Comprehensive Boiler Optimization

The boiler is the heart of steam turbine-driven electricity production and home to complex process interactions. Combustion quality, fuel and air mixing, gas and steam temperatures, fouling and tube erosion, and emissions control are just a few of the interrelated variables that must be continually managed for successful boiler operations. Fluctuating constraints and changing objectives add to the complexity.

A total Boiler Optimization solution maximizes boiler performance and manages tradeoffs so that sub-processes are in sync instead of working at cross purposes. That's why CombustionOpt® and SootOpt® are integrated to form a complete Boiler Optimization package that helps identify and manage interactions between boiler processes and align combustion control and sootblowing operations with a plant's overall objectives.

A Global Approach

Independently optimizing combustion and sootblowing processes delivers value, but can leave operational and economic benefits on the table. For example, boiler cleanliness significantly impacts combustion processes, and combustion stoichiometry and temperatures affect ash build-up, fouling, and slag formation. Boiler Optimization addresses these complex interactions to consistently achieve the best boiler performance under changing operating conditions.

Integrated Technology for Superior Results

CombustionOpt and SootOpt are built on NeuCo's ProcessLink® technology platform, which contains process modeling, optimization and analysis tools along with a reusable set of components that are shared across all NeuCo products. ProcessLink coordinates operating processes and puts them into a common context. By integrating disparate data sources and knowledge, ProcessLink enables CombustionOpt and SootOpt to share an understanding of process characteristics, make performance comparisons and tradeoffs, and align combustion and sootblowing actions towards achieving production objectives.

For instance, CombustionOpt can use SootOpt's knowledge about the boiler's heat transfer profile and then bias boiler fuel and air distribution to achieve the best NO_x and boiler efficiency. SootOpt can use CombustionOpt's understanding of the effect that boiler control can have on FEGT and differential pressures to distinguish between real fouling and slagging versus changes from fuel and air control settings. When varying coal sulfur content and other fuel properties lower ash fusion temperature, CombustionOpt can tradeoff NO_x and heat rate for lower exit gas temperatures, avoiding ash fusion, clinker build-up and plugging. This helps ensure that combustion control settings, combined with variable fuel chemistry, do not conspire to overwhelm the plant's sootblowing hardware capabilities.

Total Boiler Optimization Benefits

- Reduce NO_x by 10-25%
- Improve heat rate by 0.3-1.5%
- Improve reliability by reducing risk of fouling, slagging, tube erosion and plugging
- Control CO, CO_2 and GHG emissions
- Avoid opacity excursions
- Reduce ammonia consumption by 10-20% when an SCR system is in place
- Manage interactions between boiler processes
- Make tradeoff decisions that are truly optimal
- Roll-up multiple information sources to paint a broad picture of boiler operations
- Change optimizer instructions with a few mouse clicks as objectives or constraints change

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The Optimization Standard™

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Boiler Optimization in Action

Figure 1: High Model Fidelity with Combined CombustionOpt and SootOpt Inputs. Variables representing the fuel and air biases and those representing the heat transfer characteristics of the boiler were combined into one model that was shared by SootOpt and CombustionOpt.

The top screen shows a NO_x model that includes both CombustionOpt and SootOpt variables as inputs. The trend displays actual NO_x in green and model-predicted NO_x in blue. The fidelity of this model is higher than the model using only CombustionOpt biases (bottom screen). The better a model's ability to accurately predict, the better it will perform.

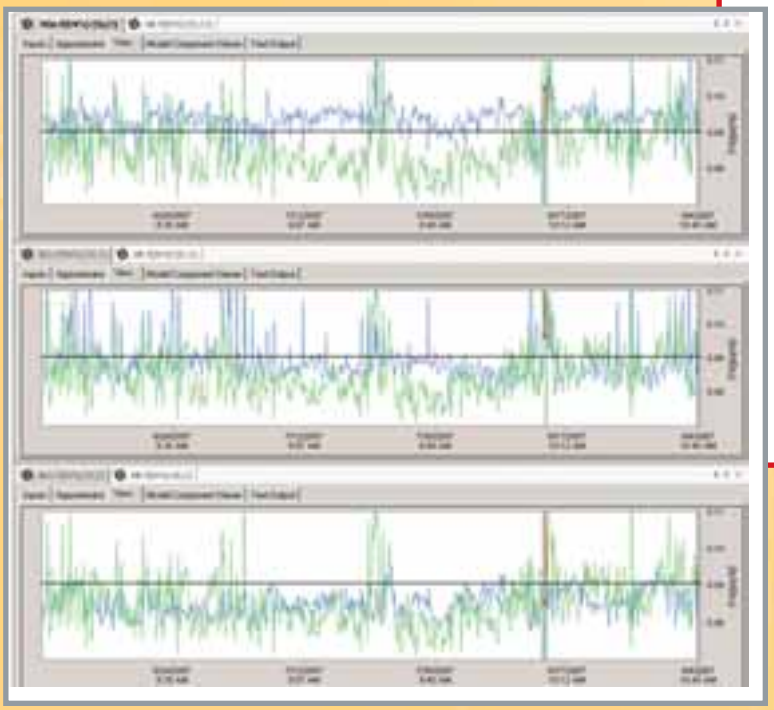

Figure 2: Model-predicted NO_x without optimization, with CombustionOpt, and with total Boiler Optimization. At top, the blue trend shows the NO_x production scenario without optimization (given actual generation, ambient and fuel conditions). In the middle, the blue trend indicates the same NO_x production scenario with only CombustionOpt. At bottom, the blue trend shows expected NO_x production with integrated Boiler Optimization

The actual NO_x production trend (in green) is most closely matched by the integrated optimization scenario. This is because both CombustionOpt and SootOpt were working together over most of the period analyzed.

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