EvenFlow™ Coal Flow Control System

Steve Ullom
Product Development Engineer
Air/Fuel Distribution

- B&W recognizes the importance of air/fuel distribution
  - Good distribution key to good performance
  - Dynamic control needed to maintain performance over operating range
- B&W has conducted air/fuel distribution R&D for decades
  - Lab-scale flow loops
  - CFD modeling
  - Field testing
- B&W has also monitored available technologies
  - Coal distribution control (adjustable orifices)
  - Coal flow measuring (microwave devices)
EvenFlow™ Coal Flow Control Technology

- Extends patented Lehigh University technology for non-pressurized mills
- Incorporates B&W’s R&D experience and design expertise
- B&W sponsored R&D at Lehigh University
  - CFD modeling to down-select designs
  - Laboratory-scale testing to confirm performance
- Lehigh testing revealed:
  - Coal distribution controlled with minimal impact on PA distribution
  - Performance impacted by location and design of control devices
Lehigh Research – Traditional Orifices

Traditional orifices have a disproportionate impact on primary air flow

Proprietary and Confidential
EvenFlow™ Installation
EvenFlow™ Test Results
EvenFlow™ Test Results

Direction of flow helix

Graph showing deviation against FCE angle with high and low limits.
Full Load Test Results

Baseline CO = 150 ppm
Improved CO = 30 ppm

Deviation (%) vs Pipe Number

Baseline Distribution
Improved Distribution
Part Load Balancing Results
EvenFlow’s Benefits

- Unique design adjusts coal with minimal impact on air
- Factory assembled – quick installation
- Wear resistant materials – low maintenance
- Lower, more consistent emissions performance
  - Lower CO
  - Lower NOx
  - Lower Excess O2
  - Lower, consistent LOI
- Reduced slagging and fouling due to poor combustion
Combustion Diagnostics
How Flame Doctor Measures Combustion

Existing flame scanner
- Optical device
- Converts flame flicker into electrical fluctuations
- Used for On/Off detection

Primary air and pulverized coal
Secondary air

Ignition front

Fuel lean
UBC NOx CO NOx Fuel rich UBC CO

Large-scale circulation
Scanner Signals Reflect Combustion State

- **Stable Flame**
- **Slight Instability**
- **More Severe Instability**
- **Very Severe Instability**

-Time

Normaled Scanner Signal

- Fast spikes
- Signal dropout
- Slow oscillations
Flame Doctor Software

• Flame Doctor Results
  ‣ Burners
    ‣ Absolute ratings (0-100)
    ‣ Flame type identification
    ‣ Operator guidance
    ‣ Air/fuel index
    ‣ CO/NO_x potential
  ‣ Mills
    ‣ Absolute ratings (0-100)
    ‣ Relative rankings
    ‣ Lean/rich alarming
    ‣ Line-to-line balance

• Availability
  ‣ Sent to DCS
  ‣ Sent to optimization system
Unique Approach to Optimization

- Open system
  - Not a “Black Box”
  - Users may view and edit optimization strategies
- Supports multiple optimization approaches
  - Does not “force fit” a single solution
  - Strategy tailored to specific application
- Flexible, expandable system
  - Capable of optimizing multiple processes
  - No additional software cost
- Cost-effective solution
  - Low initial price
  - Low annual maintenance fees
- Developed by boiler OEM
  - Built upon B&W’s 140+ years of experience
  - Ongoing support from combustion experts
Optimization With FocalPoint

• FocalPoint provides suite of tools to develop optimization strategies

• Optimization strategies created using Calculation Editor
  • Function block approach
  • Intuitive drag-and-drop interface
  • Simple flow chart layout
  • Wide array of algorithms, models, calculations and logic functions

• Strategies can be implemented or modified online
Closed Loop Stoichiometry Control

Automatic control based on FocalPoint analysis and logic

Feedback from Flame Doctor combustion analysis and/or real time coal flow measurement

Control strategy developed from demonstration testing
Questions?