FIELD APPLICATION OF ON-LINE COAL FLOW BALANCING TECHNOLOGY

Harun Bilirgen (hab4@lehigh.edu)
Edward K. Levy (ekl0@lehigh.edu)
Energy Research Center
Lehigh University
117 ATLSS Drive
Bethlehem, Pennsylvania 18015

Summary

Imbalances in coal and air flow rates from one coal pipe to the next can result in numerous operating problems. Burner imbalances are a limiting factor in the ability to reduce NOx emissions from pulverized coal boilers, and also can result in high CO emissions and high levels of unburned carbon. High fly ash unburned carbon, in turn, can adversely affect ESP collection efficiency and result in elevated particulate emission levels. Imbalances in coal pipe flows can also lead to maintenance problems associated with coal pipe erosion, plugging of coal pipes, damage to burners and windboxes, excessive localized slagging and accelerated waterwall wastage. Problems such as these reduce the operating flexibility of the unit and often require the boiler be operated at conditions which produce higher NOx levels than would otherwise be achieved. Coal pipe imbalances are particularly limiting with firing systems designed to achieve ultra low levels of NOx.

The authors have recently completed development of a technology for achieving balanced coal flows to burners in piping systems where a single pipe is divided into two, three or four outlet pipes at a splitter junction. The hardware, which can be retrofitted easily into an existing coal pipe network, requires use of a riffler with specially designed adjustable flow control elements positioned just upstream of the riffler. The flow control elements have been designed to make it possible to balance the coal flows without affecting the primary air flow balance and this can be done while the pulverizer is on-line.

After testing the technology at reduced scale in a laboratory flow loop, the flow control technology was tested at full-scale in the field. Adjustable coal flow control elements were installed at two boilers, one with coal pipes which split into two pipes and the second where there are three-way splitters junction after the mills. In both cases, the flow control elements were found to be capable of producing large changes in outlet coal flow distribution, resulting in either closely balanced coal flows or highly unbalanced flows, depending on the settings used. The resulting coal flow distributions were found to the repeatable and coal flow imbalances were reduced to less than ± 5% in both cases.

At one of the installations, the flame characteristics were observed and recorded as adjustments were made to the flow control element positions. Observations indicated that there were considerable changes in the flame color as a function of the flow control element position, with the flame color going from bright orange to dark orange as the burner stoichiometry was changed from fuel lean to fuel rich. Measurements were also made of the pressure drop due to the coal flow elements as a function of mill loading (damper position). The pressure drops across the flow control element were found to be between 0.4 and 0.8 inches of water.

Air flow rate measurements showed that adjusting coal flow distribution had negligible effect on primary air flow distribution. The relative insensitivity of air flow distribution to flow controller setting greatly simplifies the balancing process. This makes it possible to first balance the dirty air flow using orifices in the outlet pipes and then balance coal flow using the adjustable coal flow balancing system.