Advancing ULN Technology for Industrial Combustion Applications

Texas Technology Showcase
Radisson Hotel, Houston, TX

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Coen's On-Going Success with ULN Technology

- Coen was Deliberate in Entering the ULN Burner Market
  - First 9 ppm Burners Commissioned in 1999
  - Subsequent Success for All Industrial ULN Burners
    - Single & Multiple Burner Boilers
    - Steam Flood Generators
    - Heaters
  - Coen's QLA is mature and successful ULN Burner

ULN Technology is Evolving

- Coen Proceeds to Next Generation Technology
- Now Deliver ULN Performance From:
  - Traditional LNB Design
  - Traditional LNB Controls
  - Traditional LNB Stability (Actually Better)
  - Traditional LNB Costs! (Almost)
- Dial-A-NOx
  - Burner Stable with 0 – 45+% FGR
    - Or Waste Steam Equivalent

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ULN Case Histories

- Single Burner Package Boiler Retrofit
  < 0.01 #/mmBtu
- Single Burner Package Boiler Retrofit
  < 0.02 #/mmBtu
- Multi-Burner Power Boiler Turnkey Retrofit
  < 20 ppm on RFG
- VC Heater Retrofit (non-ULN)
  < 0.03 #/mmBtu
- Low Emissions Duct Burner Performance

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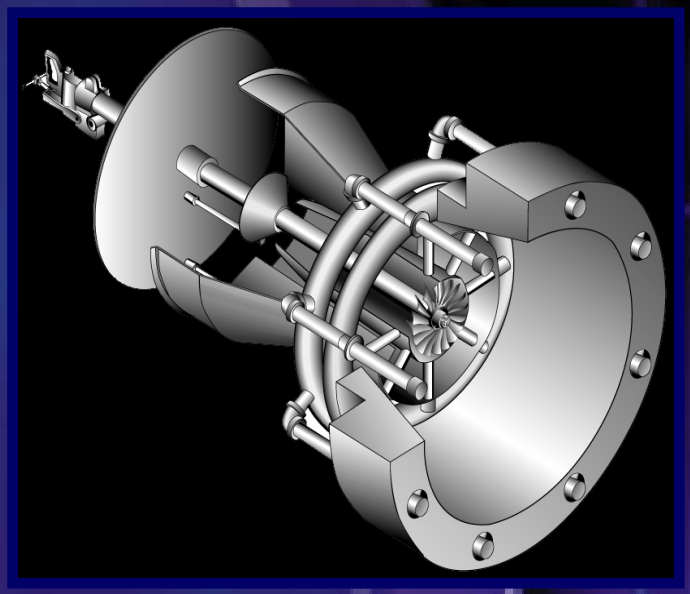
Packaged Boiler - 0.01 # NOx

- **Situation** – Calpine, Pryor, OK
- 170,000 lb/hr CE ‘A’ Type
- Refractory Lined Floor & Front
- Natural Gas
- Reuse Existing FD Fan
- Add ULN Mods to Existing Coen Delta-NOx-42
- Permit Limits: 40 ppm NOx
  100 ppm CO
- Demonstrate < 9 ppm NOx



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Calpine

- **Solution & Results**
- Simple ULN Modification
- No Moving Parts
- Reuse Simple Controls
- Wider Stability with Higher FGR
- Fast Ramp Rate
- NOx < 7.5 ppm
- CO well below 100 ppm

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Packaged Boiler Retrofit - 0.02 lb/mmBtu NOx

- **Situation** – Petrochemical Plant in HGA
- 125,000 lb/hr Murray MCF5-99
- ‘D’ Type No Refractory Floor
- Natural Gas
- Emission Limits: 0.02 # NOx (18 ppm)
  0.08 # CO (100 ppm)

Petrochemical Plant in HGA

- **Solution**
- Turnkey Retrofit Delta-NOx ULN-36
- Induced FGR
- Excess air @ 15%
- New Fisher Delta V Controls (not by Coen)
- Predicted Limits: 0.015 # NOx (< 13 ppm)
  0.04 # CO (< 50 ppm)
- Start-up Summer 2003

Multi-Burner Boiler - 20 PPM NOx

- **Situation** – So. Cal. Refinery
- Reduce Overall Plant Emissions
- Turnkey Retrofit
- 250,000 lb/hr B&W PFI
- Firing Refinery Gas
- Target: 20 ppm NOx
  100 ppm CO
- 60% below Existing LNB (52 ppm)
- 85% below Uncontrolled NOx (130 ppm)

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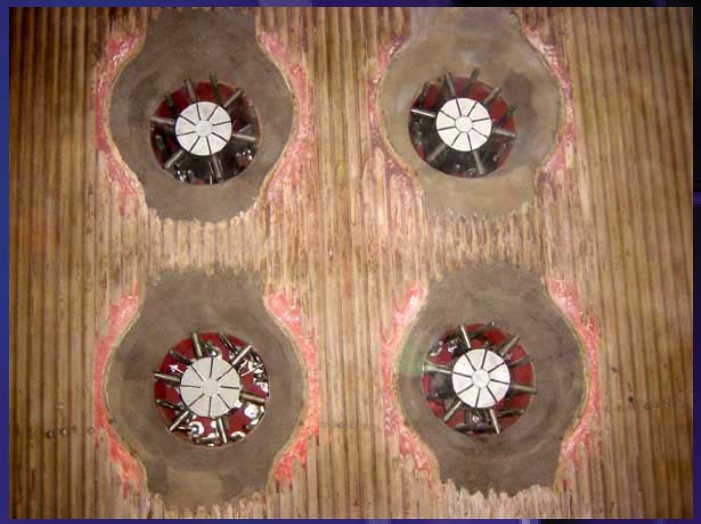
So. Cal. Refinery

- **Solution**
- (4) Delta Power ULN-27
- Reuse Windbox
- Reuse FD and FGR Fans
- Reuse Old Pneumatic Controls
- CFD Design FGR Mix Box and Combustion Air Flow
- Remove Air Preheater
- Install New Economizer



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So. Cal. Refinery

- **Results**
- 14 Day Turnkey Turnaround
- Safe Continuous Operation
- < 20 ppm NOx
- Near “Zero” CO
- Stable “Out-of-the-Box” Performance
- Overall Efficiency Increase

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VC Heater Retrofit - 0.03 # NOx

- **Situation** – Petrochemical Plant in HGA
- (2) VC Heaters
- 202 mmBtu/hr Heat Input
- Firing Refinery Gas
- Limits: 0.03 # NOx
  0.034 # CO

Petrochemical Plant in HGA

- **Non-ULN Solution**
- (4) Coen QLG-3.2 per Heater
- Common Air Plenum
- Reuse Controls & BMS
- Bulk Mix FGR @ 5%
- Excess Air @ 15%
- Start-up April 2003

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Low Emissions Duct Burner

- Tenaska, Cleburne, TX
  - Westinghouse “F” Class Turbine
    - Power Augmentation
    - Supplemental Duct Firing
  - Deltak HRSG
  - Westinghouse Steam Turbine

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Tenaska

- **Situation**
  - Needed Peak Summer Power
  - Power Augmentation with Duct Firing
  - TEG @ 10.9% O_2 and 16.5% Moisture
  - Limits: 25 ppm CO, 9 ppm NOx @ 15% O_2
  - Existing CO Emissions above Permit Levels
  - Aged Duct Burner Elements
  - Pilots not Reliable

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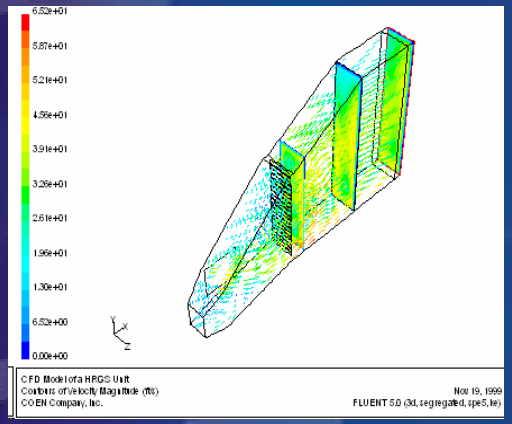
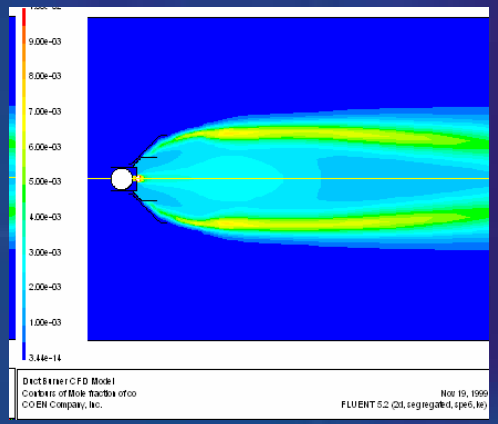
Tenaska

- **Solution – *Power Plus***
  - CFD Modeling of System
  - Modified Flow Baffles
  - Direct Replacement
    - New Coen Elements
    - New High Stability Pilots





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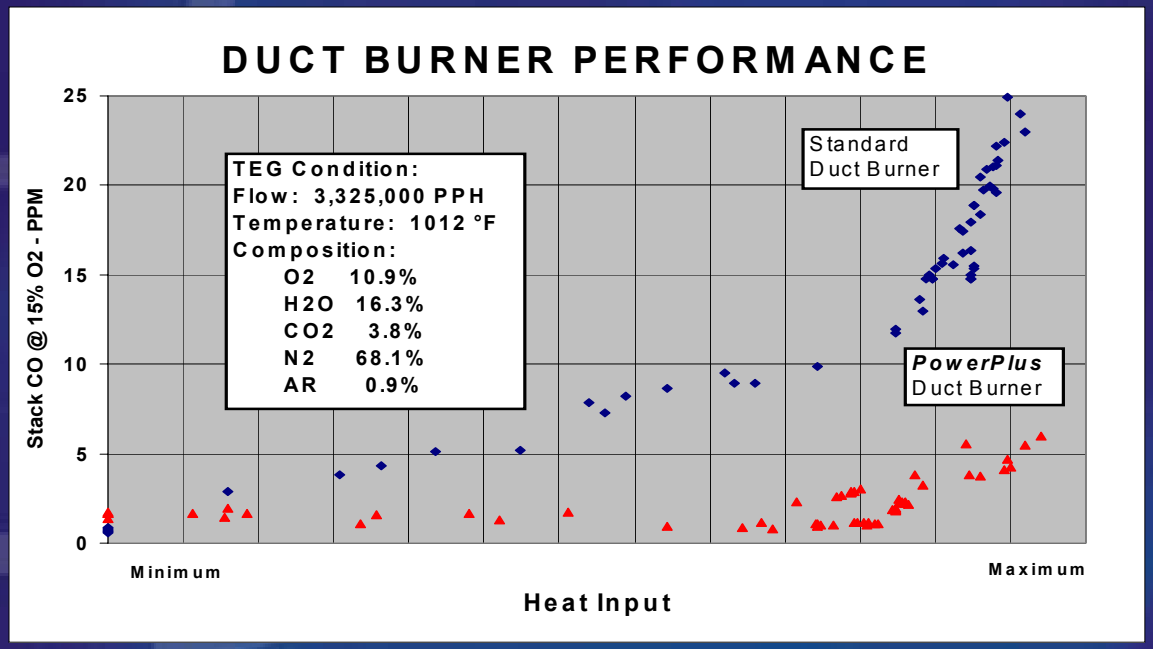
- **Results – *Power Plus***
  - Reduced Stack CO below 10 ppm
  - NOx Remained below 9 ppm
  - Met All Permitting w/o Augmented Air
  - Successful Operation since 1998



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Conclusion

- Continue Work on Duct Burner ULN Technology
- Successfully Advanced Industrial ULN Design
- Successfully Taken Next Step
- Wide Range of Applications
- Ready to Go

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