities are looking to automation for solutions to their problem. ABB Automation is currently developing active methods for control of Carbon in Ash (CIA). Like all robust control applications, these are based on a solid, real time sensor for process feedback. According to Lord Kelvin, "When you can measure what you are speaking about and express it in numbers you know something about it. When you can not measure it your knowledge is meager and unsatisfactory." Since 2001, ABB has installed and gained experience with our real time Carbon in Ash Load instrument. This instrument has been installed on several boiler types, including Wall, Tangential and Cyclone fired units.

The active control of carbon in ash is quite a unique problem on several fronts. Often, methods to improve CIA results in degradation within other Controlled Variables (CV). Primary of these is NOx. It is important to be able to balance these conflicting demands for efficiency and governmental regulation as operations and seasonal demands change. This balancing act, depending on the Manipulated Variables (MV) available, may require control applications of higher complexity than traditional Proportional, Integral, Derivative (PID) control. Fuzzy Logic or Model Predictive controls are desirable when multivariable and often non-linear control is needed. This is particularly true when the MV is global, as in the case of Excess Air. In other cases when single MV control is possible, such as dynamic control of coal fineness, PID may be absolutely appropriate.

For example, designed tests conducted on a 340MW wall fired unit demonstrated that the relationship between CIA and global Excess Air is load dependent, nonlinear with respect to current operating point, and even counter-intuitive in

some cases. The same tests also exhibited strong correlations between air distributions among different row/column burners with CIA, which provided an additional freedom of controlling CIA without degrading NOx control performance. Once the model between CIA and most influential MV's is established, a neural-net based Combustion Optimization System (COS) was applied to actively control CIA together with other CVs in real time.

This paper has described the experience that ABB is gaining in pursuit of closed loop, active control of CIA. Many of the lessons learned are applicable to all unit types, but there are also unusual relationships and operating modes that can only be discovered with real time measurement of CIA. The degree of improvement may be in the form of overall reduction, improvement in consistency or both. Use of real time data in conjunction with advanced data evaluating and modeling techniques shows that active control of CIA is possible.