Ovation™ Advanced Power Applications Combustion Optimization

Features

- Dynamically optimizes boiler operation, resulting in heat rate improvements of up to 0.5% to 1.5%
- Dynamically process optimization throughout full operating range – does not rely on steady state optimization
- Directly integrates optimal control setpoints and biases into the control system for closed loop integration
- Improves NOx control levels, with or without low NOx burners, up to 35% while maintaining or improving boiler efficiency
- Supports the ability to earn NOx credits
- Considers opacity limits in optimization goals, delivering the ability to meet EPA regulations.
- Improves steam temperature balance and stability

Benefits

- Reduces fuel consumption by $275,000[1]
- Generates NOx credits up to $292,000 for a 5-month season and up to $700,000 annually[1]

[1]These benefits are based on case studies and target the industry average for a 500MW plant, 10,000 BTU/kwh, 84% capacity factor, $1.50/mmBTU, current NOx of .220 lb/mmBTU, and an Ovation benefit of a .5% heat rate and 7.0% NOx reduction.

Introduction

Deregulation of the U.S. electric utility industry and stranded cost issues have rendered a highly dynamic and competitive power market. Increases in fuel costs, power demands and emissions control regulations as well as the need for reduced power generation costs are impacting the economic climate of the power generation industry. In addition, the EPA Clean Air Interstate Rule (CAIR) required further reductions in NOx and SO2 emissions.

These economic circumstances are forcing the electric utility industry to take sophisticated steps in effort to improve unit heat rates. According to EPRI, the ability to improve heat rate on a utility steam generator by 1.0% at a coal fired 500 MW unit, can result in cost savings amounting to $800,000 per year. As a result, power producers have made optimizing energy usage within the production process a targeted goal.

Goals

- Optimize heat rate
- Reduce CO_2 emissions
- Reduce NOx emissions
- Manage trade-off between excess air flow (O_2) and boiler efficiency
- Minimize amount of excess air
- Maintain compliance with opacity, NOx, CO and SO_2 emissions regulations
- Improve ability to load follow
- Extend plant equipment lifecycles
- Reduce plant maintenance requirements

Challenges

- Managing economic tradeoffs to determine the most profitable operating conditions at any given time
- Maintaining the optimal breakpoint between boiler efficiency and EPA emissions compliance
- Minimizing costly heat transfer degradation associated with boiler sections.
- Determining effective firing strategies for optimal combustion.
- Maintaining optimal combustion while using a staged combustion process
- Determining optimal fuel-to-air ratio to manage the tradeoff between boiler efficiency and emissions levels
- Identifying factors associated with the formation of NOx
- Balancing variations in fuel quality and fuel supply
- Tracking boiler mechanical equipment status

Solution

Emerson's combustion optimization solution, an Ovation advanced power application, increases boiler efficiency while maintaining emissions, loss on ignition (LOI), and several other cost-impacting factors. Designed for open- or closed-loop use with any size boiler of any firing type, it achieves and maintains maximum efficiency in the balances of boiler processes.

The solution uses a model-based approach to provide advanced control capabilities unattainable by traditional control systems.

The plant model utilizes both linear and non-linear (a new multi-regional model matrix) structures to provide the most stable and accurate solution for power generation, a highly interrelated and complex process.

This solution supports optimization of many plant variables simultaneously, including those that are indirectly related such as NOx, opacity, and boiler efficiency.

By considering current plant operating constraints and varying economic factors, the solution provides optimal results over a full range of process characteristics.

Unlike other optimization products on the market, Ovation combustion optimization has the ability to dynamically optimize the process at all times, even while the plant is moving through load ranges.

This feature produces significant advantages over steady state packages, executable only when boiler load is stable. With both economic and path optimization functions, the application's dynamic optimization is both possible and desirable.

As optimal plant settings, bias signals, and setpoint adjustments are generated, they can be used in advisory mode, or they can be transferred directly to the distributed control system for automatic on-line process optimization.

When implemented in advisory mode, a display will indicate recommended optimized plant setpoints and bias signals. If the package is integrated in closed loop mode, new advisory setpoints are automatically distributed to the control system.

The result is a balanced, optimal fuel-to-air ratio, where heat rate is maximized, without compromising efficient plant performance.

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Components

Ovation combustion optimization solutions are comprised of the following components:

- **Workstation** – hardware platform with Red Had Linux 7.x operating system connected to the control system for software development and module execution
- **Ovation model builder software** - tools used to develop the plant model
- **Combustion optimization DMPC software** - executable application for on-line plant modeling and optimization
- **Operator interface** – enables selection of the optimization solution for combustion control

Operation

The combustion optimization application executes in standard Ovation controllers equipped with additional memory or advanced controller licenses.

Graphic displays are used to control the execution of the optimization solution. The displays are used to perform the following functions:

- View permissives
- Enable or disable combustion optimization application based on displayed permissives
- Tune optimization parameters.
- Compare optimization-recommended setpoints and bias signals against DCS-recommended setpoints

Project Execution

Emerson's implementation strategy for Ovation advanced power applications, including combustion optimization, centers on a proven methodology. A typical installation involves the following project implementation steps executed by our project team:

- Project kick off
- Installation of algorithms and controller licenses
- Project start
- Development of plant integration plan
- Execution of plant integration plan
- Data collection and conditioning
- Solution design and validation
- Installation of solution
- Advisory mode operation
- Closed loop mode operation
- Document / benchmark benefits and training activities

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