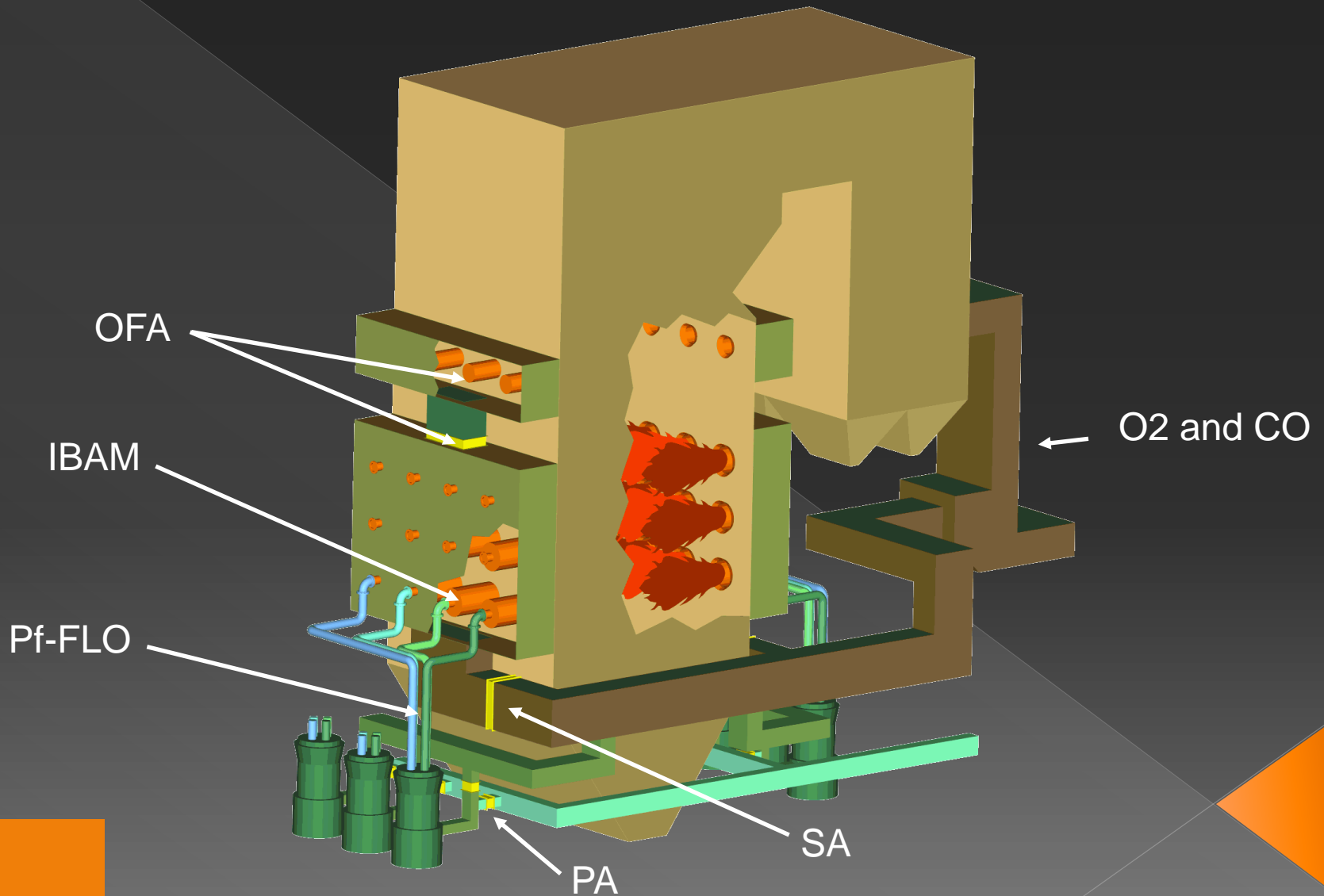


Instrumentation and Controls for Coal Fired Power Plants

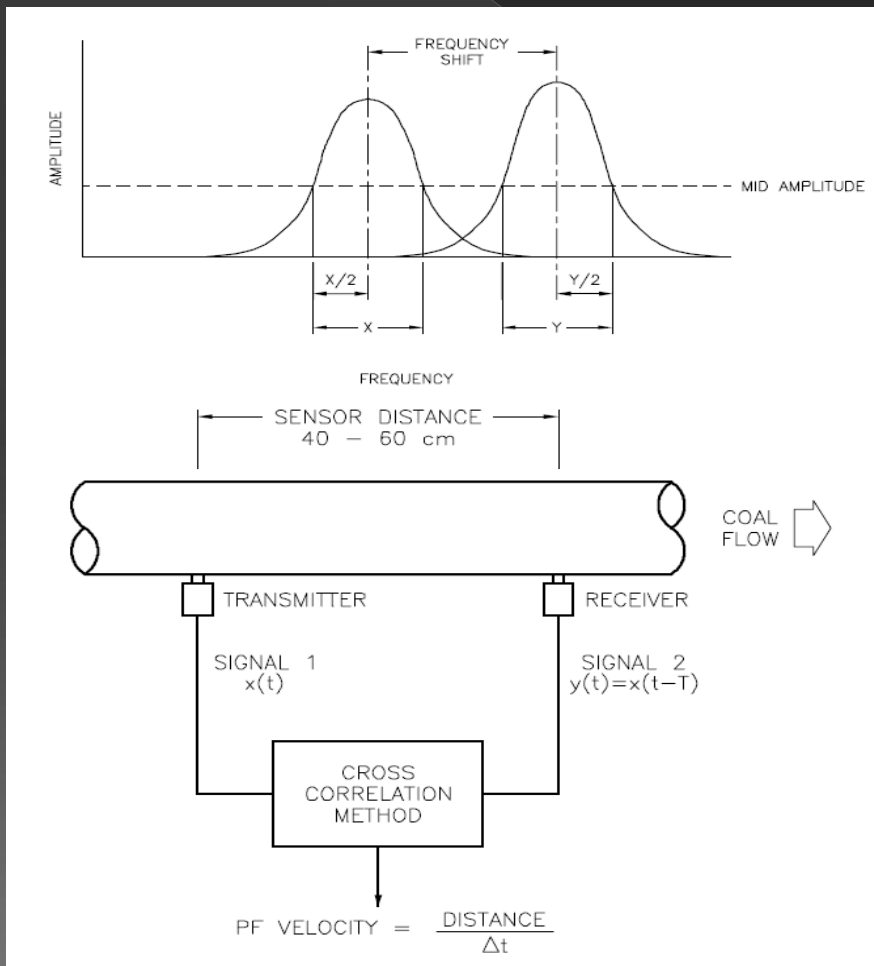
Air & Coal Flow Measurement Systems



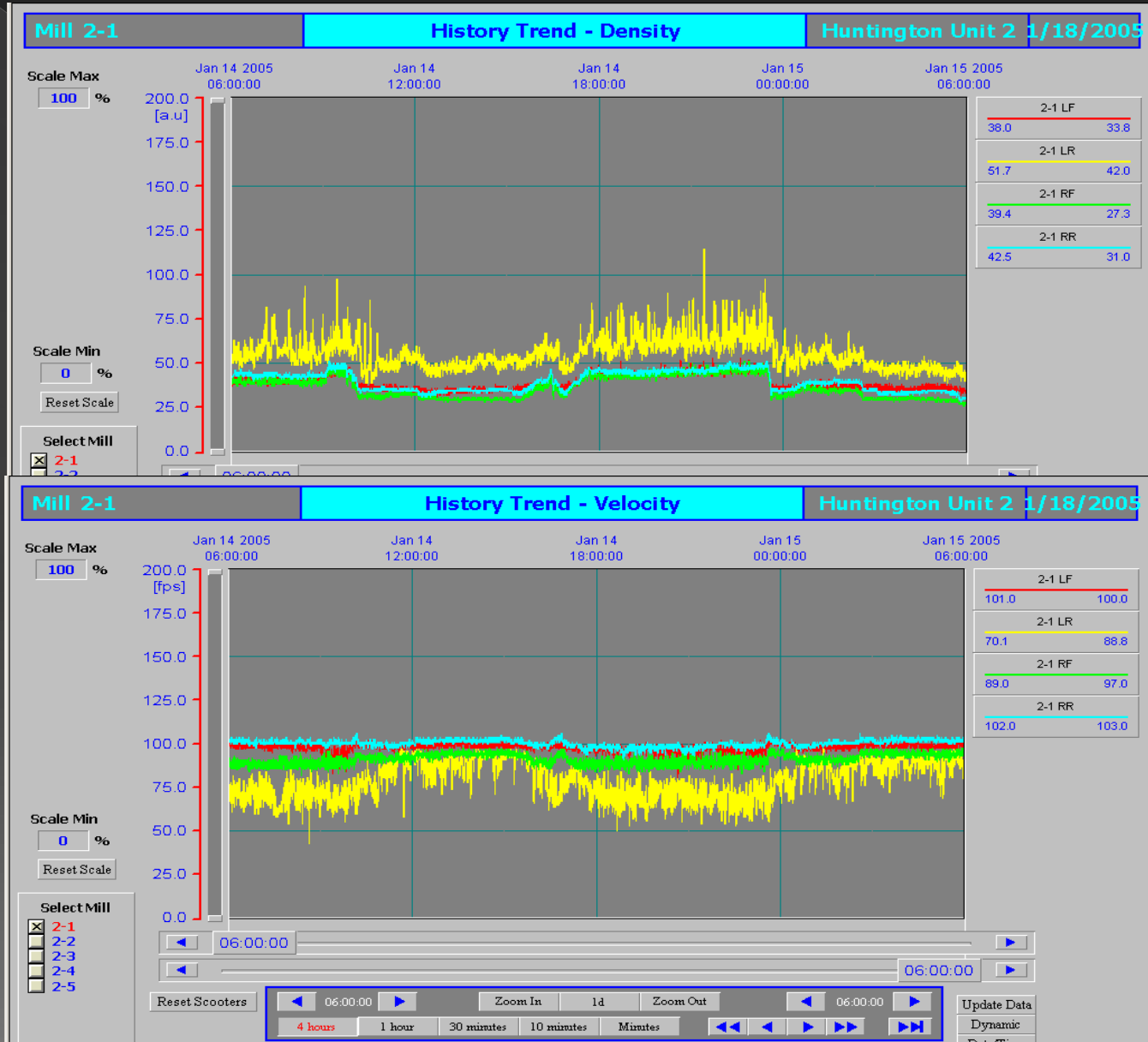
Proven solutions for a tough industry

Coal Flow Measurement

- Microwave mass measurement
- Cross-correlation velocity measurement



Mass (Density) and Velocity



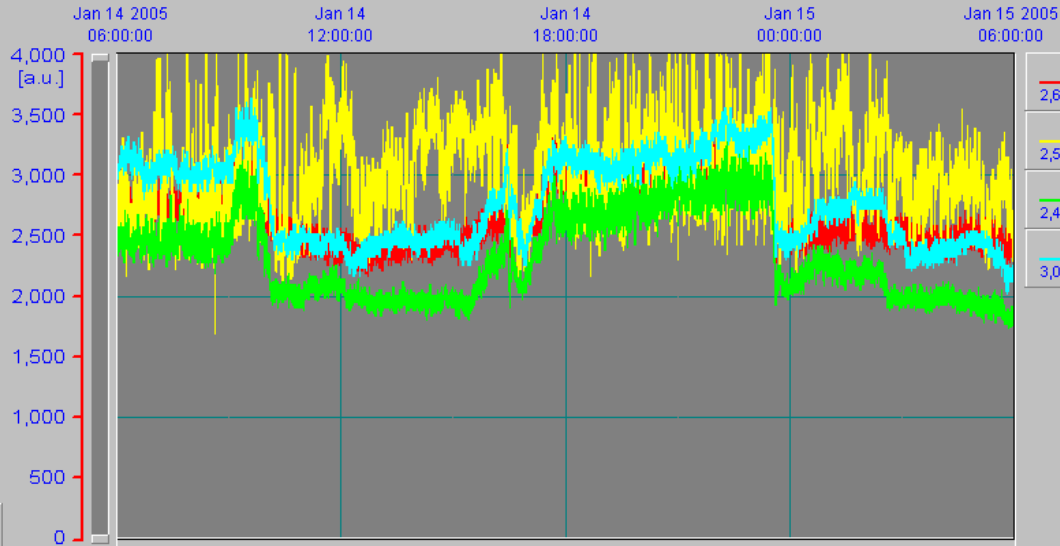
Mill 2-1

History Trend - Mass Flow

Huntington Unit 2 1/18/2005

Scale Max

100 %



2-1 LF	2,689	2,386
2-1 LR	2,531	2,610
2-1 RF	2,447	1,875
2-1 RR	3,048	2,235

Scale Min

0 %

Reset Scale

Select Mill

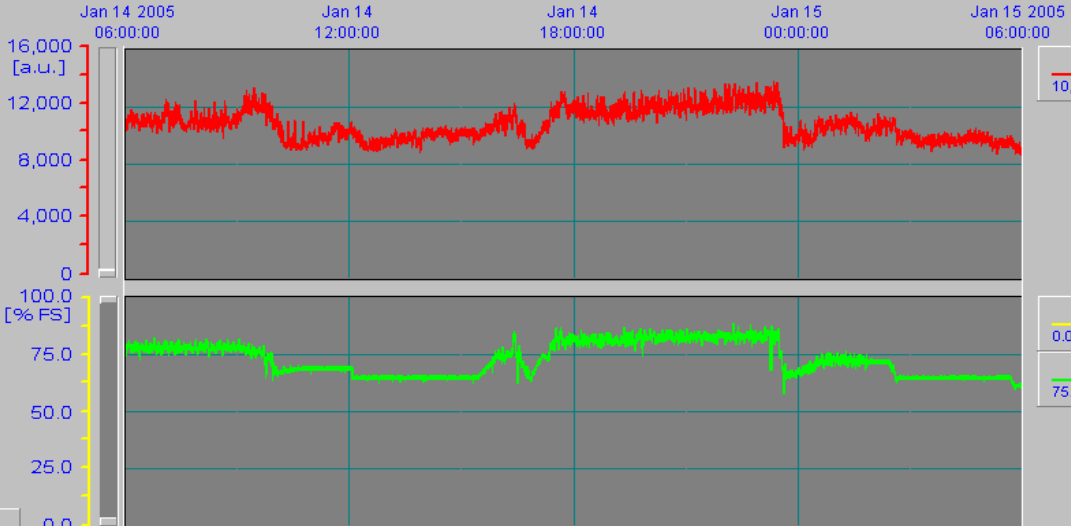
Mill 2-1

History Trend - Total Mass Flow

Huntington Unit 2 1/18/2005

Scale Max

16,000



Total Flow	10,684	9,085
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Primary Air	0.0	0.0
Feeder	75.8	61.6

Scale Min

0

Scale Max

100 %

Scale Min

0 %

Select Mill

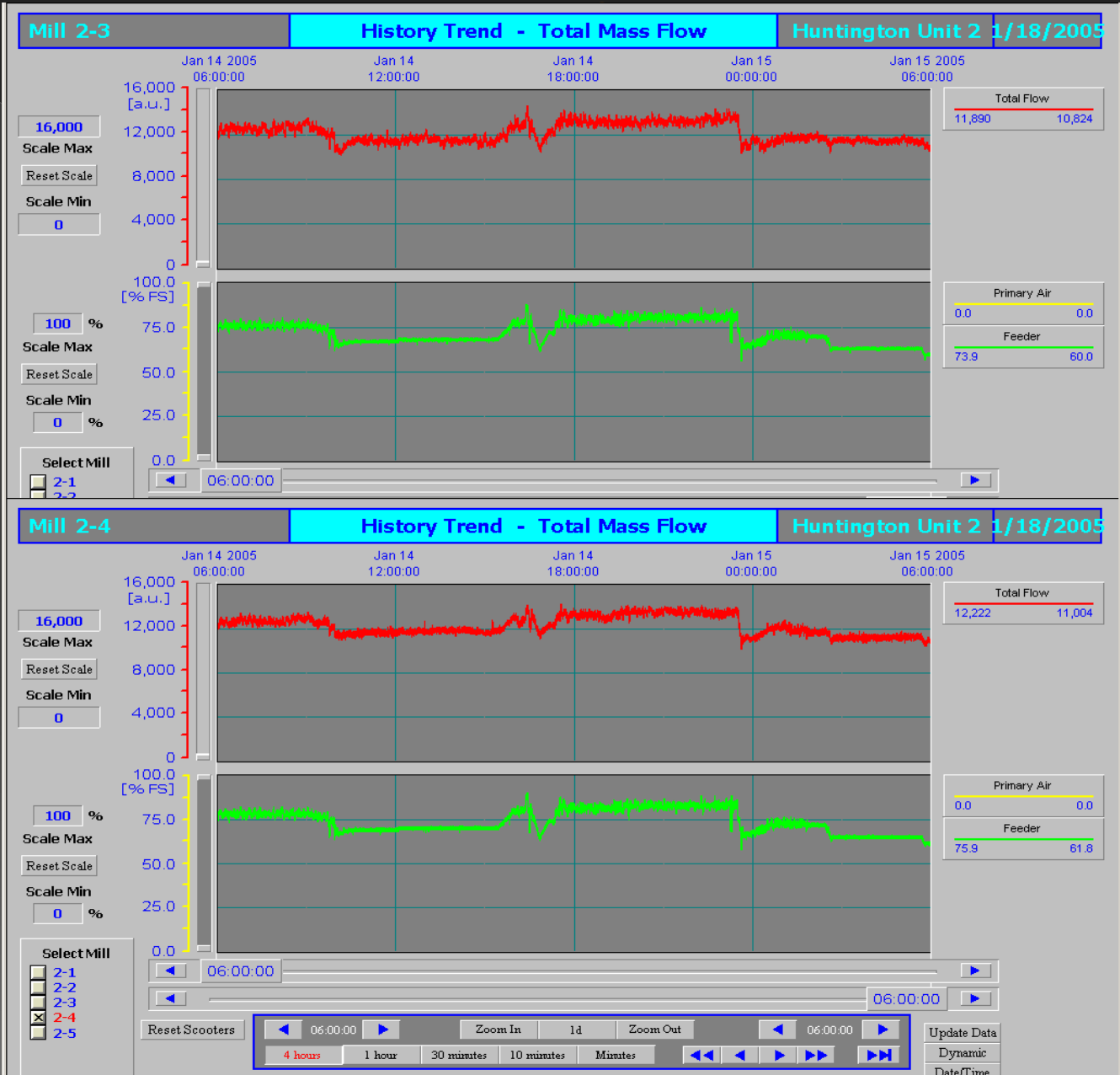
- 2-1
- 2-2
- 2-3
- 2-4
- 2-5

06:00:00 06:00:00

Reset Scooters Zoom In 1d Zoom Out 06:00:00

4 hours 1 hour 30 minutes 10 minutes Minutes

Update Data Dynamic Date/Time

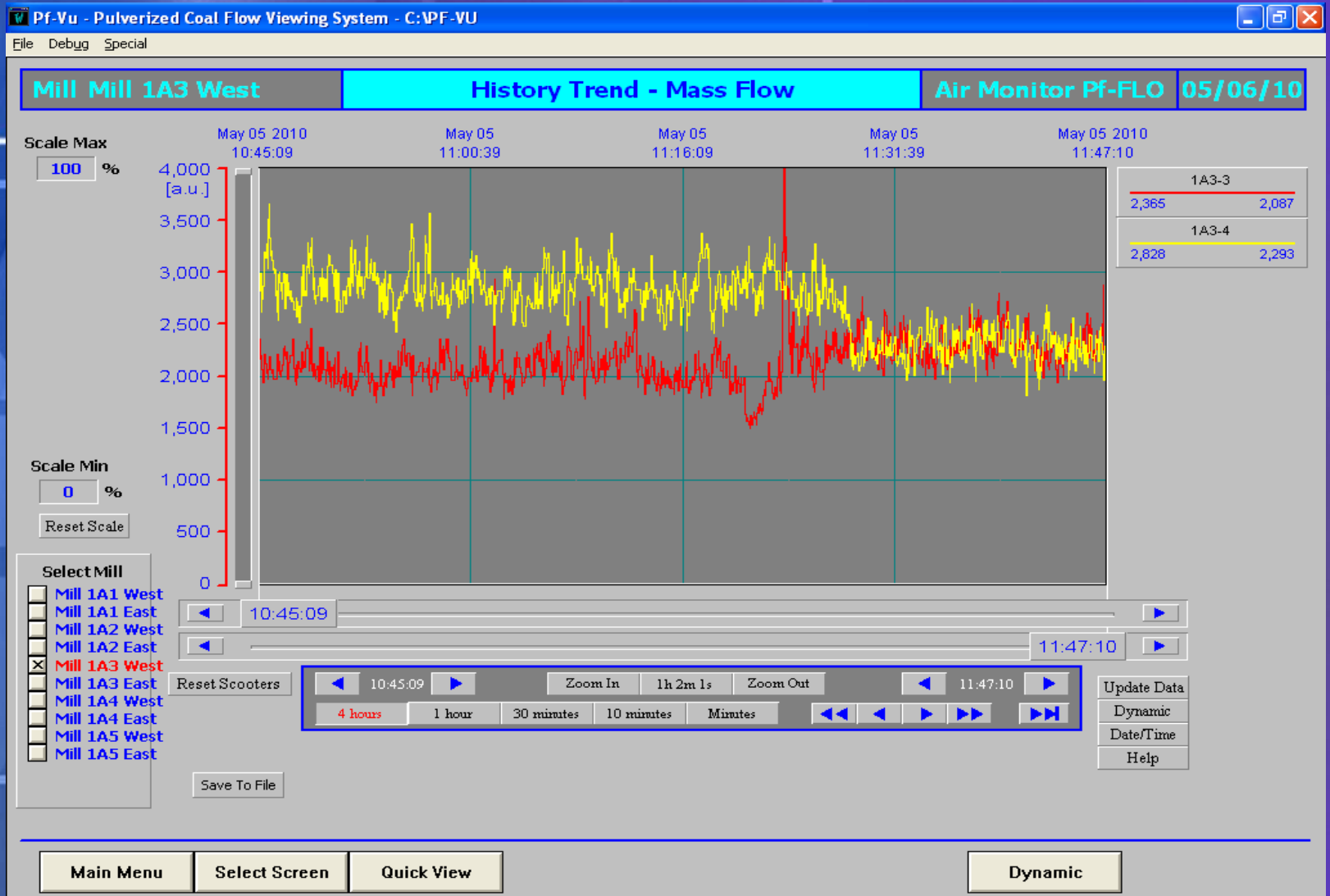


Proven solutions for a tough industry

Coal Pipe Balance - Adjustable Orifice



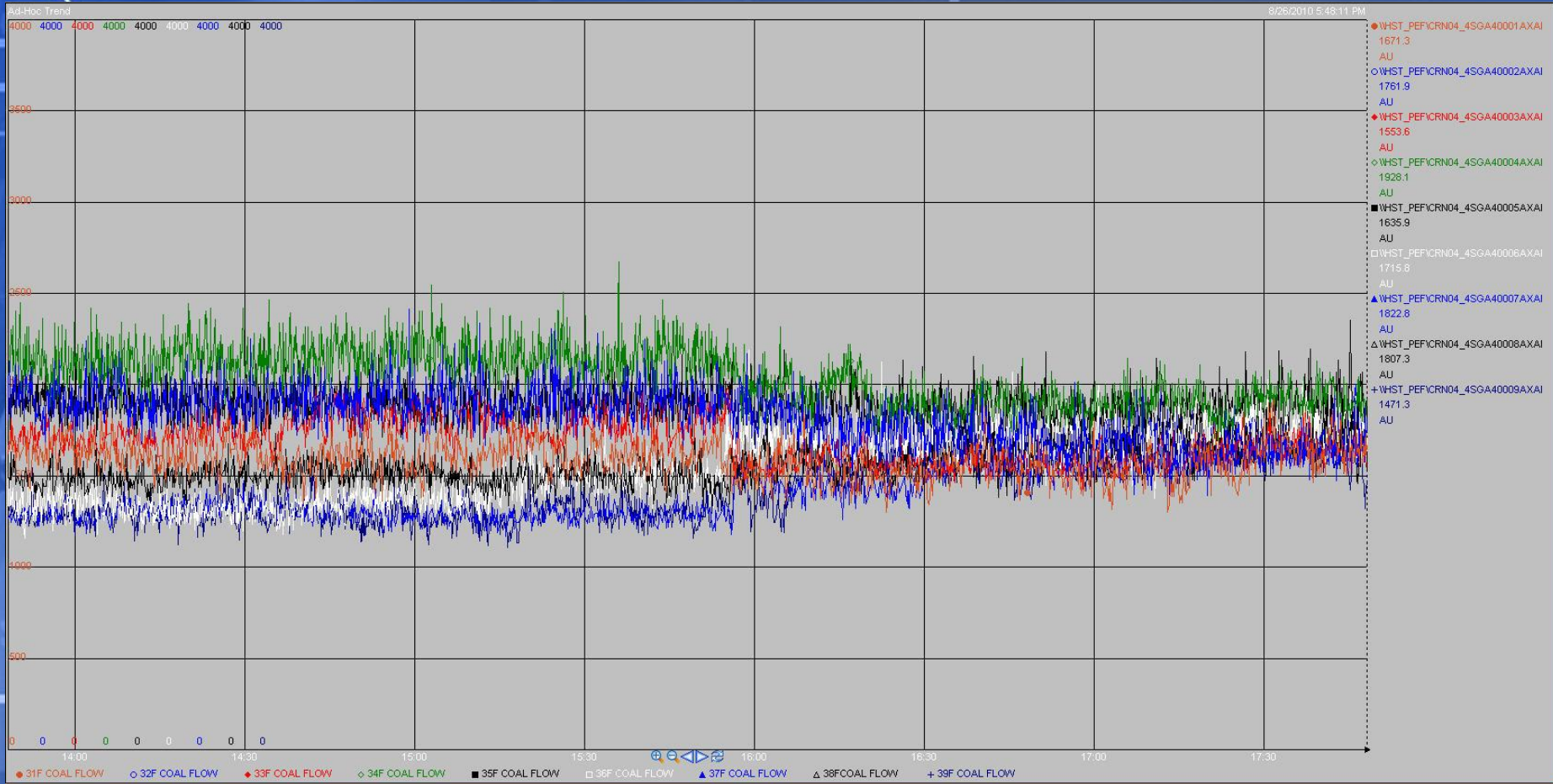
Burner to Burner Balancing



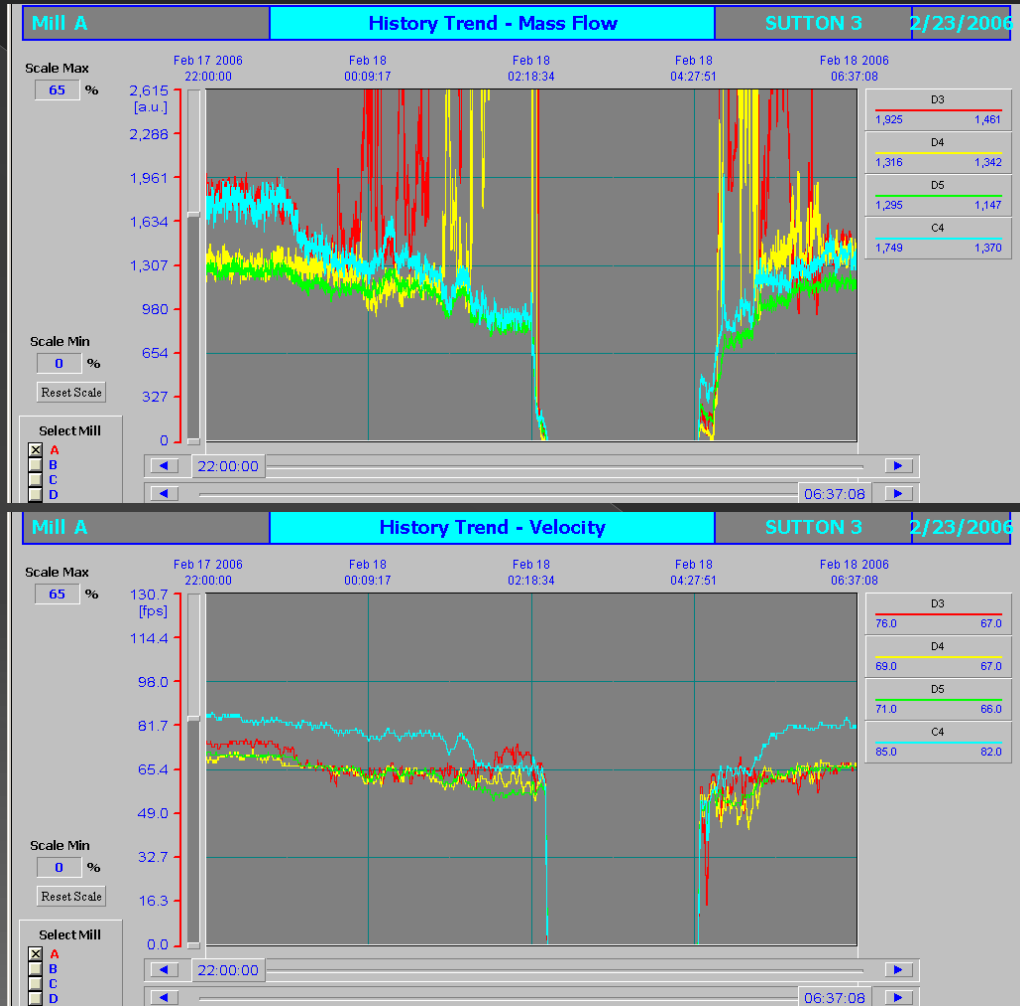
Coal Pipe Balance - Adjustable Orifice



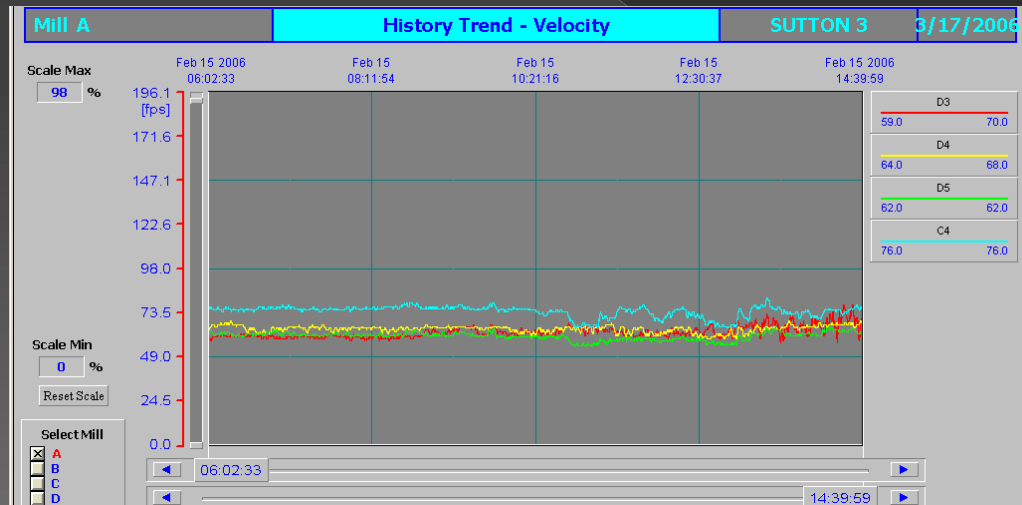
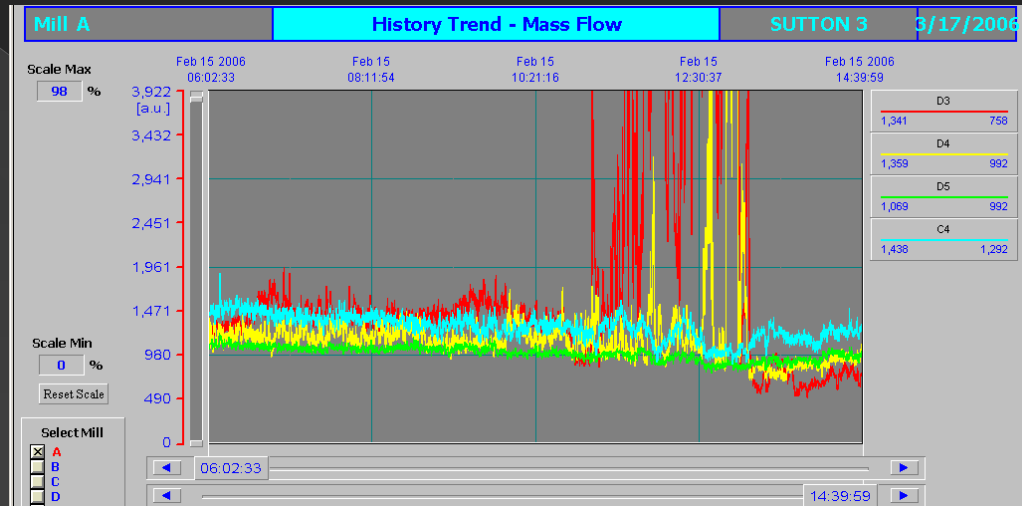
Coal Flow Balancing



Mill Trip Ignoring Low Velocity

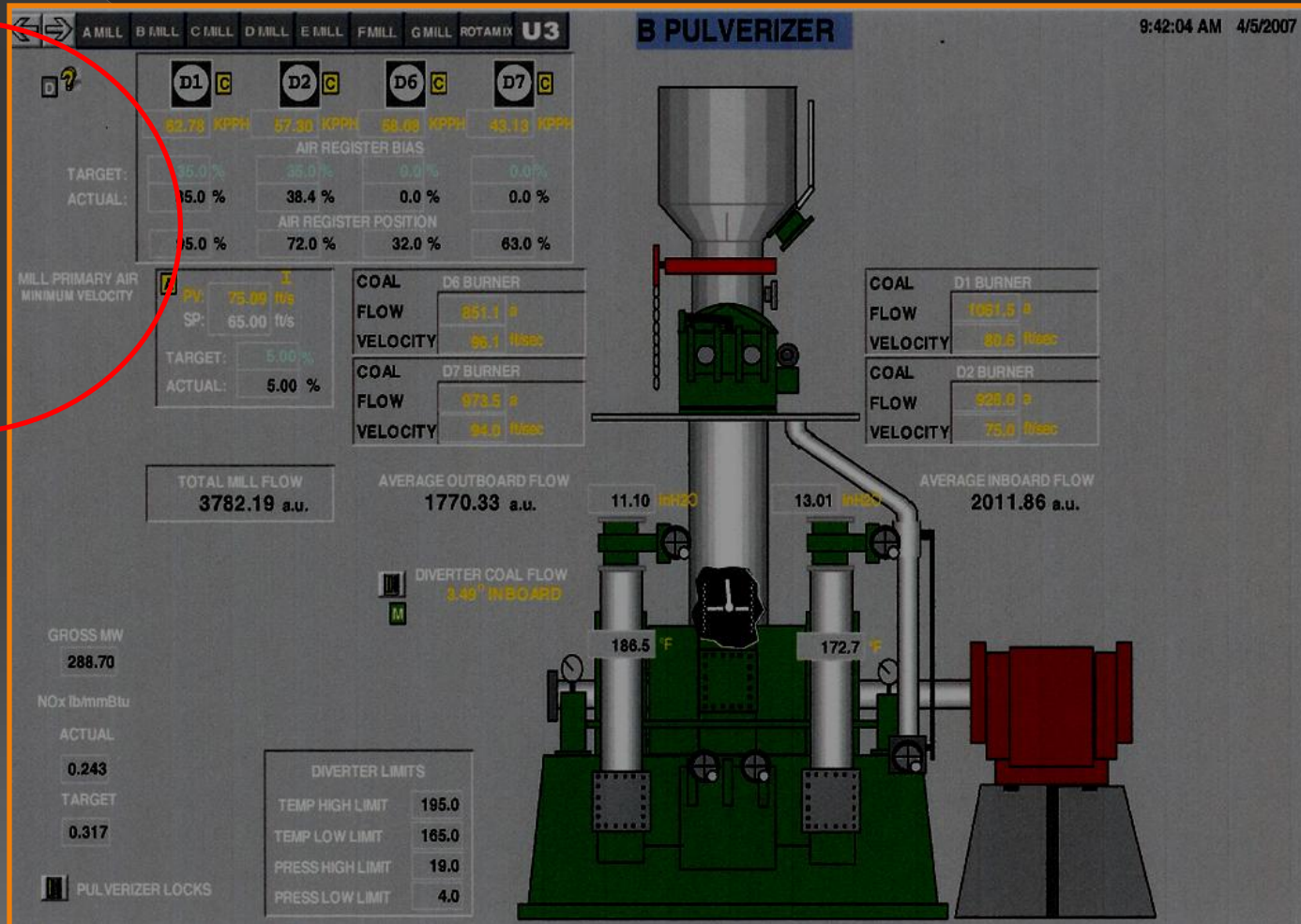


Avoiding Mill Trip with 5% PA Increase

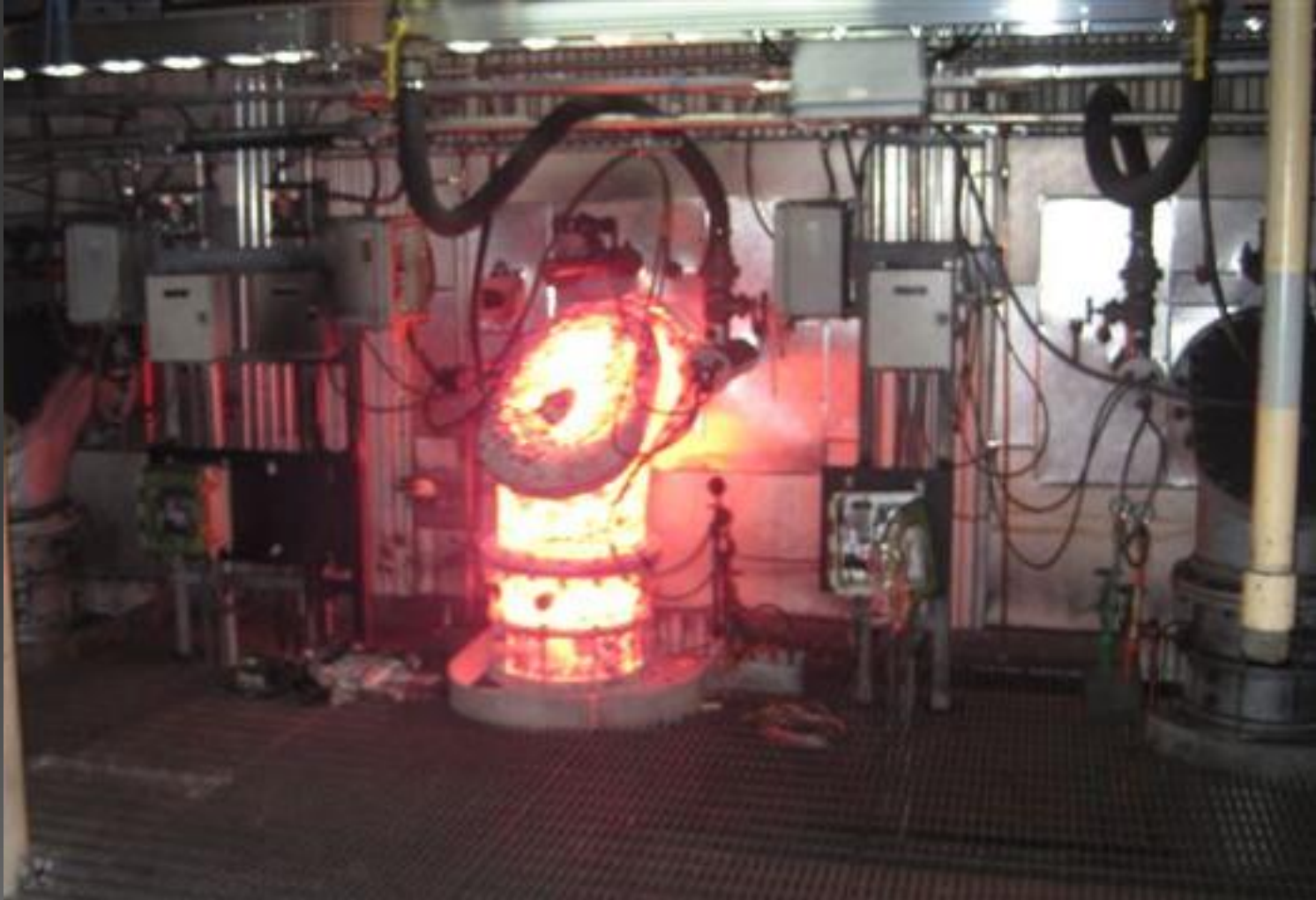


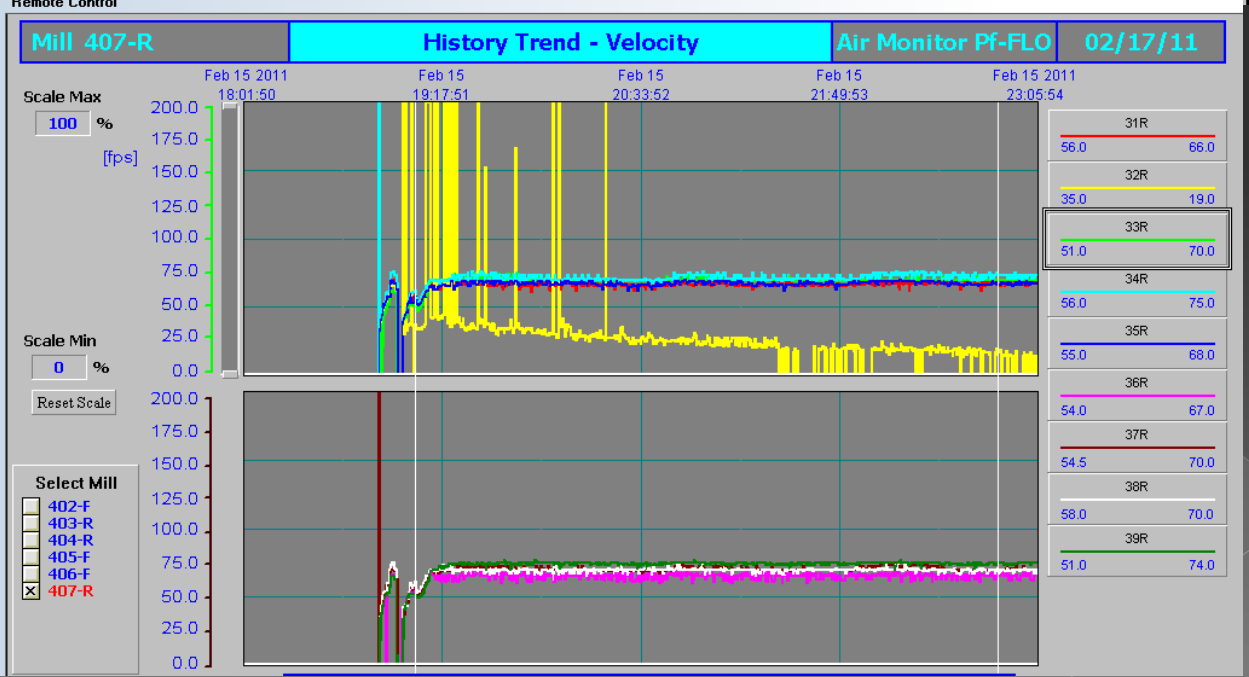
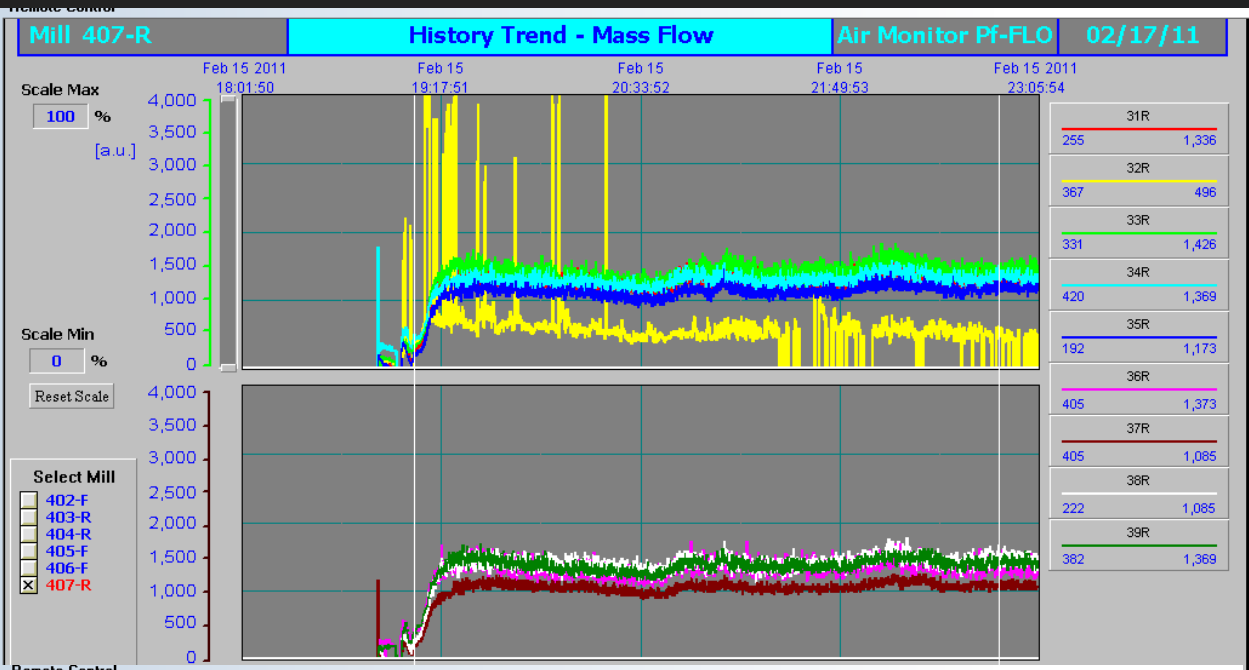
Pulverizer Overview

- Automatic PA “kicker” for lowest pipe velocity limit



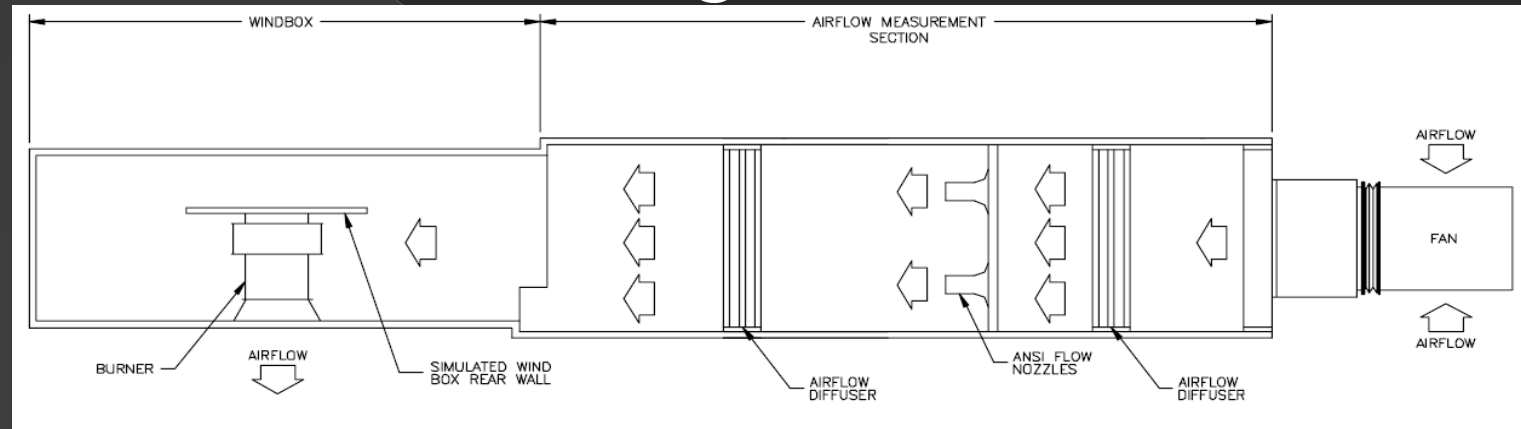
Prevent Burner/Pipe Fires





Secondary Air Measurement

Wind Tunnel Testing at Air Monitor HQ



Equation 2: Inner Vane Position - 15° Open, Outer Vane Position - 55° Open

$$\text{Coefficient} = 0.0000335938 * X^4 - 0.0013321146 * X^3 + 0.0179408814 * X^2 - 0.0886535541 * X + 0.8467944546$$

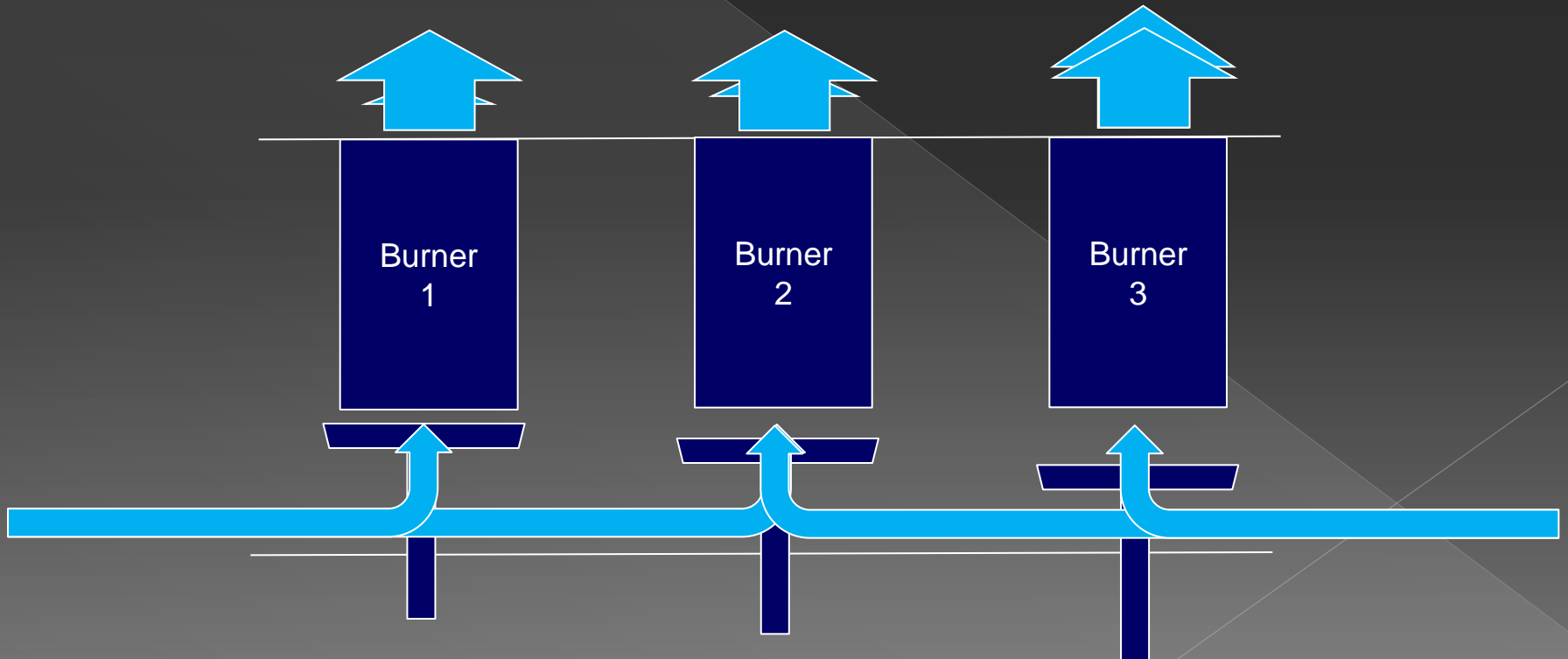
Equation 3: Inner Vane Position - 15° Open, Outer Vane Position - 60° Open

$$\text{Coefficient} = 0.0000718750 * X^4 - 0.0025442917 * X^3 + 0.0314481881 * X^2 - 0.1504645772 * X + 0.9413919352$$



Why Automate SA Dampers?

- Dynamic windbox flow profiles
 - > Fluctuating windbox pressure
 - > Ash build-up



Burner SA Measurement – IBAMs



F/A Screens in Control Room



Proven solutions for a tough industry

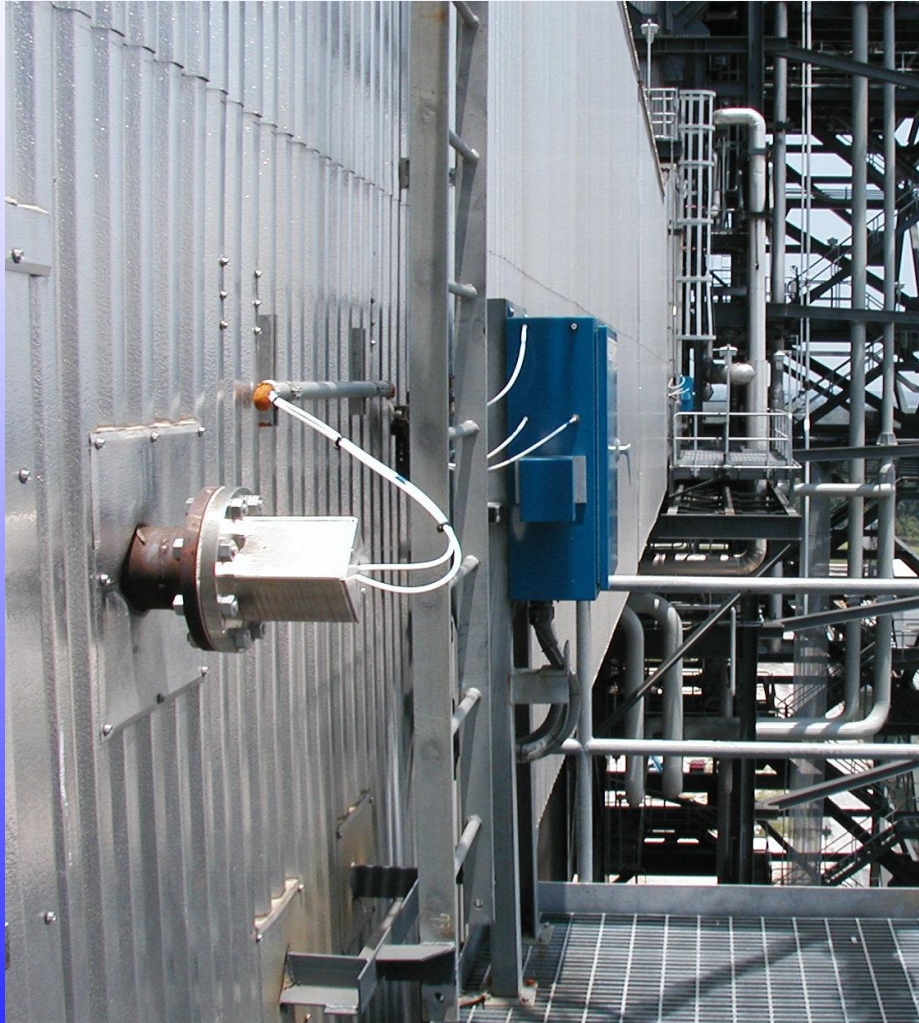
New F/A Screens in Control Room

Username: ADMINISTRATOR 4/7/2008 9:18:29 PM

4/7/2008 9:18:29 PM

CORNER 5		CORNER 8	
TOP AUX AIR REGISTER	0.0 lb/hr	TOP AUX AIR REGISTER	0.0 lb/hr
A FUEL REGISTER	0.0 lb/hr	A FUEL REGISTER	0.0 lb/hr
COAL FLOW	0 A.U.	COAL FLOW	0 A.U.
COAL VELOCITY	0 f/s	COAL VELOCITY	0 f/s
AIR/FUEL RATIO	0.000	AIR/FUEL RATIO	0.000
AB AUX AIR REGISTER	0.0 lb/hr	AB AUX AIR REGISTER	0.0 lb/hr
B FUEL REGISTER	0.0 lb/hr	B FUEL REGISTER	0.0 lb/hr
COAL FLOW	0 A.U.	COAL FLOW	0 A.U.
COAL VELOCITY	0 f/s	COAL VELOCITY	0 f/s
AIR/FUEL RATIO	0.000	AIR/FUEL RATIO	0.000
BC AUX AIR REGISTER	0.0 lb/hr	BC AUX AIR REGISTER	0.0 lb/hr

Why CO ?



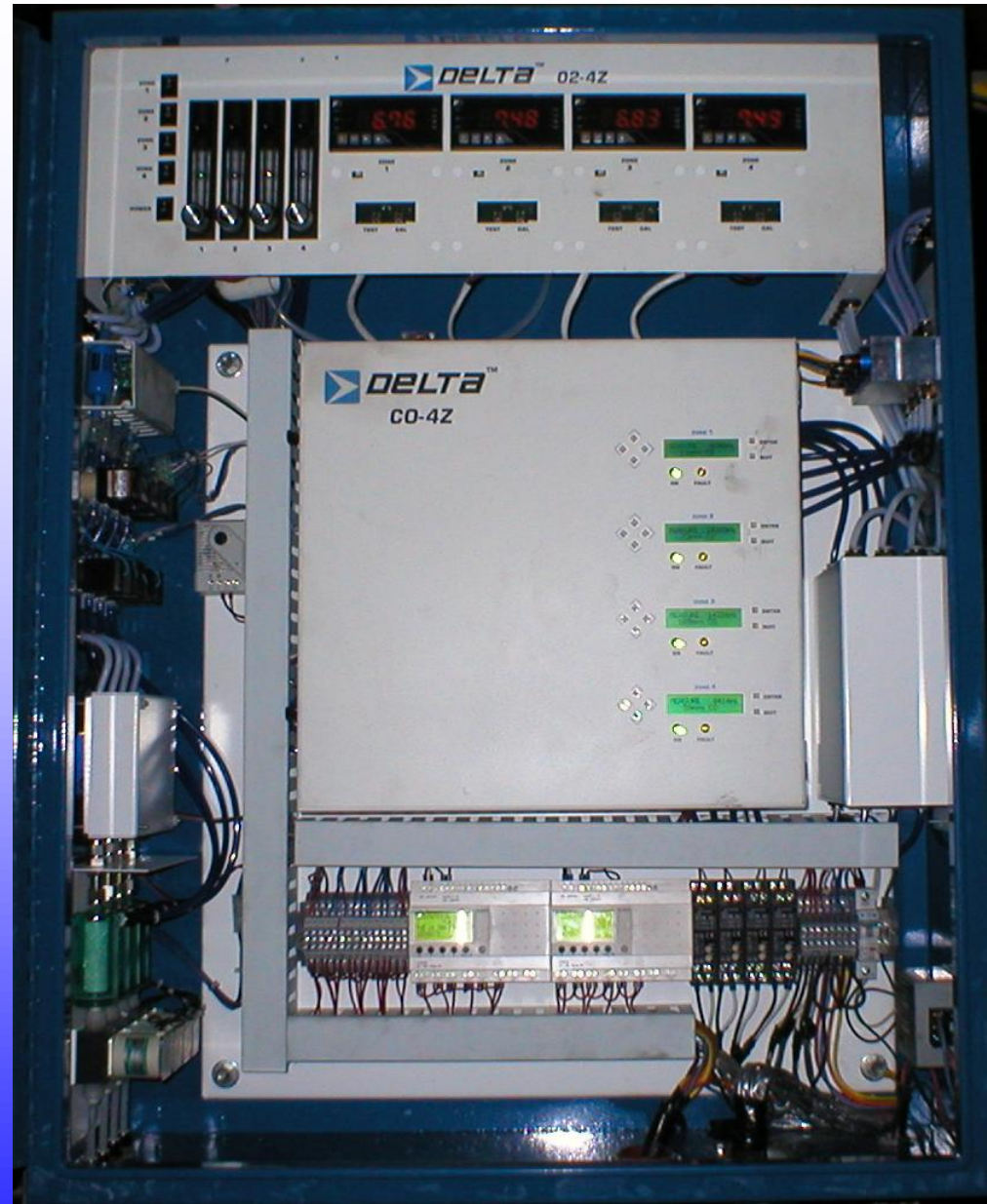
- **O₂ Measurement not reliable – drift and effects of boiler in-leakage.**
- **Reducing excess air leads to NO_x reduction.**
- **To safely reduce excess air, need to measure CO.**
- **Measuring CO can help identify and correct poor combustion.**

Combined CO and O2 Measurement



Multi-Points in Common Enclosure

Extraction Probe with filter system



Recent Project Results (54 burner 770 MW unit)

- **Boiler Efficiency Increase = 0.5%**
 - Annual fuel savings
- **Combustion NOx Reduction**
 - 7% at full load, 15-25% at part load
 - Annual Ammonia Reagent Usage Reduction
 - SCR Catalyst Life Extension
- **Fan Auxiliary Power Savings**
- **LOI Reduction**