Advancing ULN Technology for Industrial Combustion Applications

Texas Technology Showcase
Radisson Hotel, Houston, TX
Thomas Sayers
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
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
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
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
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)
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
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
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
Low Emissions Duct Burner

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

 Situation
 - Needed Peak Summer Power
 - Power Augmentation with Duct Firing
 - TEG @ 10.9% $\text{O}_2$ and 16.5% Moisture
 - Limits: 25 ppm CO, 9 ppm NOx @ 15% $\text{O}_2$
 - Existing CO Emissions above Permit Levels
 - Aged Duct Burner Elements
 - Pilots not Reliable
Tenaska

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

- **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

![Graph showing duct burner performance](image)
Conclusion

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