

**Combustion Solutions for
Low CO Operation:**





Combustion Components Associates Profile

- Leader in Design, Development, Testing and Manufacture of High-Efficiency Low Emission Combustion Equipment
- 20,000 MW of Pollution Compliance Experience
- 100+ Large Utility & Industrial Customers
- 300+ Staff Years of Combustion Experience
- 30 Patents & Patents Pending
- 3 Licensed Technologies
- 20,000 sq.feet Manufacturing Facility
- 45 Employees

Environmental Compliance at the Lowest Cost



CCA Experience

- Burner Modifications
 - 18,725 MW Oil & Gas -1173 Burners (90 Boilers)
 - 50,000 pph steam to 6,200,000 pph steam
 - 6,915 MW Coal – 550 Burners (42 Boilers)
 - 250,000 pph steam to 6,000,000 pph steam
- OFA & Boosted OFA
 - 6,172 MW (28 Boilers)
 - 250,000 pph steam to 6,200,000 pph steam
- FGR & IFGR
 - 70,000 pph to 4,400,000 pph (13 Boilers)
- SNCR
 - 2,104 MW (20 Boilers)
- SCR
 - 128 Stationary Diesel Engines
 - 20 On-Road & Off Road Diesel Engines
 - 2 wood stokers
- Stokers Three Complete Three in Engineering Phase

CCA Capabilities Overview

CO Emission limits, ppm



	Existing Boilers	New Boilers
Biomass Stoker	490	160
Pulverized Coal	160	12
Stoker Coal	270	6
Oil	10	3
Natural Gas	9	3

30 Day Averages



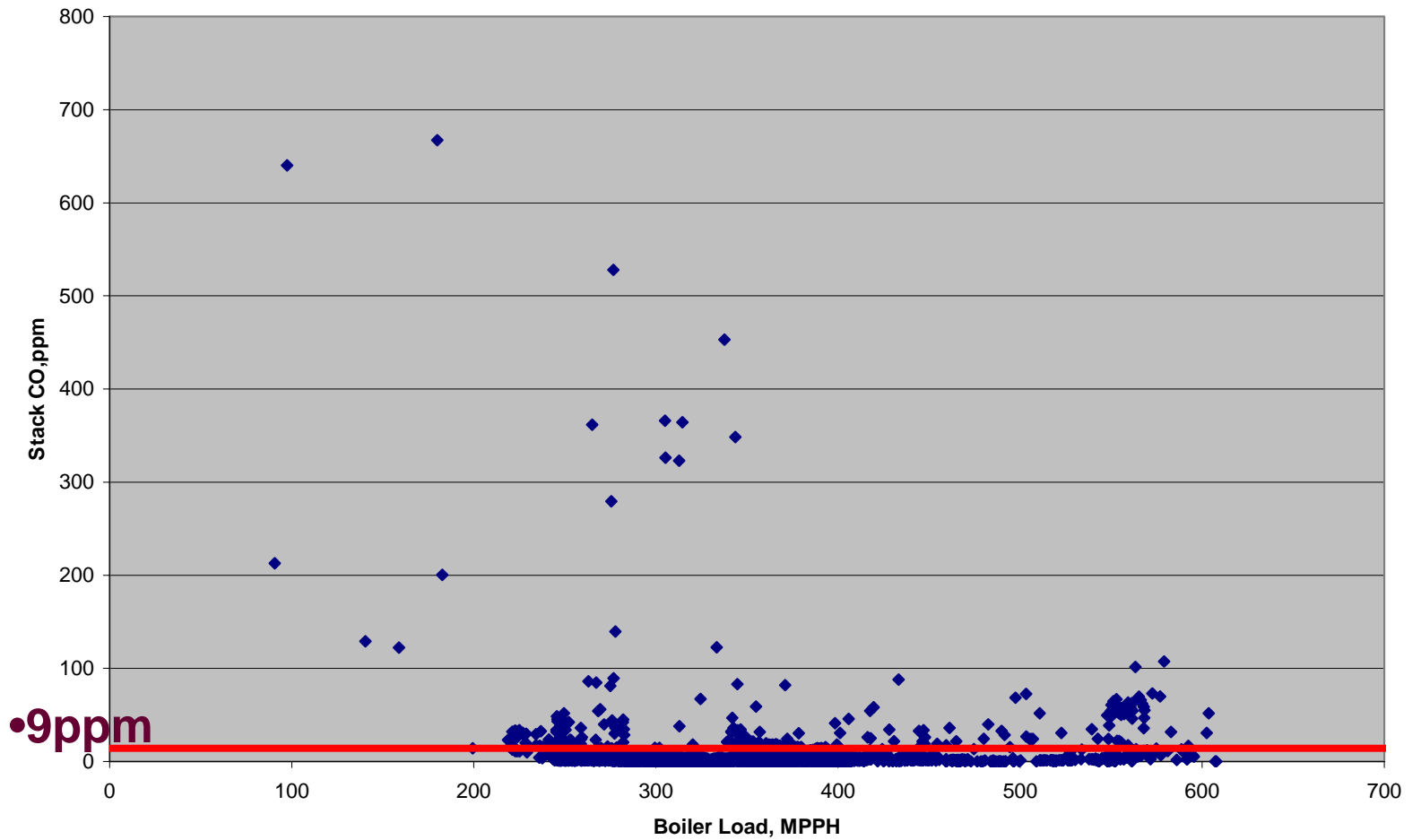
- Testing & Tuning
- Replace Key Parts with New
- Upgrade Key Parts or Systems
 - Atomizers
 - Burners
 - OFA/ Boosted OFA
 - Gas Pokers
 - Coal Spreaders
- Air and Fuel Balance
- CFD Analysis
- CO Catalyst

Testing and Tuning



CCA Capabilities Overview

CO From a Heavy Oil Industrial Boiler



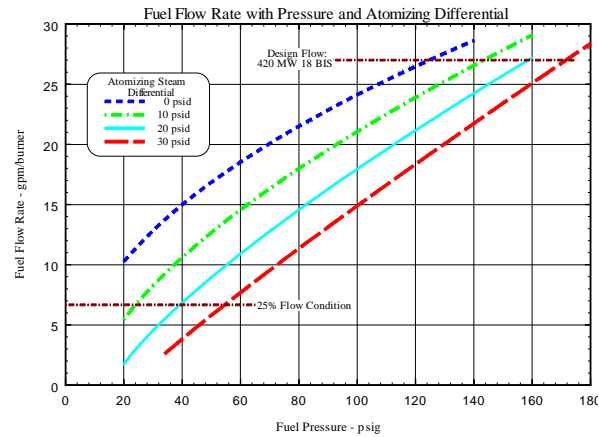
Upgrade Key Parts



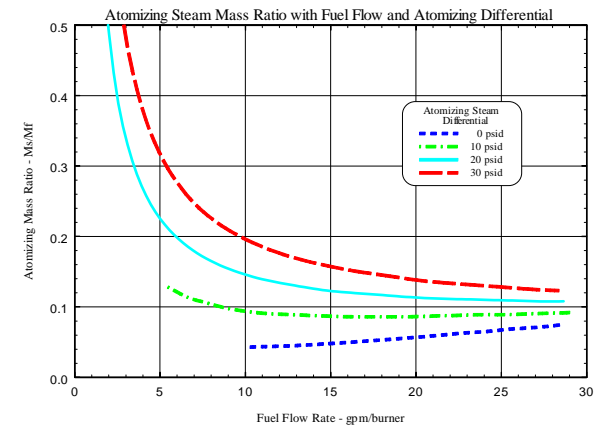
CCA Capabilities Overview



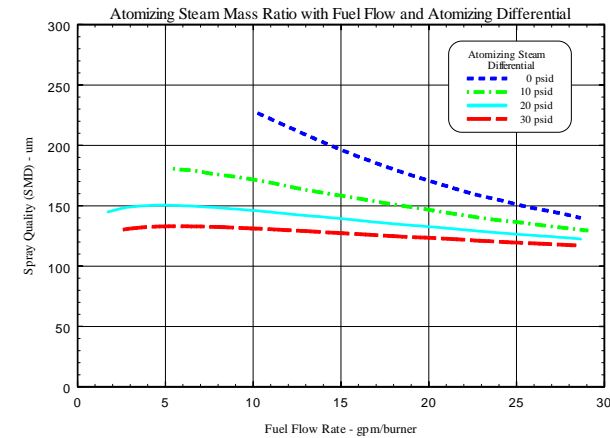
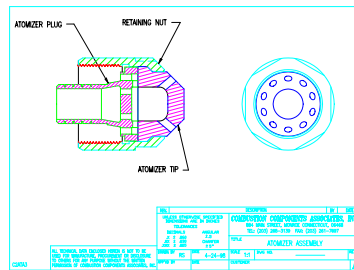
Typical Atomizer Flow Characterization



Map-wf



Map-af



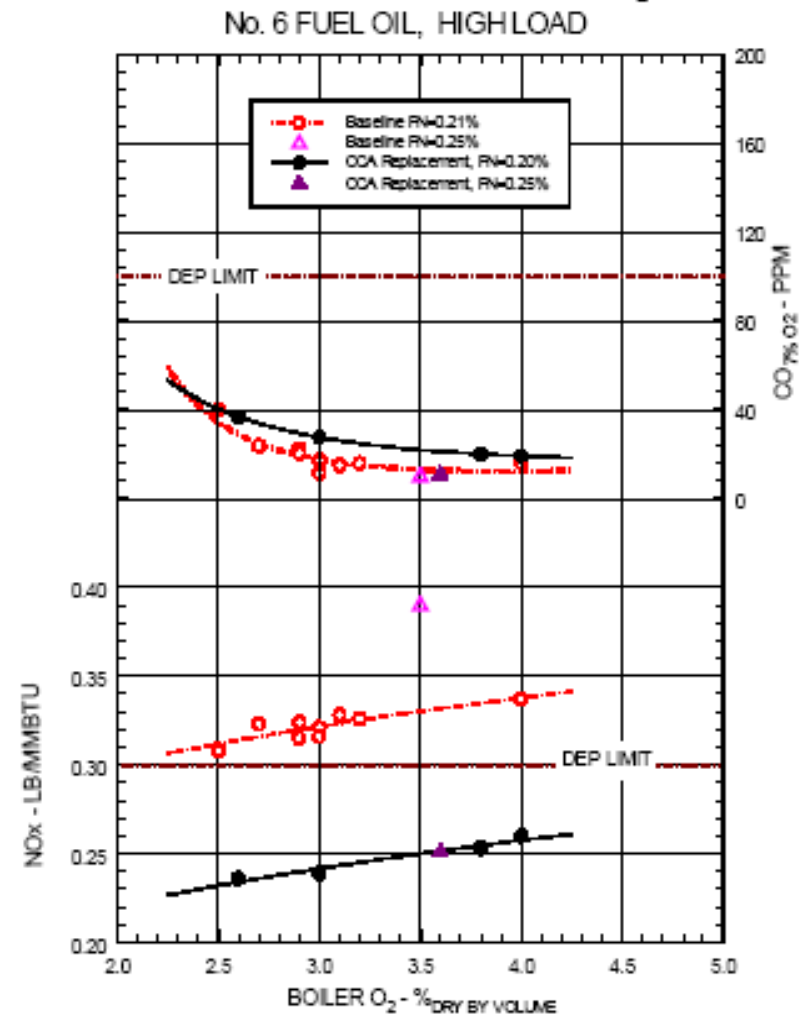
Map-SMD





75 kpph Package Boiler

- No. 6 Oil Operation
- Single Burner – Dual Register
- CCA Hardware Change
 - Low NOx Atomizer
 - Staged Flame Stabilizer
- Emissions
 - 25% Reduction in NOx
 - Lower Influence of Fuel Nitrogen (FN)
 - Small (10ppm) Increase in CO
 - Zero Visible Emissions Maintained
 - Opacity up to just under 5% at CO of 40 ppm



CCA Capabilities Overview

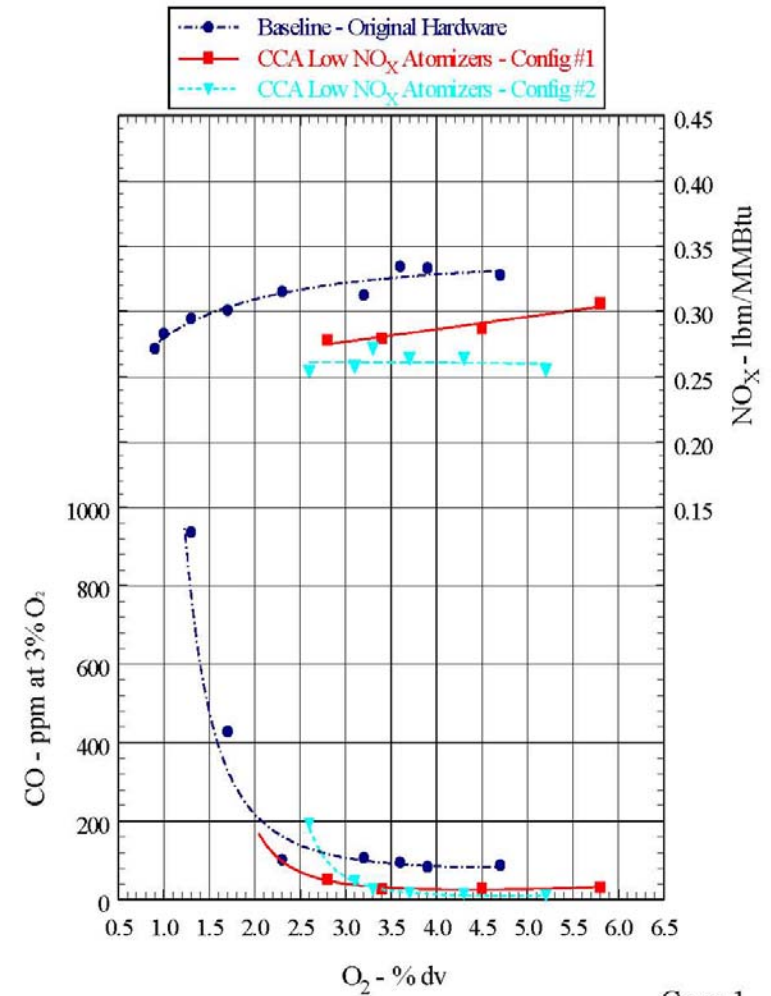
Example Atomizer Upgrade



120 kpph Package Boiler

- Single Burner - Multi-zone counter rotating registers
- Steam atomized No. 6 fuel oil
- Atomizer Change Alone
- NO_x Emissions (lbm/MMBtu) at 3.5% O₂
 - 0.325 - Baseline
 - 0.280 - CCA Low NO_x Atomizers - Config #1
 - 0.260 - CCA Low NO_x Atomizers - Config #2
- CO Emissions (ppm @ 3% O₂) at 3.5% O₂
 - 240 ppm - Baseline
 - 90 ppm - CCA Low NO_x Atomizers - Config #1
 - 75 ppm - CCA Low NO_x Atomizers - Config #2
- NO_x Reductions from Baseline at 3.5% O₂
 - 14% with CCA Low NO_x Atomizers - Config #1
 - 20% with CCA Low NO_x Atomizers - Config #2

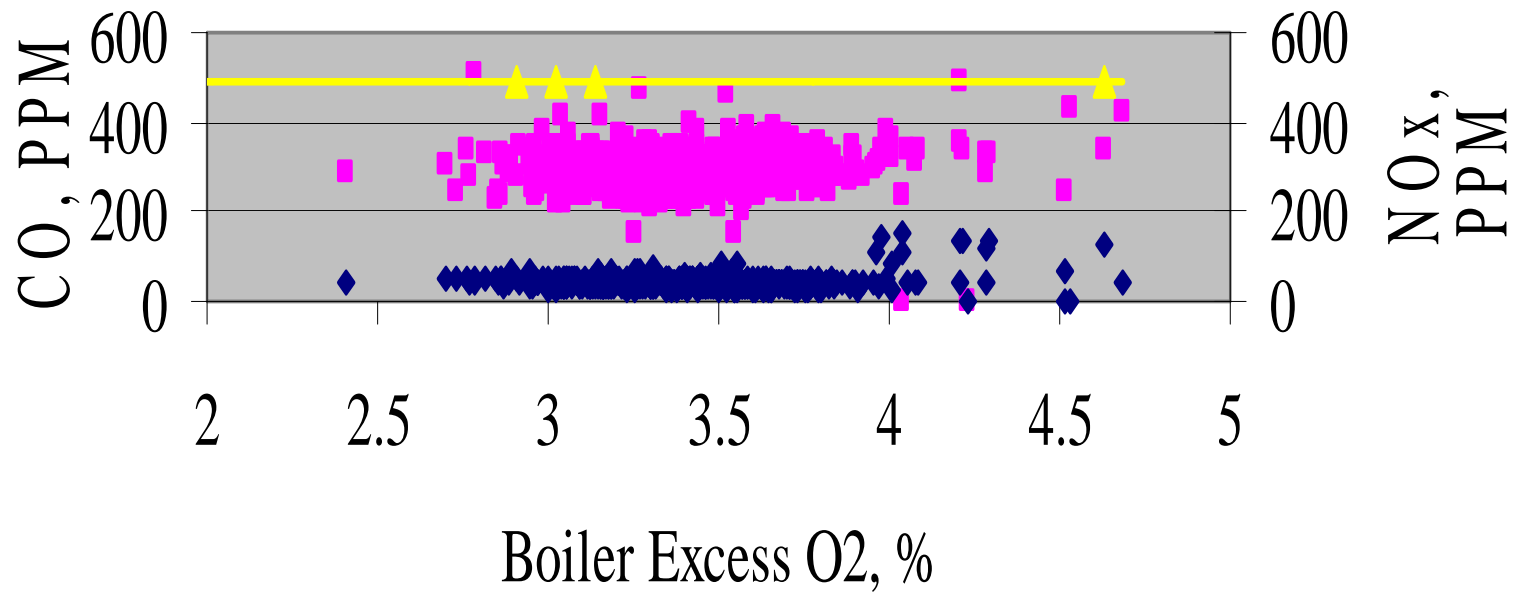
Typical Operation at Full Load



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Green Wood Chips Stoker Result of Key Upgrade



Air and Fuel Balance



CCA Capabilities Overview
Air And Fuel Balancing



Goals

- Air \pm 5%
- Coal \pm 10%
- Oil and Gas \pm 5%

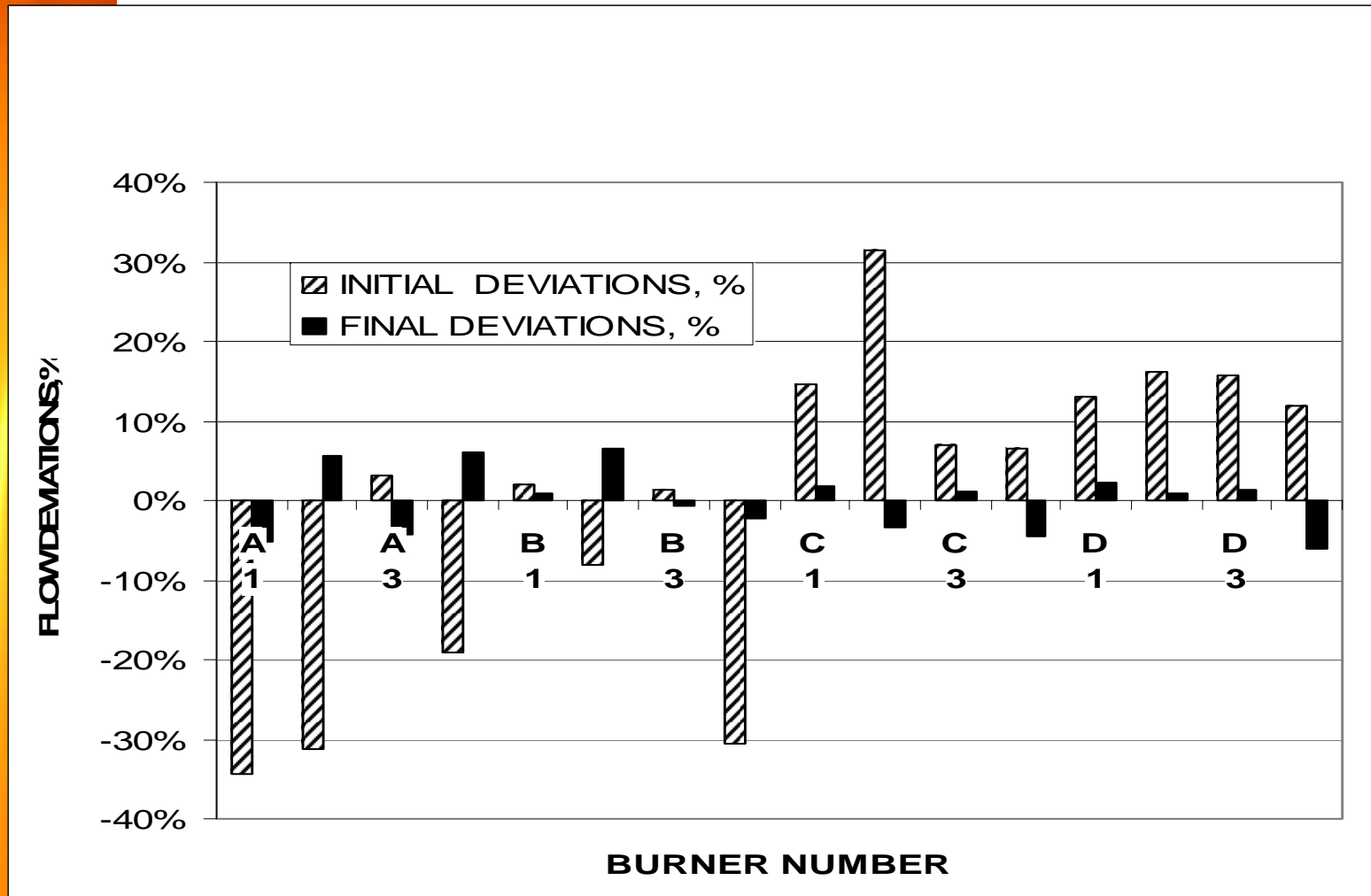


BENEFITS

- LOWERS LOI
- LOWERS CO
- REDUCES SLAGGING
- LOWERS NO_x
- LOWERS OPACITY
- IMPROVES EFFICIENCY
- REDUCES GREENHOUSE GASES

CCA Capabilities Overview

Burner Air Flow Deviations



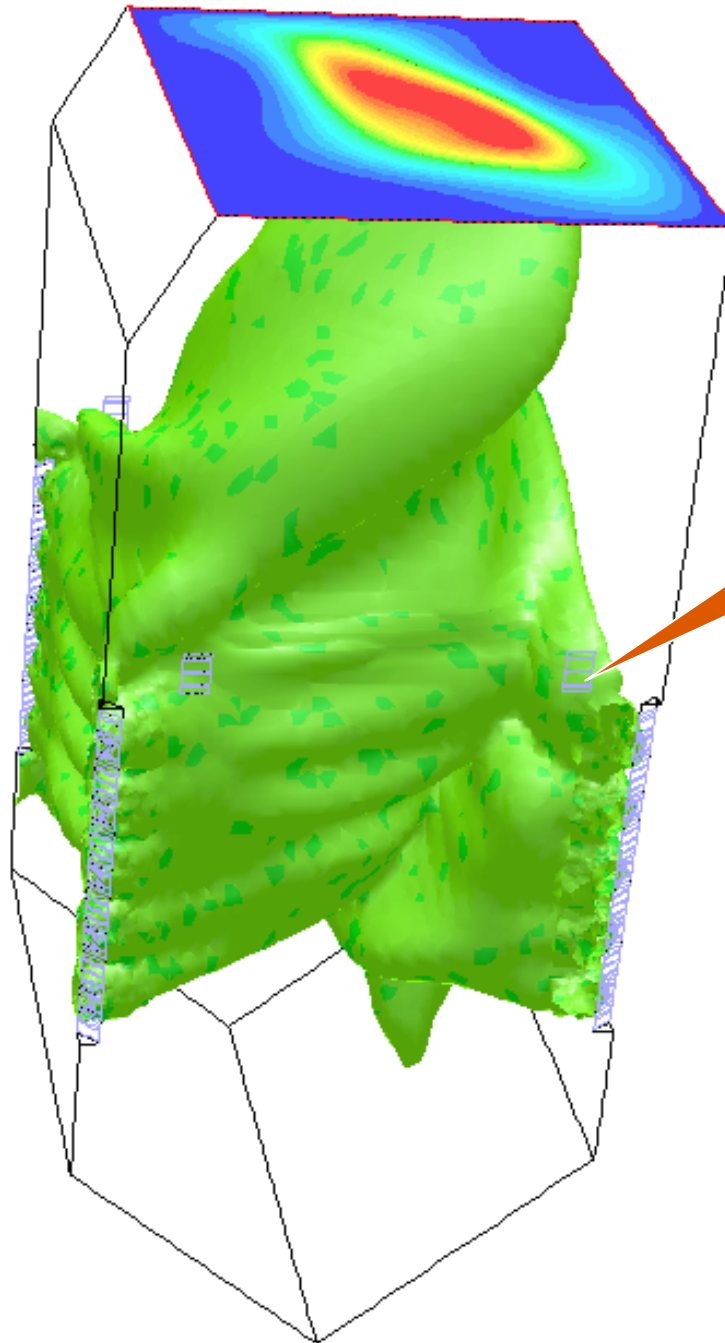
CFD Analysis



CFD Modeling



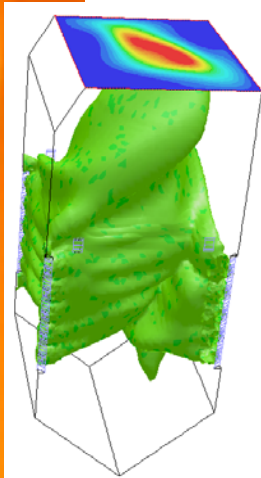
- Fully optimizes combustion process
- In-depth CCA modeling experience
- Provides basis for final design
- Ensures it will work when installed



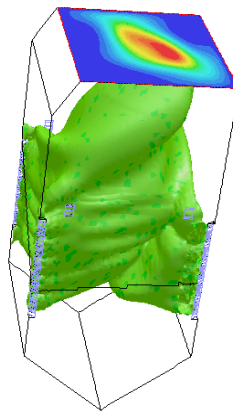
EXISTING
OFA PORTS

- 5000 ppm CO
- ISOSURFACE

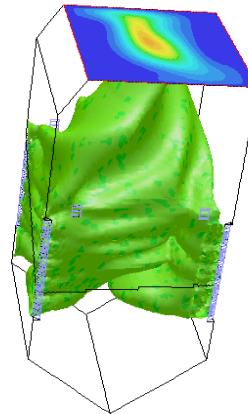
5000 ppm CO ISOSURFACE COMPARISON OF UPGRADES



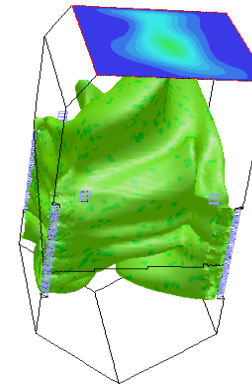
Upgrade



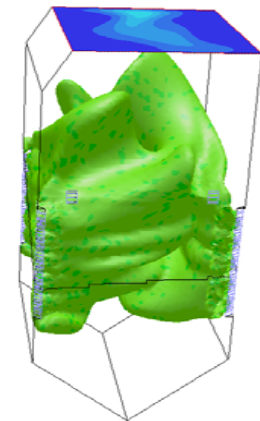
Independent
Operation



SW Corner
Modification



Upper Aux
Air Port Mod



Corner Fuel
Biasing

Catalyst for CO



CCA Capabilities Overview

SCR views



165 kpph Boiler



220 kpph Boiler

