BOILER OP USED TO DEVELOP CLOSED-LOOP ON-LINE COMBUSTION CONTROL

Over the last several years, Lehigh University’s Energy Research Center and the Potomac Electric Power Company have been developing intelligent computer software for use by plant personnel in tuning a boiler to achieve optimized combustion. Referred to as Boiler OP, the software is used to guide the plant engineer through a series of parametric boiler tests which gather a database to characterize boiler operations over a wide range of conditions. The software then analyzes the data and identifies optimal boiler operating conditions.

The recommended control settings are typically used to obtain the desired NO\textsubscript{x} levels while achieving the lowest possible unit heat rate. Boiler OP was developed as an off-line advisory system, providing advice to plant engineers and operators, helping them identify the best boiler control settings. However, recent results obtained at PEPCO’s Morgantown and Potomac River Stations show how Boiler OP results can also be used to develop closed-loop on-line combustion control.

There are two 600 MW tangentially-fired boilers at Morgantown station, both of which have low NO\textsubscript{x} burners with both separated and close coupled overfire air. Following the low NO\textsubscript{x} burner conversions in 1994 and 1995, parametric tests were conducted using the Boiler OP approach to determine the optimal boiler control settings. These tests were carried out over the load range and provided the data needed to specify key parameters such as overfire air damper setting, economizer O\textsubscript{2} level and burner tilt angle as functions of load. The control systems for the units were then configured to permit automatic operation at these optimized settings. Despite the fact that the boilers met the NO\textsubscript{x} and heat rate objectives most of the time, it was found there were periods during which NO\textsubscript{x} deviated from the target level. These deviations occurred because of fluctuations in coal quality, variations in furnace cleanliness, and changes in equipment condition, which in some cases caused the NO\textsubscript{x} to be higher than desired, and in other cases to be lower.

Data published in the literature show NO\textsubscript{x} depends on coal composition, varying with volatile content, amount of fixed carbon and the nitrogen content of the coal. Analysis of coal quality data from PEPCO suppliers showed the expected variations in coal composition are large enough to cause significant variations in NO\textsubscript{x}.

Furnace cleanliness also affects NO\textsubscript{x} emissions. As slag accumulates on the waterwalls, the flame temperature increases and this results in increased NO\textsubscript{x}. Soot-blowing tests carried out at Morgantown Unit 2 showed changes in NO\textsubscript{x} emissions ranged up to 0.06
Average daily deviations from the target NO\textsubscript{x} were reduced from 6.4 percent to 1.2 percent at Morgantown Unit 2 through use of a combustion control logic developed from Boiler OP predictions.