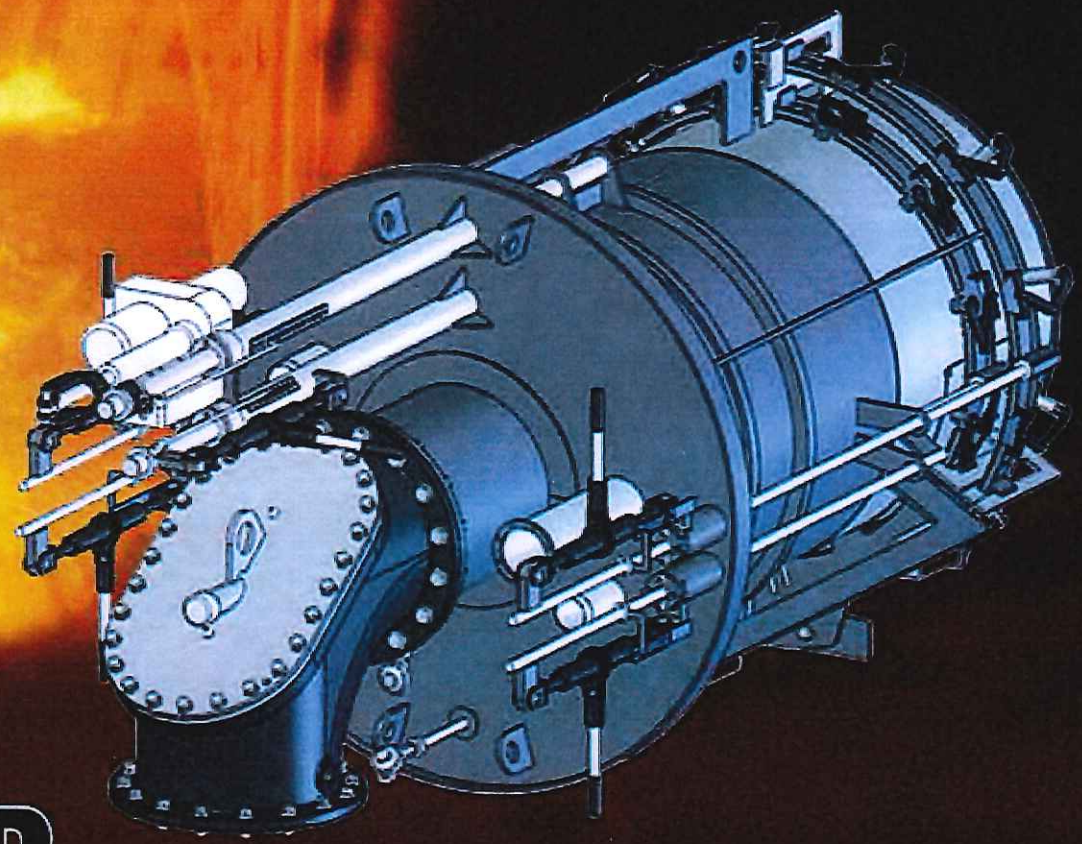
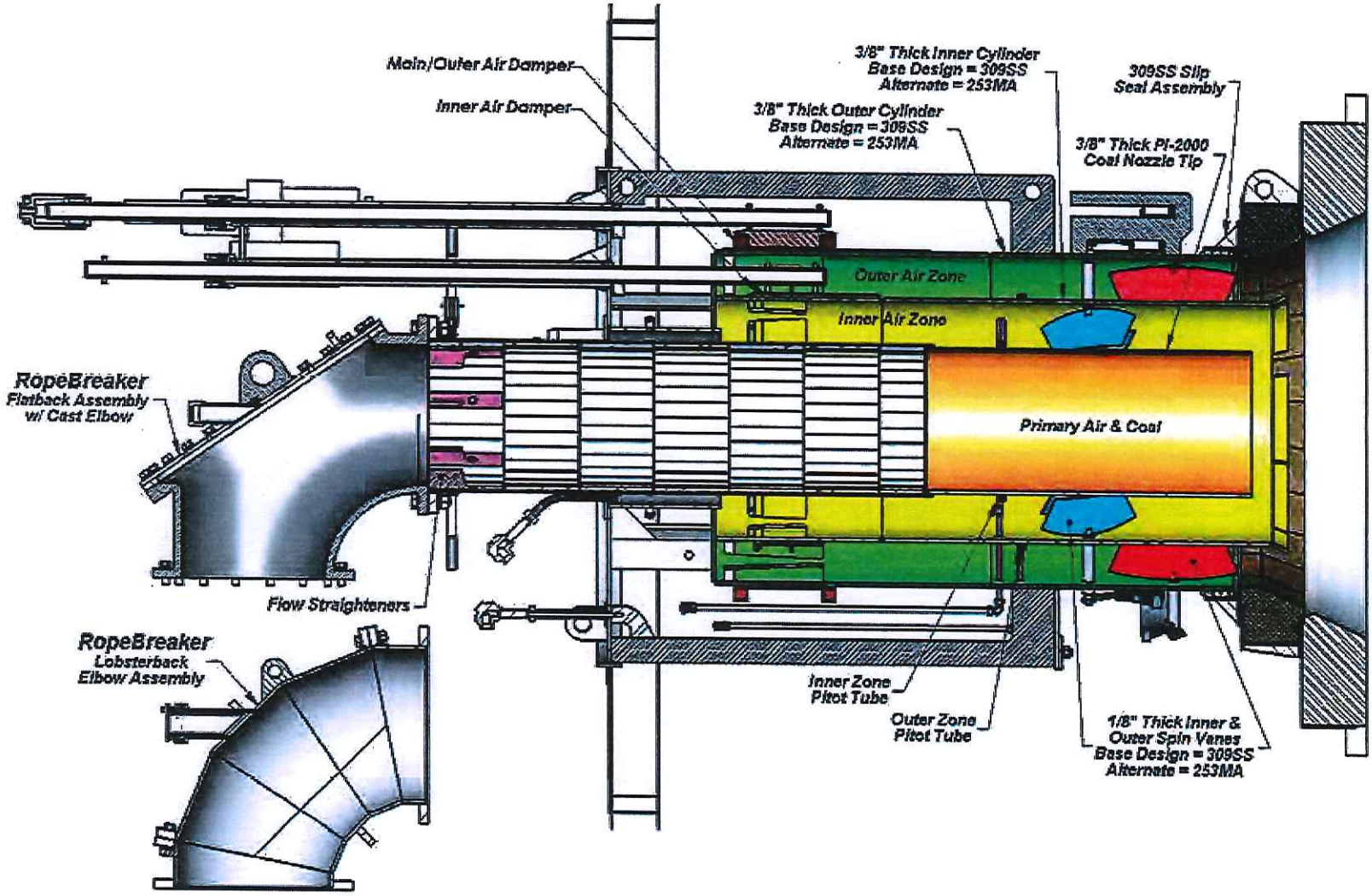
# LOW $NO_x$ BURNER



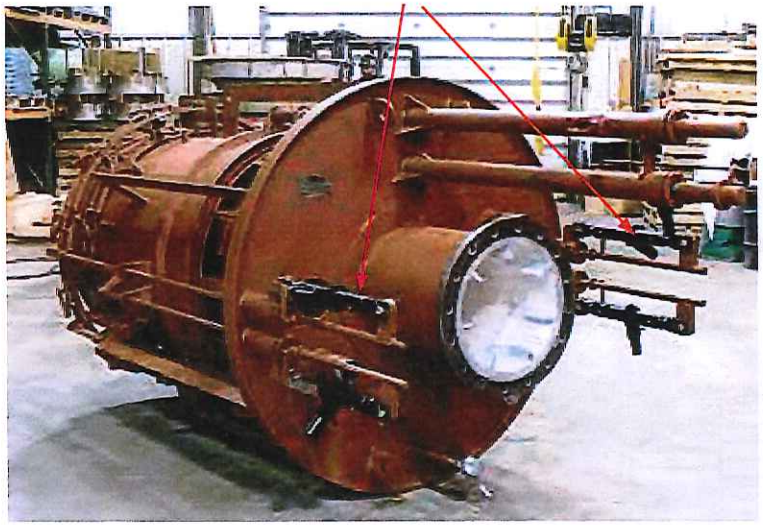
POWER & INDUSTRIAL
SERVICES CORPORATION

# PI-LNB

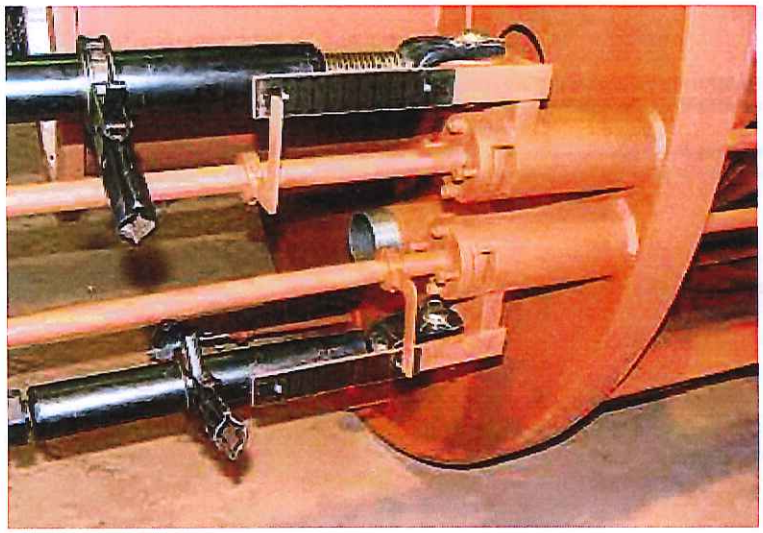

Main/Outer Air Damper
Inner Air Damper
3/8" Thick Inner Cylinder
Base Design = 309SS
Alternate = 253MA
3/8" Thick Outer Cylinder
Base Design = 309SS
Alternate = 253MA
309SS Slip
Seal Assembly
3/8" Thick PI-2000
Coal Nozzle Tip
Outer Air Zone
Inner Air Zone
Primary Air & Coal
RopeBreaker
Flatback Assembly
w/ Cast Elbow
Flow Straighteners
RopeBreaker
Lobsterback
Elbow Assembly
Inner Zone
Pitot Tube
Outer Zone
Pitot Tube
1/8" Thick Inner &
Outer Spin Vanes
Base Design = 309SS
Alternate = 253MA

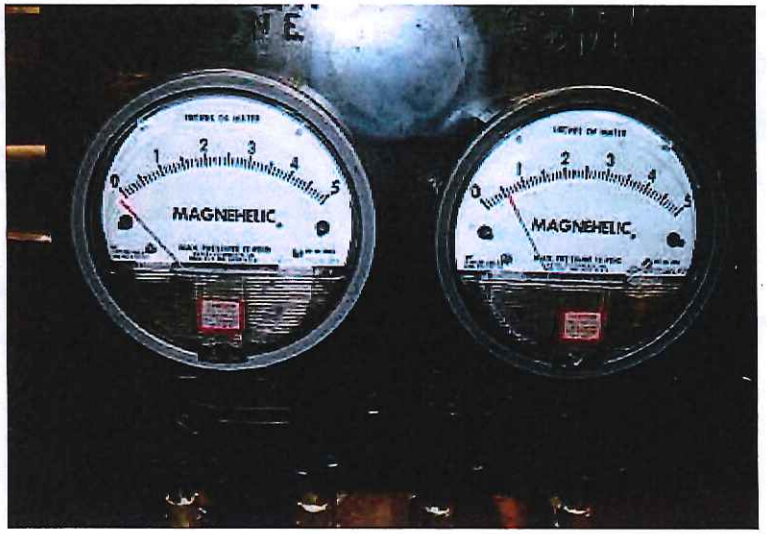
# PI-LNB Tuning features

INNER AND OUTER SPIN VANE RATCHET DRIVES



PITOT TUBE RINGS IN THE OUTER AND INNER AIR ZONES WITH MAGNEHELIC GAUGES GIVE SEPARATE ZONE AIR FLOW VALUES FOR MORE PRECISE AND REPEATABLE TUNING OF EACH BURNER





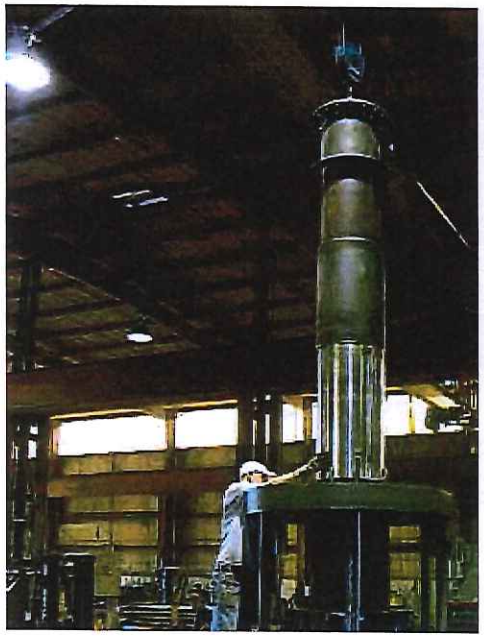

INNER AND OUTER SPIN VANE ANGEL INDICATORS

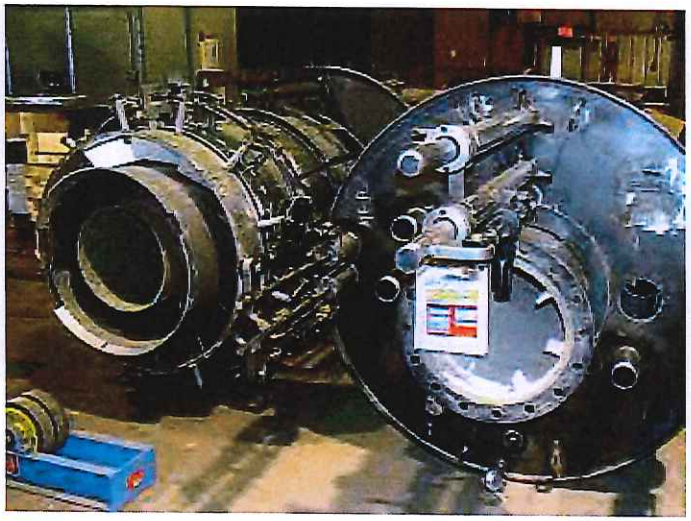
OUTER—40° TO 90° OPEN INNER—10° TO 60° OPEN

POWER & INDUSTRIAL SERVICES CORPORATION

# INNOVATIVE SHOP ASSEMBLY AND QUALITY CONTROL PROCESS

- Complete fabrication and assembly performed by our experienced team
- Custom jigs are used for assembly to ensure proper alignment of all moving parts
- QC job traveler for each burner

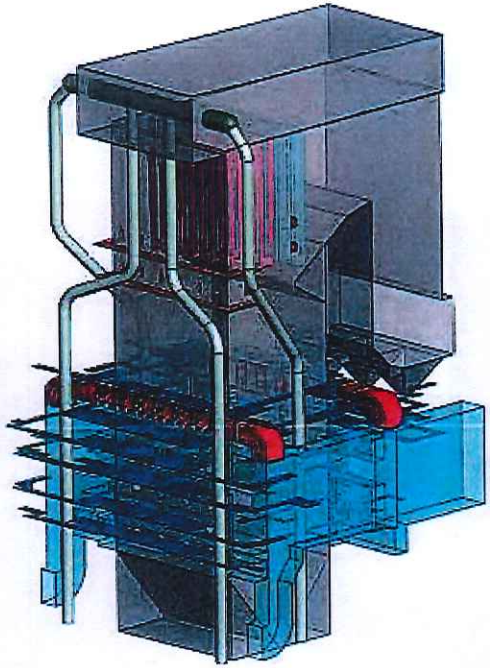




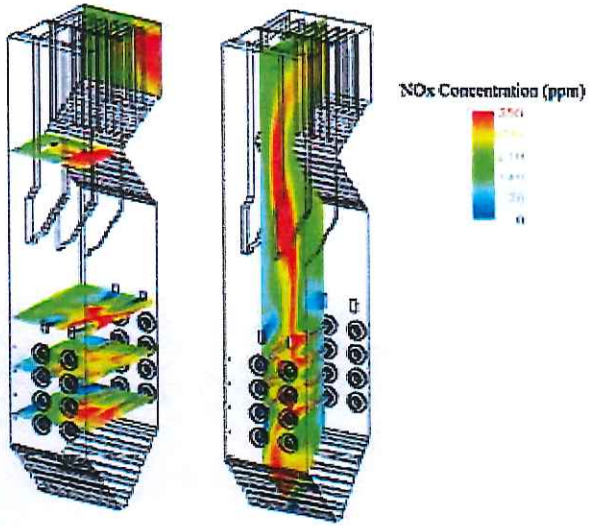
# PI-LNB Burner Design and Unit Review

- Coal and boiler operating data review
- Test data review
- CFD modeling of air flow and chemical species of combustion
- 3D Solidworks models of the combustion system is made after field measurements. This helps with mechanical design and reducing installation problems.

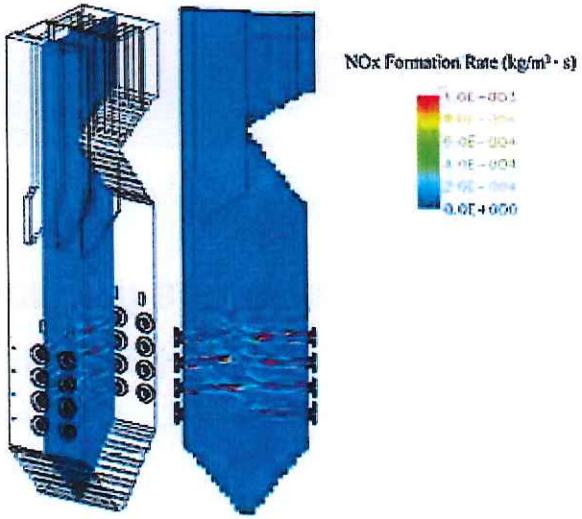
## CUSTOM DESIGN



- Once the baseline CFD model is completed, the addition of Low $NO_x$ burners with and without Overfire Air can be tested.
- Elevation changes of the OFA can be tested as well as various mill and burner combinations and operating conditions.



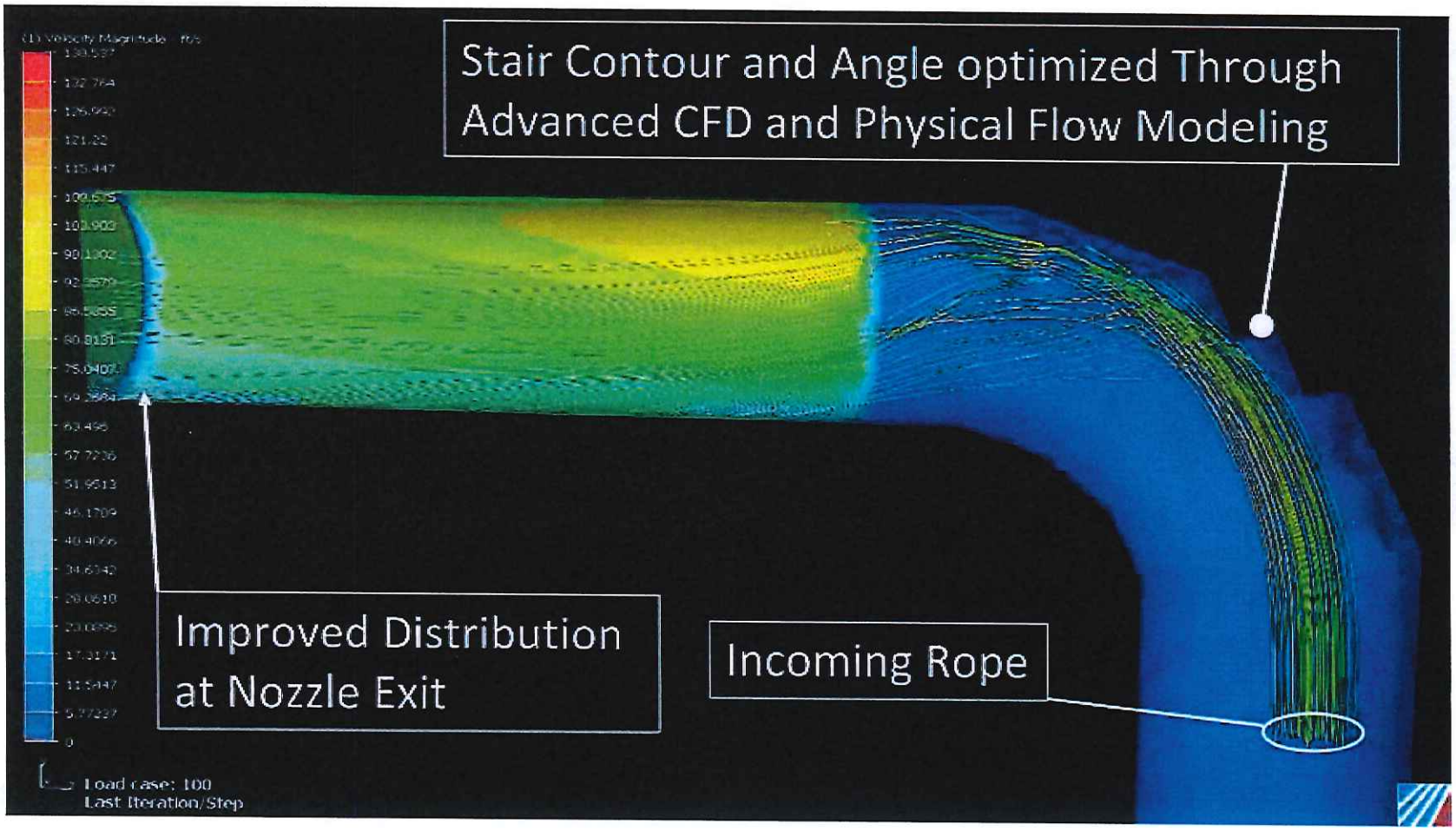

$NO_x$ concentration profiles for the baseline case




Net $NO_x$ formation rate for the baseline case

# PI-LNB Rope Breaker Fuel Distribution System

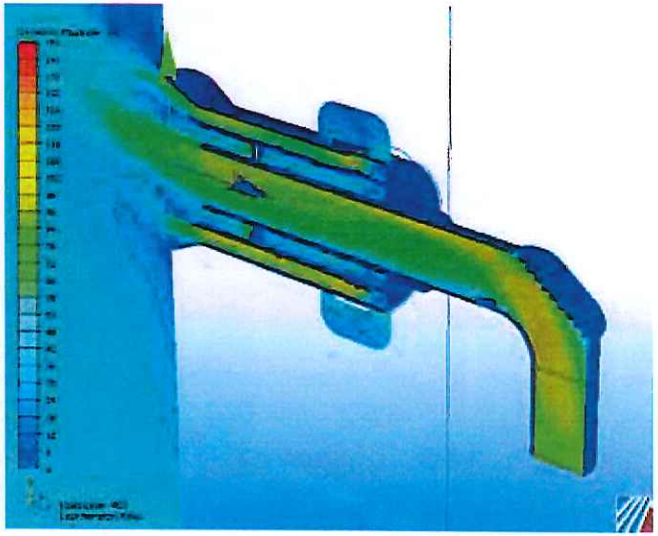
- Good secondary air control and fuel distribution exiting the coal nozzles are essential for Low $NO_x$ combustion.
- P&I developed the Rope Breaker Flatback through CFD modeling and two phase flow modeling resulting in excellent fuel distribution.



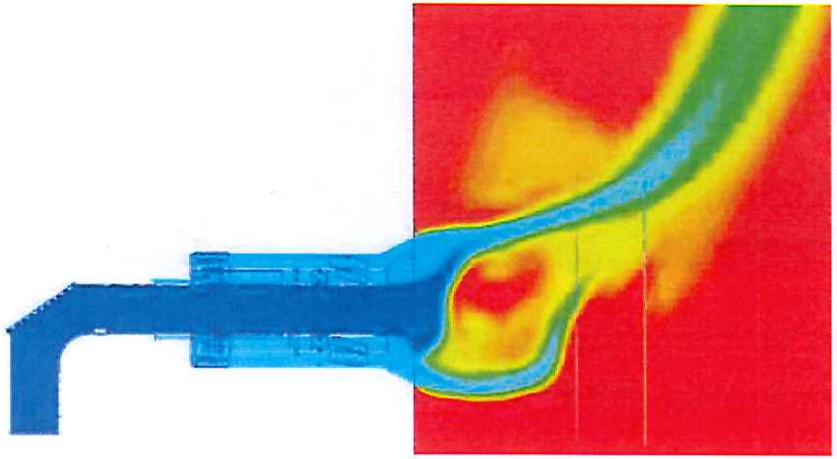
# PI-LNB Design Review

## CFD MODELING

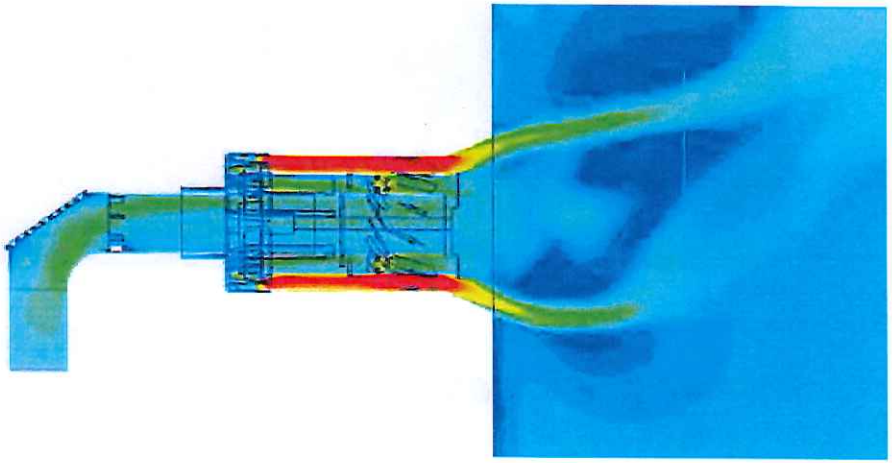
- Assists in predicting the flame shape by running multiple register and spin vane settings
- Helps quantify the amount of secondary air to each burner by running multiple windbox pressure settings
- Assists in predicting fuel distriution and how it affects burner performance



VELOCITY PROFILES

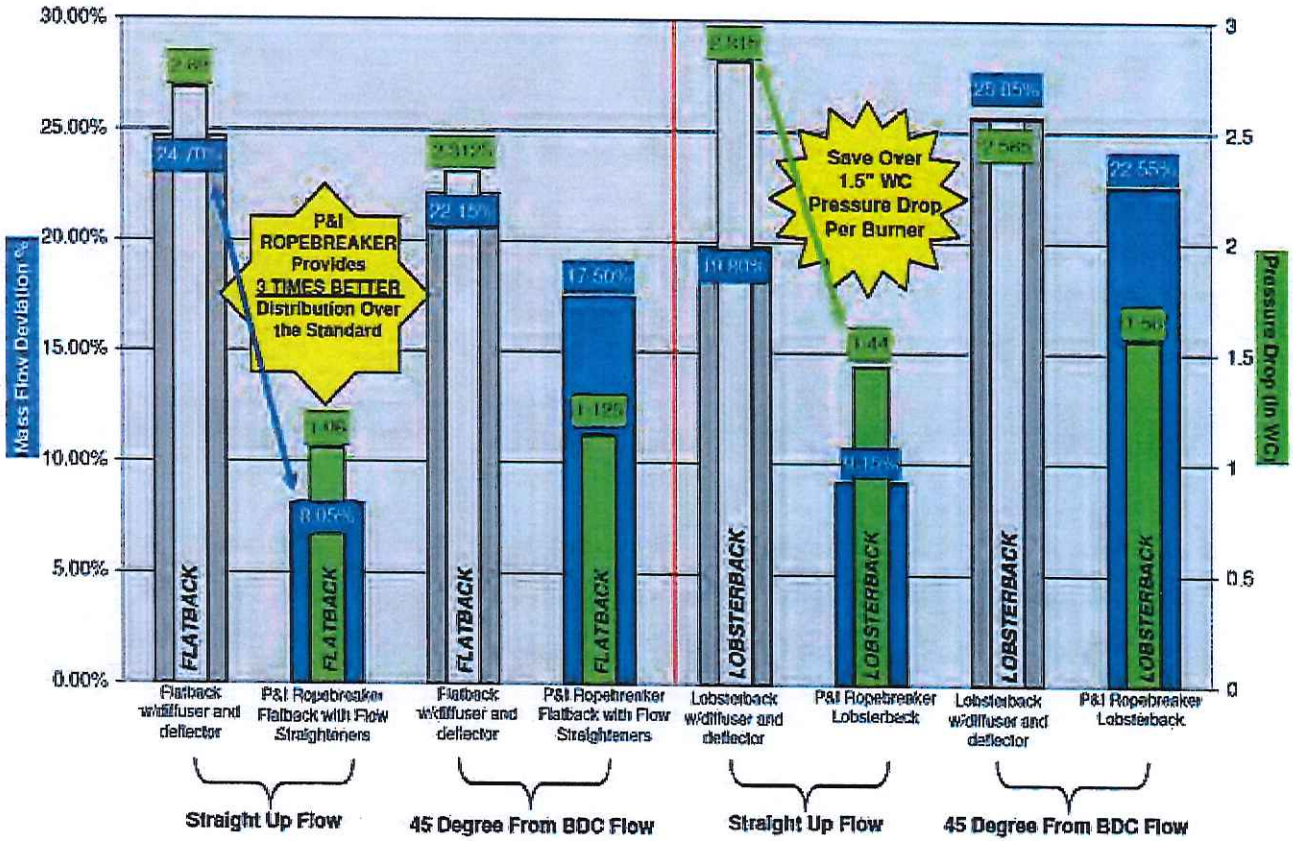


TEMPERATURE PROFILE



# PI-LNB

## POWER & INDUSTRIAL SERVICES ROPEBREAKER FLATBACK AND LOBSTERBACK PERFORMANCE TESTING SUMMARY

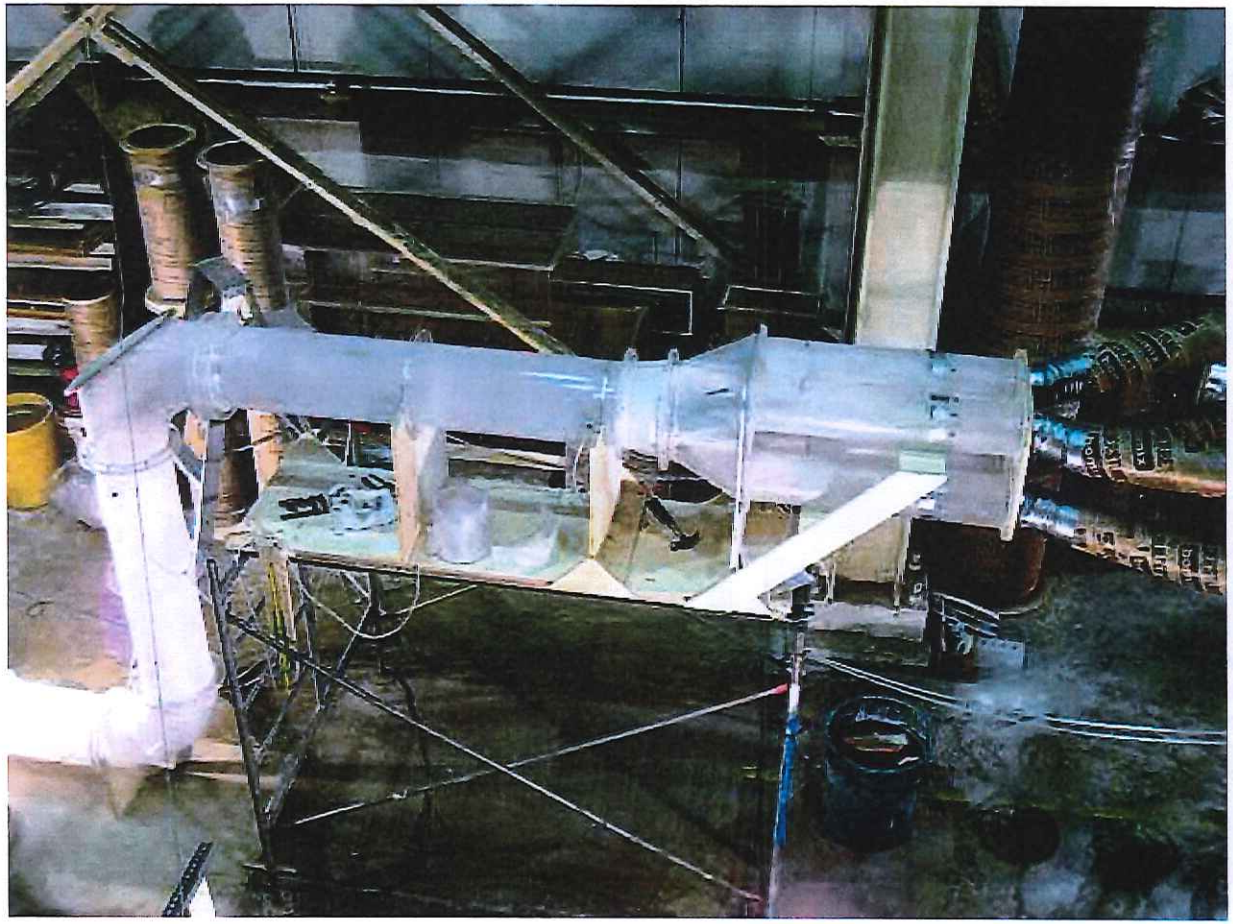



- Results show superior fuel distribution
- Reduced pressure drop
- Eliminates fuel distribution devices in the coal flow that cause wear and maintenance problems

POWER & INDUSTRIAL SERVICES CORPORATION

# PI-LNB

## ROPE BREAKER FUEL DISTRIBUTION SYSTEM —TWO PHASE TESTING



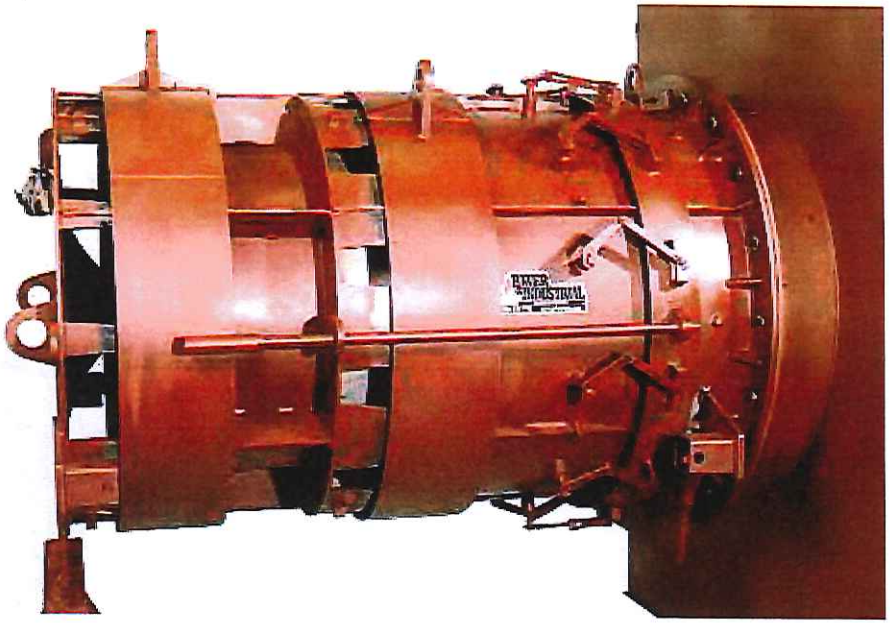
TESTING SET-UP AT NELS CONSULTING FACILITY

INDUCED ROPE FORMATION

# PI OVER FIRE AIR DESIGNS

## OVER FIRE AIR SYSTEM

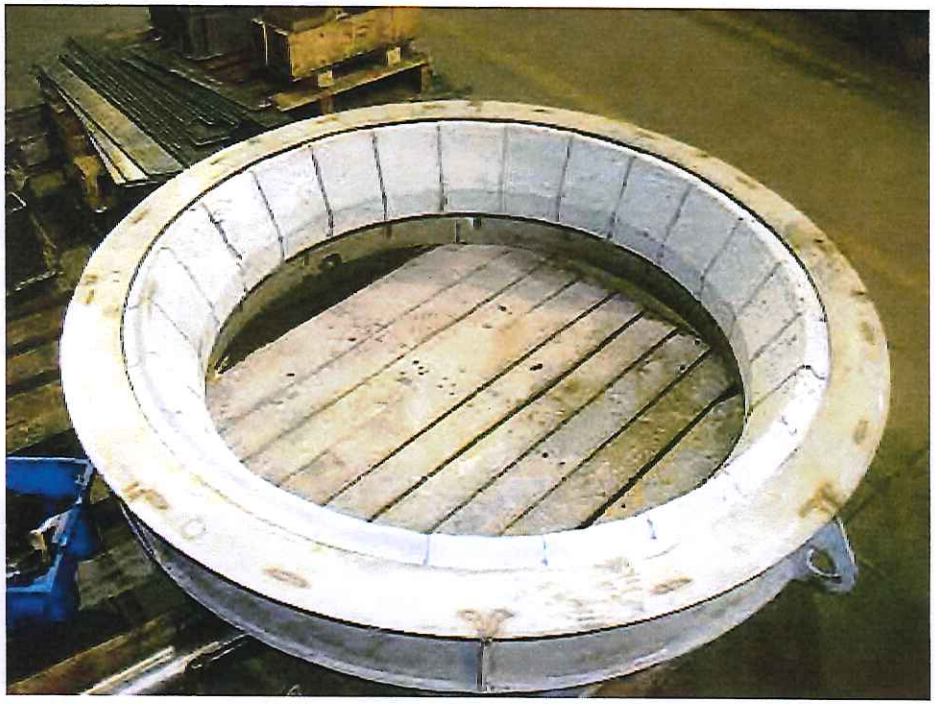
Requires plant specific solutions based on availability of secondary air supply and the best elevation for $NO_x$ and CO reduction

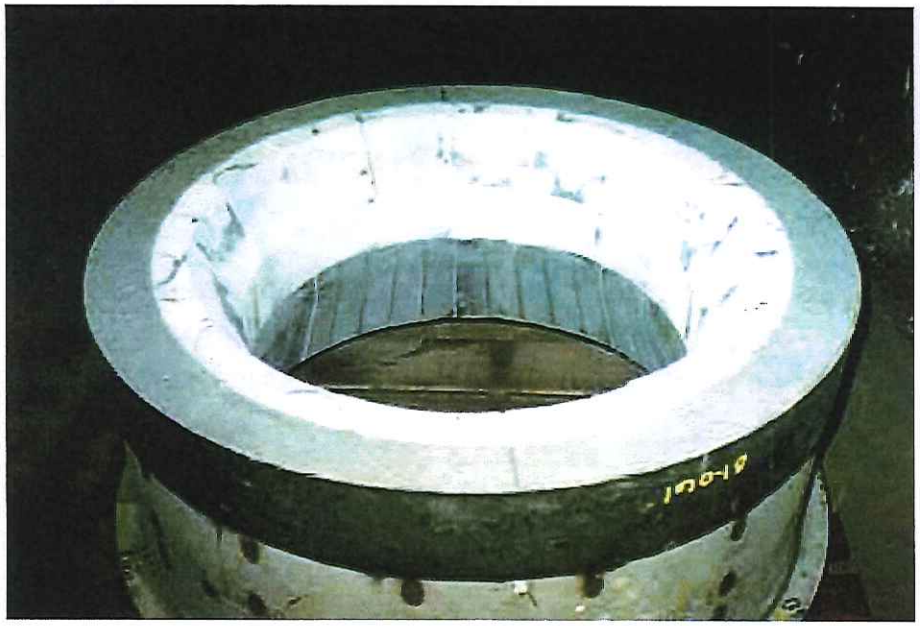


## COMPARTMENTALIZED OFA DESIGN

# PI-LNB

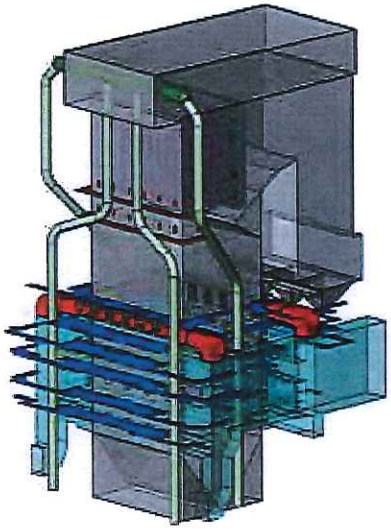
- To maximize $NO_x$ reduction when overfire air is used, burner throat modifications are supplied for optimum performance
- Silicon carbide interlocking segments and 309 stainless steel retaining ring

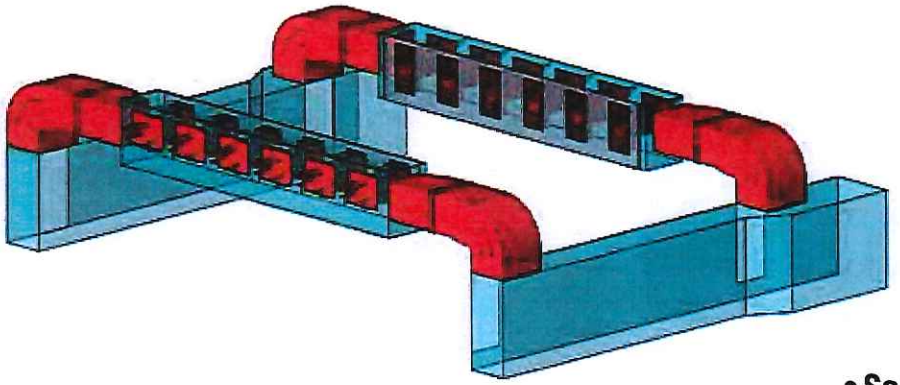




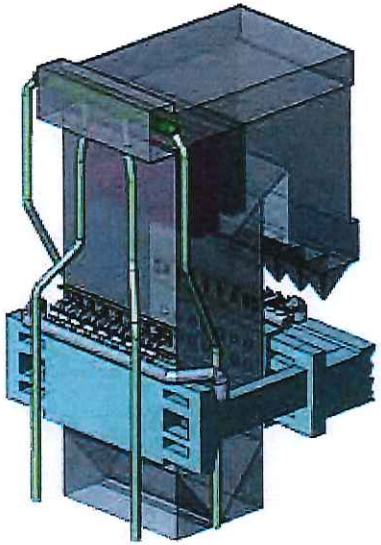
# TYPICAL OFA DESIGNS

## COMPARTMENTALIZED OFA

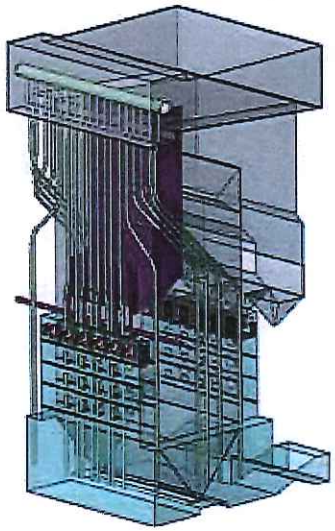




## FINGER DUCT OFA

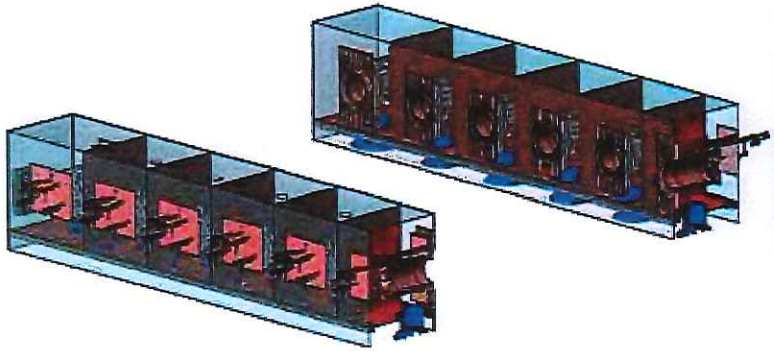


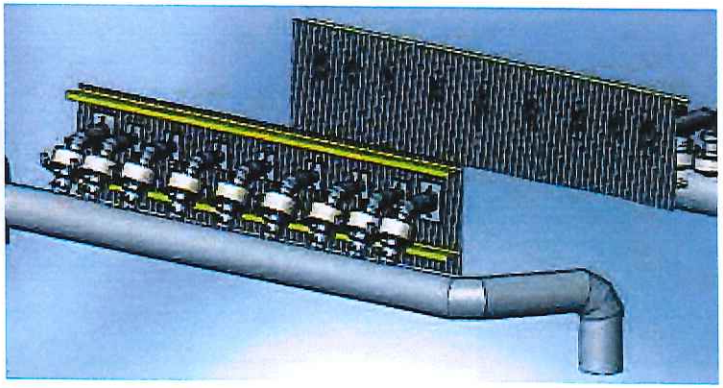
- Secondary air header added
- Finger duct OFAs
- Dampers and Eastern Instruments High-Betas for air flow measurement and OFA balancing



## COMMON WINDBOX CONVERSION

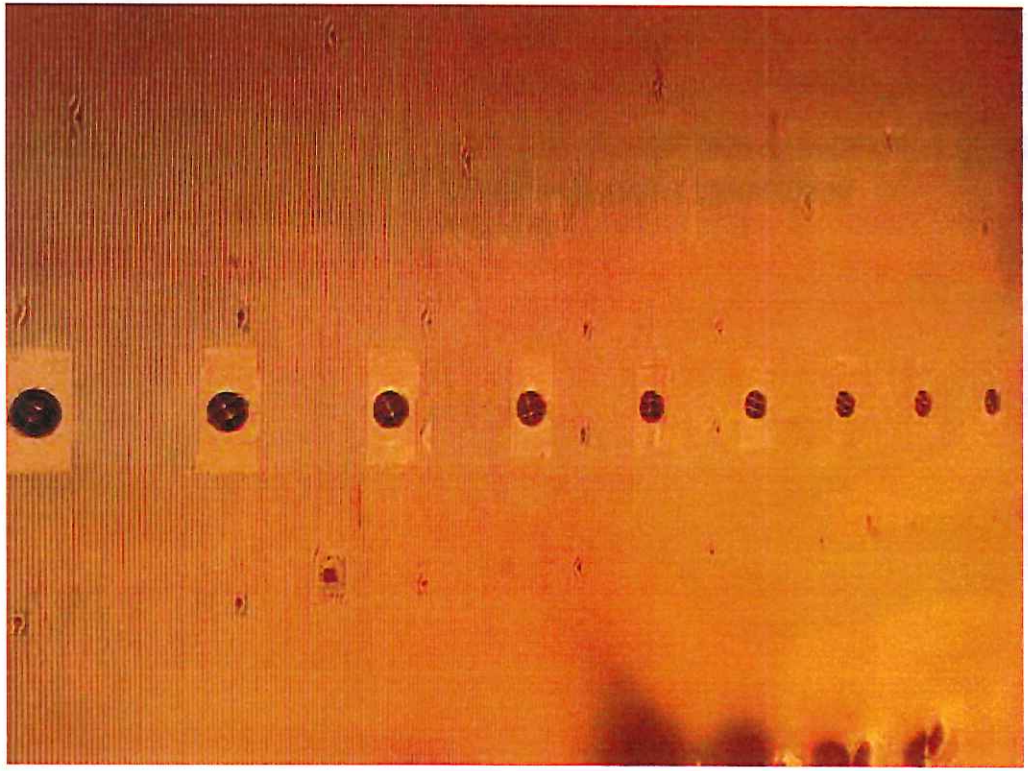
- Compartmentalized windbox and OFA added
- Eastern Instruments High-Beta for air flow managenment to each OFA





# PI-OFA DESIGNS

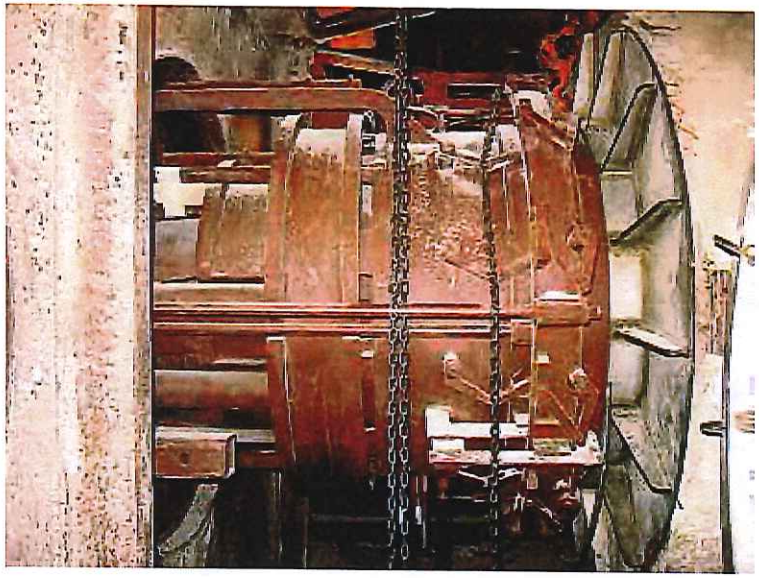
Larger OFA ports are used above and outboard of the burners to more efficiently reduce $NO_x$ and CO that tend to flow up the corners of a boiler.

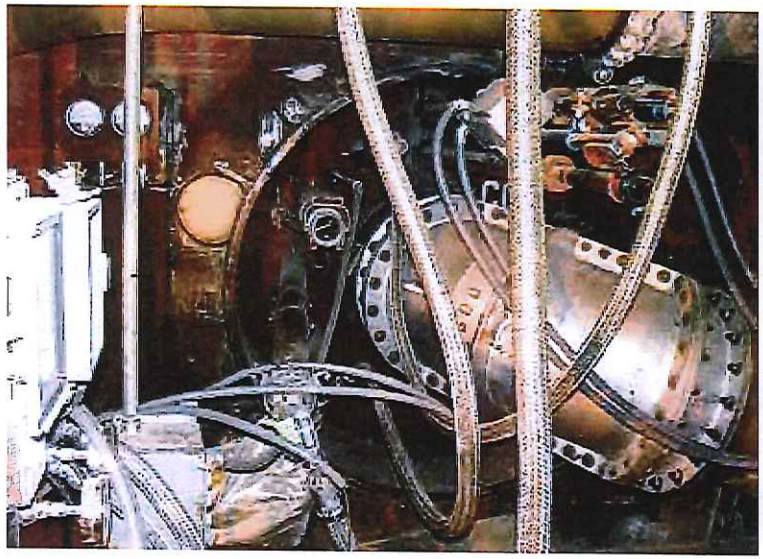


# PI-LNB Installation Support and Packaging

## WEBINAR INSTALLATION REVIEWS SAVE TIME AND MONEY

- On site installation support





***SPECIAL PACKAGING***

**OPTIONAL CASTERS—INSTALLATION SAVINGS**

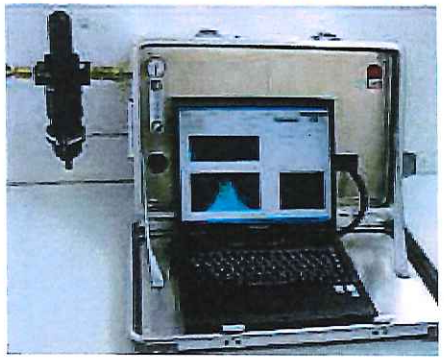
**SHRINK WRAPPED FOR OUTSIDE STORAGE**

# PI-LNB Start-up and Optimization Tuning

- Base line testing
- Start-up assistance 100% at the site
- Tuning
  - Initial start-up settings
  - Cooling air adjustment
  - Economizer exit grid recommendations
  - Tune via economizer exit grid data

# Exclusive USA Distributor COAL FINENESS AND AIR-FUEL RATIO

## RESULTS IN MINUTES

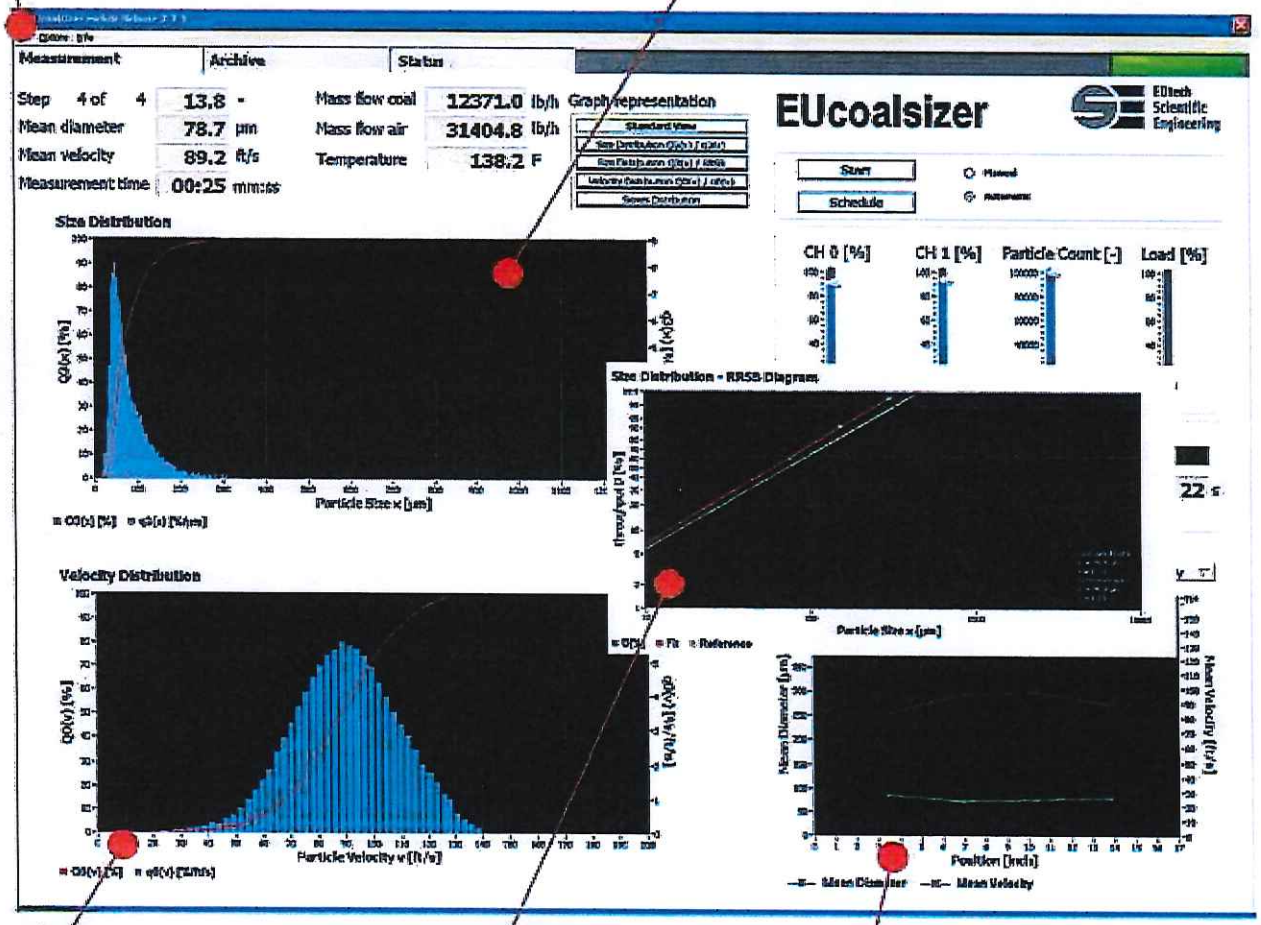


## EUcoalsizer user interface

EUtech Scientific Engineering

Overview data: Particle size, velocity, throughput, massflows and controls

Particle size distribution plot




Velocity distribution plot

Rosin-Rammler distribution plot

Test series result plot

Dennewartstraße 25-27, 52068 Aachen, Germany www.eutech-scientific.de Phone:+49/241/963-23-80 Fax:+49/241/963-23-81

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# COMBUSTION AIR FLOW MEASUREMENT

HighBeta®

EASTERN INSTRUMENTS

## HIGH BETA® DUCTS

*REPLACES SECONDARY AIR AIRFOILS OR VENTURI*

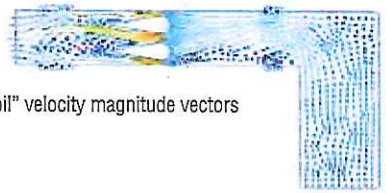
- **Accurate secondary air flow measurement**
- **Reduced pressure drop**

**COMPARTMENTALIZED WINDBOX AIRFOIL REPLACEMENT—5' x 7'**

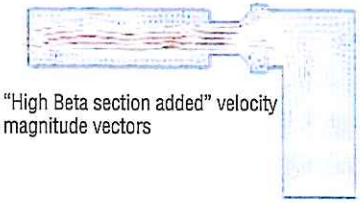
**COMMON WINDBOX AIRFOIL REPLACEMENT—6' x 24'**

## CFD (Computational Fluid Dynamic) Modeling

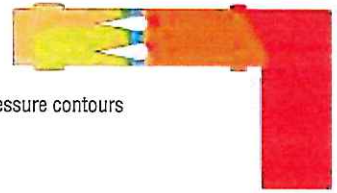
- **Identifies problems**
- **Verifies solutions**



"Airfoil" velocity magnitude vectors

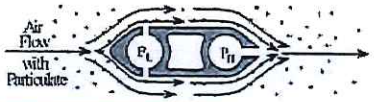


"High Beta section added" velocity magnitude vectors



"Airfoil" pressure contours

"High Beta section added" pressure contours




VAP 3TM/PA PITOT

**ACCURATE PRIMARY AIR MEASUREMENTS WITH LITTLE OR NO STRAIGHT RUNS**

**HIGH BETA® ENGINEERED SYSTEMS FOR MEASURING PRIMARY AND TEMPERING AIR**

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