# Combustion & Emissions Control Solutions

## 2017

**CCA Combustion Systems**

www.cecoenviro.com/cca-combustion-systems

CECO ENVIRONMENTAL

A global diversified and energy company providing clean, safe and efficient technologies for the industrial challenges of energy, environmental air pollution control, and fluid handling and filtration

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# Rollup of CCA and PMFG into CECO Environmental

Combustion solutions including Burners, OFA, FGR.

Urea and ammonia based SCR for boilers, turbines and engines, urea to ammonia conversion

SNCR for boilers

Acquired CCA in 2014 for urea injection and combustion expertise

Over 1000 SCR units installed on boilers, engines and turbines

Pressure products fabrication and fluids separation business

CECO: $ 400 million

(NADASQ: CECE)

Acquired PMFG in 2015 for urea and ammonia SCR and combustion expertise.

Provides dampers, ducts, exhaust stacks, filtration and air pollution controls world wide under “One CECO” brand

Renewed emphasis on relations, OEM support as well as retrofit and aftermarket sales across boilers, turbines and IC engines

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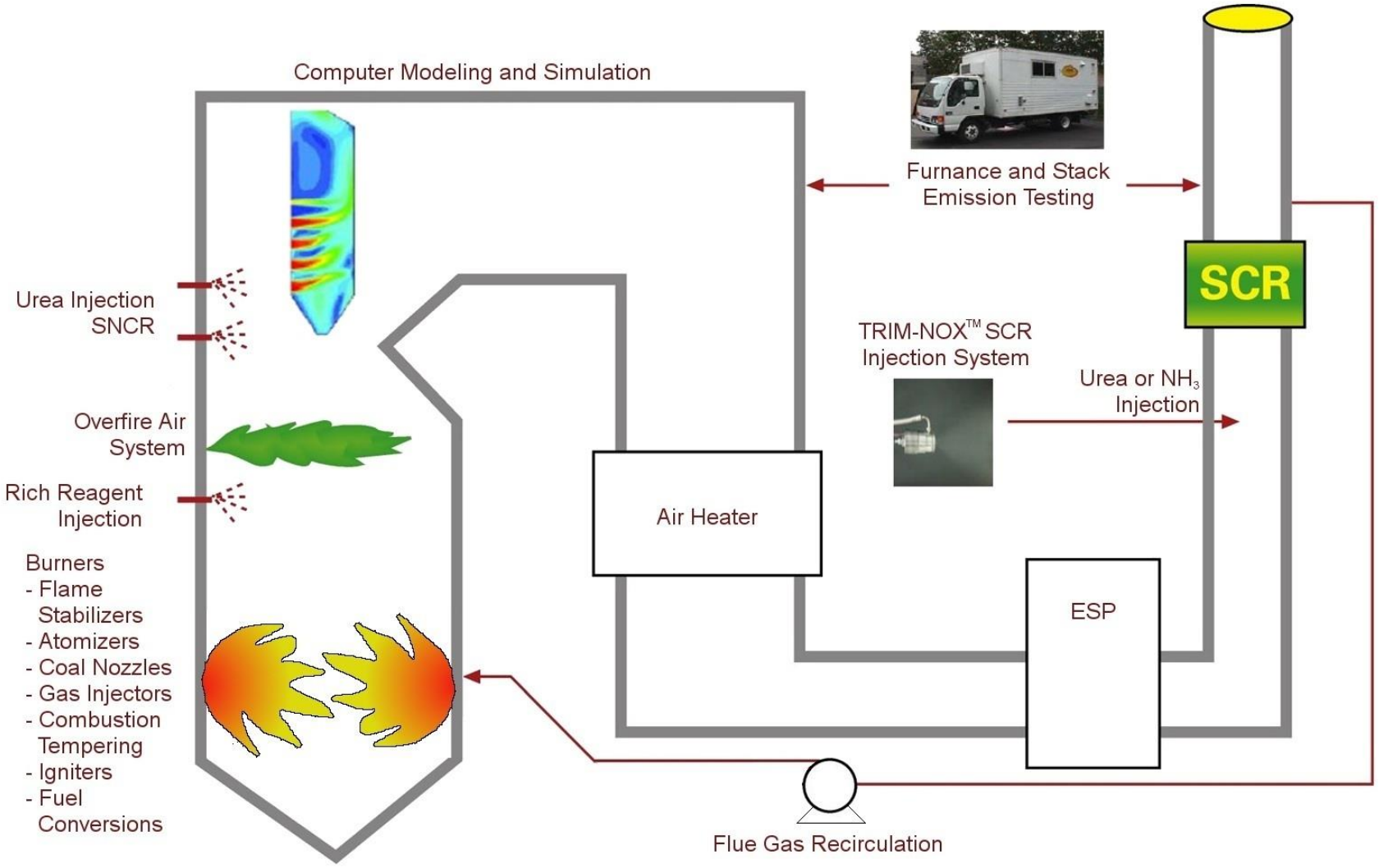
# PMFG Environmental Systems Summary

**840 Emission Control Systems totaling more than 100,000 MW**

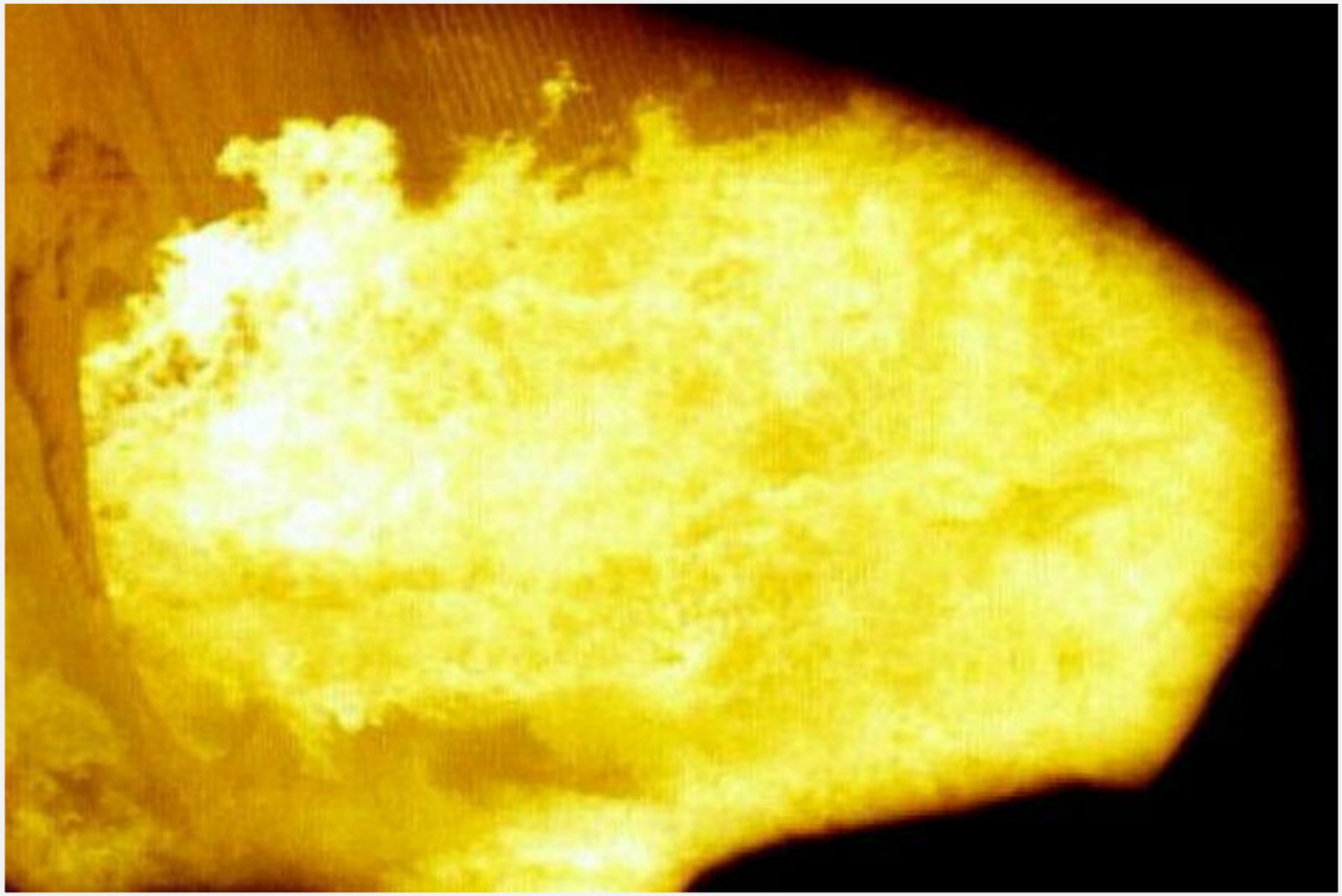
- **Peerless**
  - More than 500 Combustion Turbine applications
  - More than 85 Simple-Cycle Turbine exhaust systems
  - More than 60 retrofit systems for power and refinery applications
  - More than 50 industrial boiler SCR systems
  - 16 I/C engine SCR systems
  - Expertise on custom-engineered solutions and system integration with focus on lowest installed life-cycle cost
  - Expertise in retrofit SCR/CO systems minimizing downtime
  - Expertise in aqueous and anhydrous ammonia based SCR systems, including ammonia flow control units and AIGs
- **CCA**
  - Peerless acquired Combustion Components Associates in March 2014 for expertise in combustion, SNCR and urea based SCR systems. Re-named as CCA Combustion Systems, a division of PMFG.
  - CCA experience on over 400 boilers, IC engines and turbines
  - Provides patented urea to ammonia conversion systems for on site generation of ammonia from safe urea reagent as well as patented direct injection SCR technology

SCR Retrofit for Gulf Coast Refinery Cogen

# CCA Technologies and Services



# Combustion Solutions



# Low-NOx Burner Design

- Multi Fuel
  - Up to 4 Fuels Simultaneously
  - Liquids / Gases
- Fuel Injection
  - Segmented Fuel Streams
- Flame Stabilization
  - Circumferential and Radial Staging

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# Custom Combustion Solutions for Package Boilers

Capacities: 25 to >300 MMBtu/hr heat input

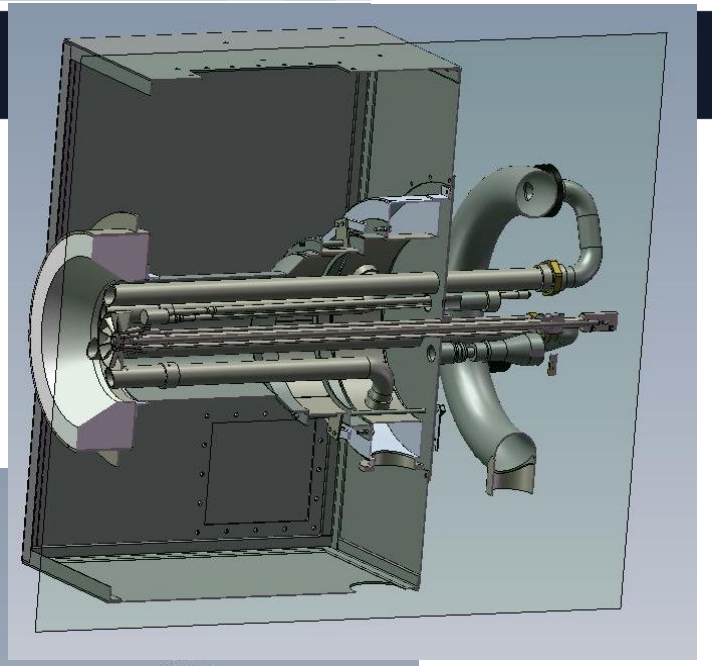
Fuels:

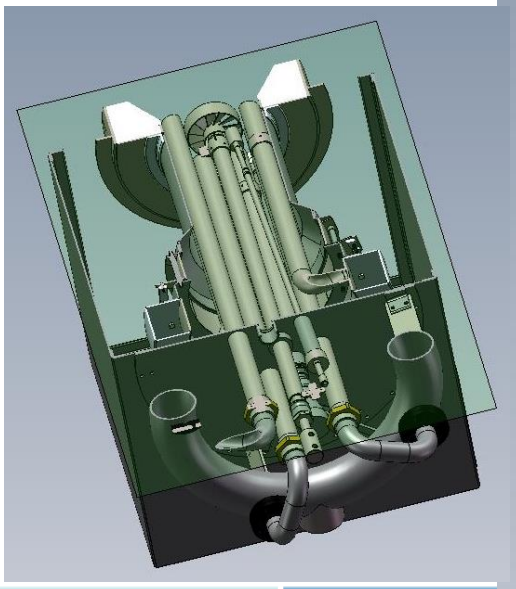
- Virtually all combustible gaseous and liquid fuels including:
  - Natural gas, Refinery gases, Propane, Hydrogen, Landfill / Digester gases
  - Process Off Gases/liquids
  - Heavy Fuel Oil
  - Ultra Heavy Fuel Oils (pitch / bitumen)
  - Light Fuel Oil
    - Ultra-Low Sulfur Oil
  - Kerosene
  - Biomass (walnut shells)
- Air Side Pressure Drop:
  - 6-10”WC (typical)
- Turndown:
  - Natural Gas: 10 – 1 (typical)
  - Oil: 8 - 1 (typical)
- Design Excess Air @ MCR:
  - Gas: 10%
  - Oil: 15%
- CO Emissions:
  - <50 ppm @ 3% O2 typical
  - CO Catalyst Can be Added for <10 ppm

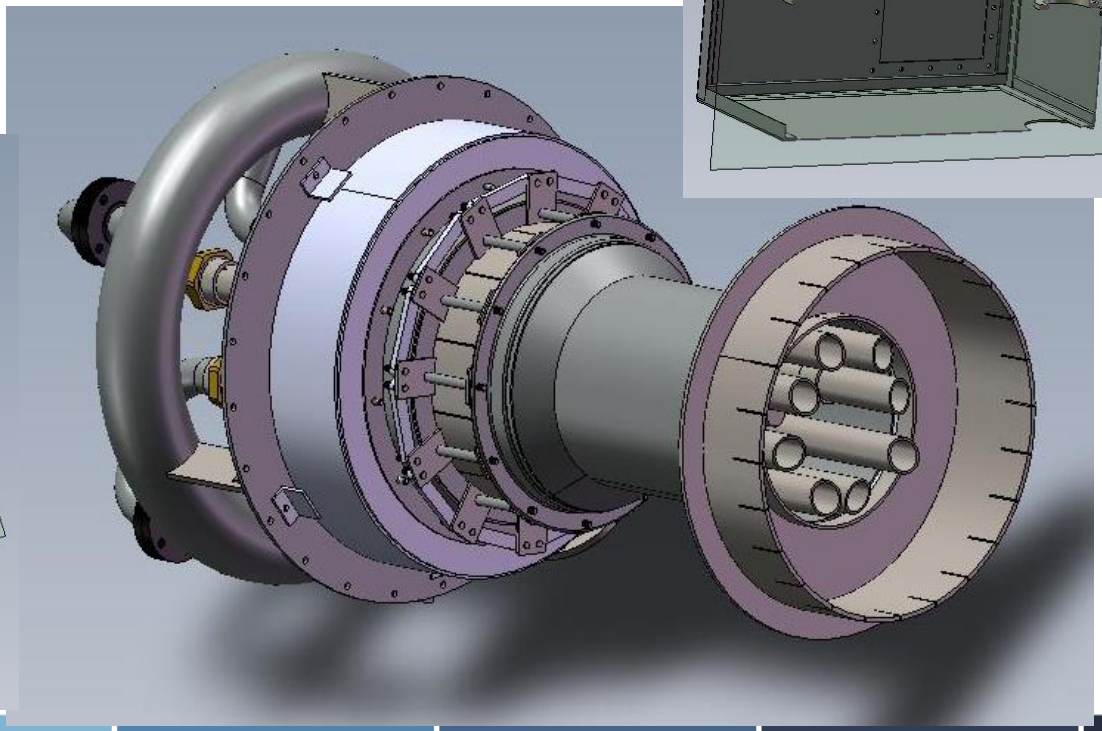

# 3D Solid Works CAD

Better visualization:

- Component Fit
- Clearance review / confirmation







# Fuel Trains

- Oil, Atomizing Media, Main, Secondary and Ignition Gas
- Windbox mounted
- Free standing valve skids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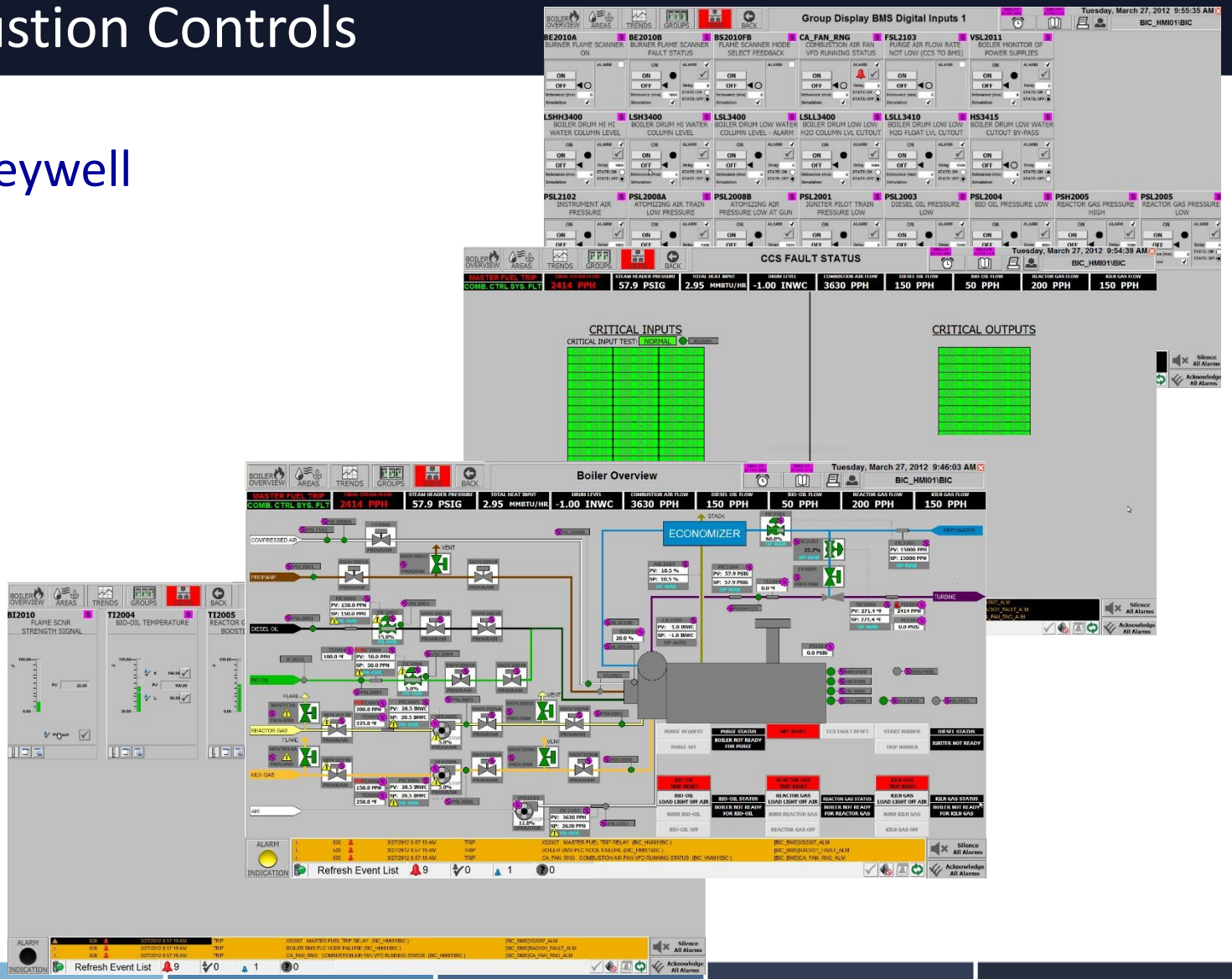
# BMS / Combustion Controls

- Fireye / Honeywell
- PLC Based
- HMI



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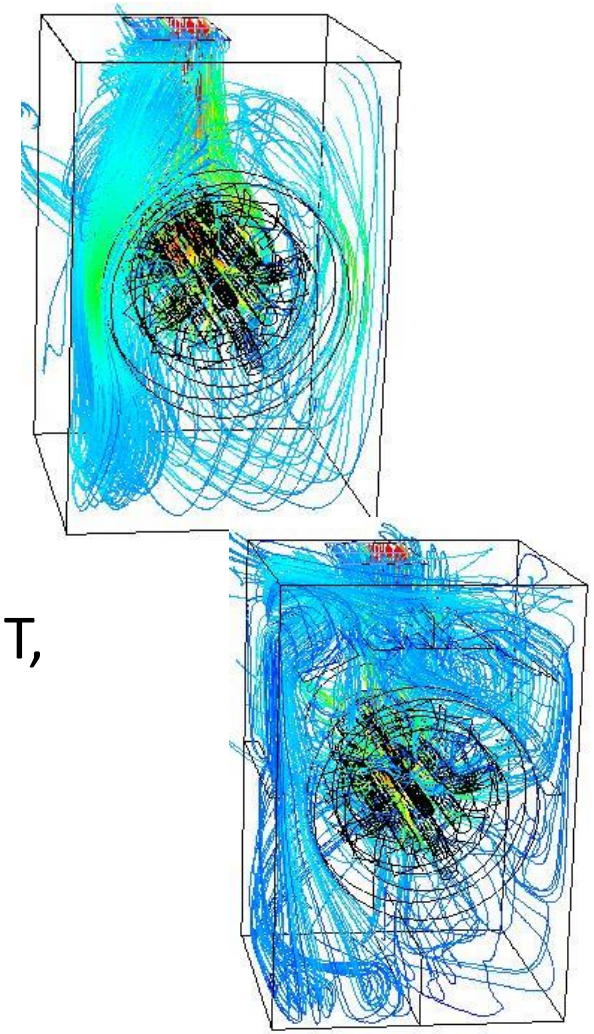
# Integrated Solutions for Package Boilers

## NOx emissions down to <5 ppm:

- Single source (system) responsibility (front and back end) for emissions compliance
- A sub-5 ppm NOx solution which, compared to “ultra” low NOx burners:
  - eliminates the requirement of:
    - extreme levels of FGR
    - increased power consumption
    - sophisticated control / safety systems
    - prolonged commissioning periods
- Can incorporate safe urea based solution to meet ultra-low NOx emissions, not requiring on site storage and handling of ammonia.
  - Flexibility to meet future NOX emissions without major equipment change.
  - Ability to burn low sulfur diesel fuels and still meet ultra-low (sub-10 ppm) NOx
  - Fuel flexibility

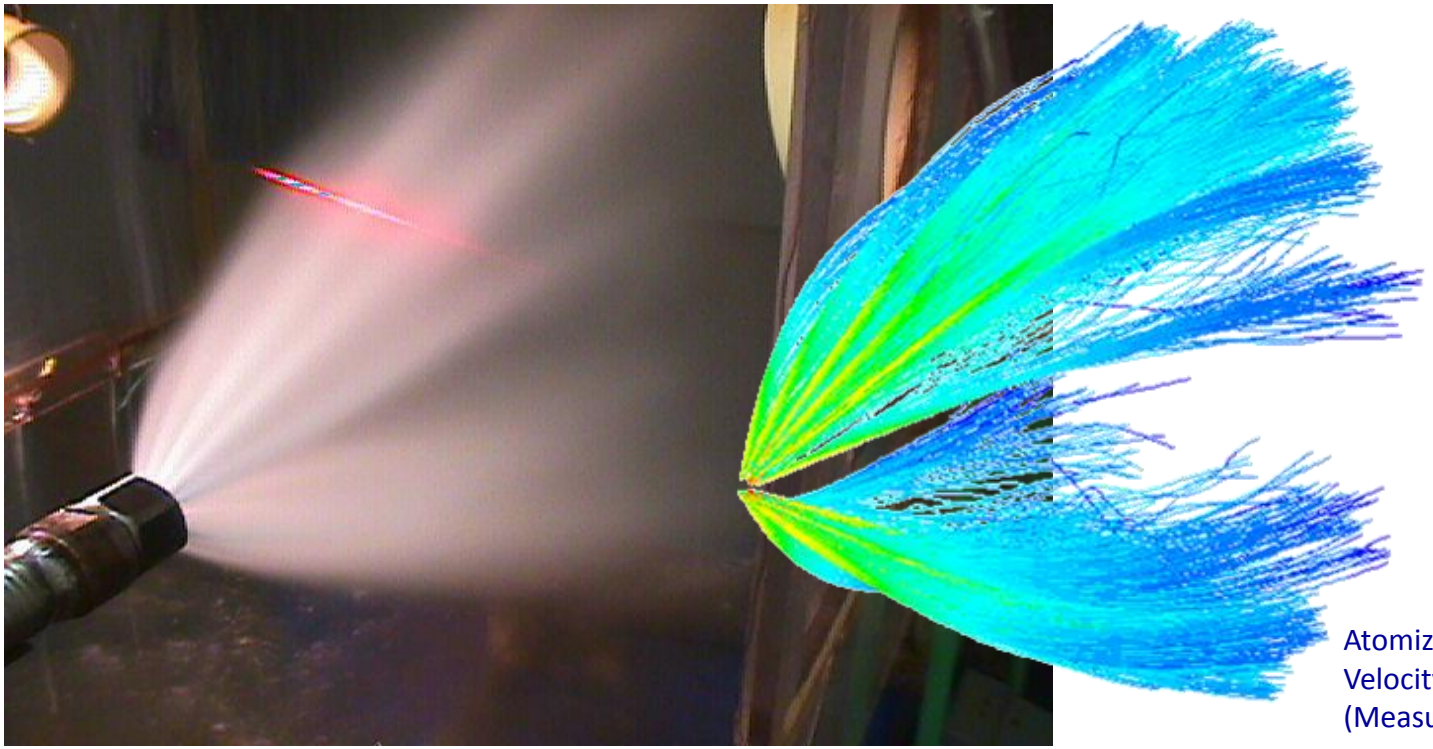
# Computational Fluid Dynamics

- Support Design of Burners, OFA, FGR, SNCR, and SCR Injection Systems
- Fluent & ANSYS CFD Software
- Fully Reacting Model
  - Furnace Mixing & Gas Speciation
  - Particle Trajectories and Streamlines
  - Velocity, Pressure, Momentum, Turbulence
- Heat Transfer (including Radiation), FEGT, and Reaction Species
- Input Basis for Final Design – Ensure Technology Works When Installed



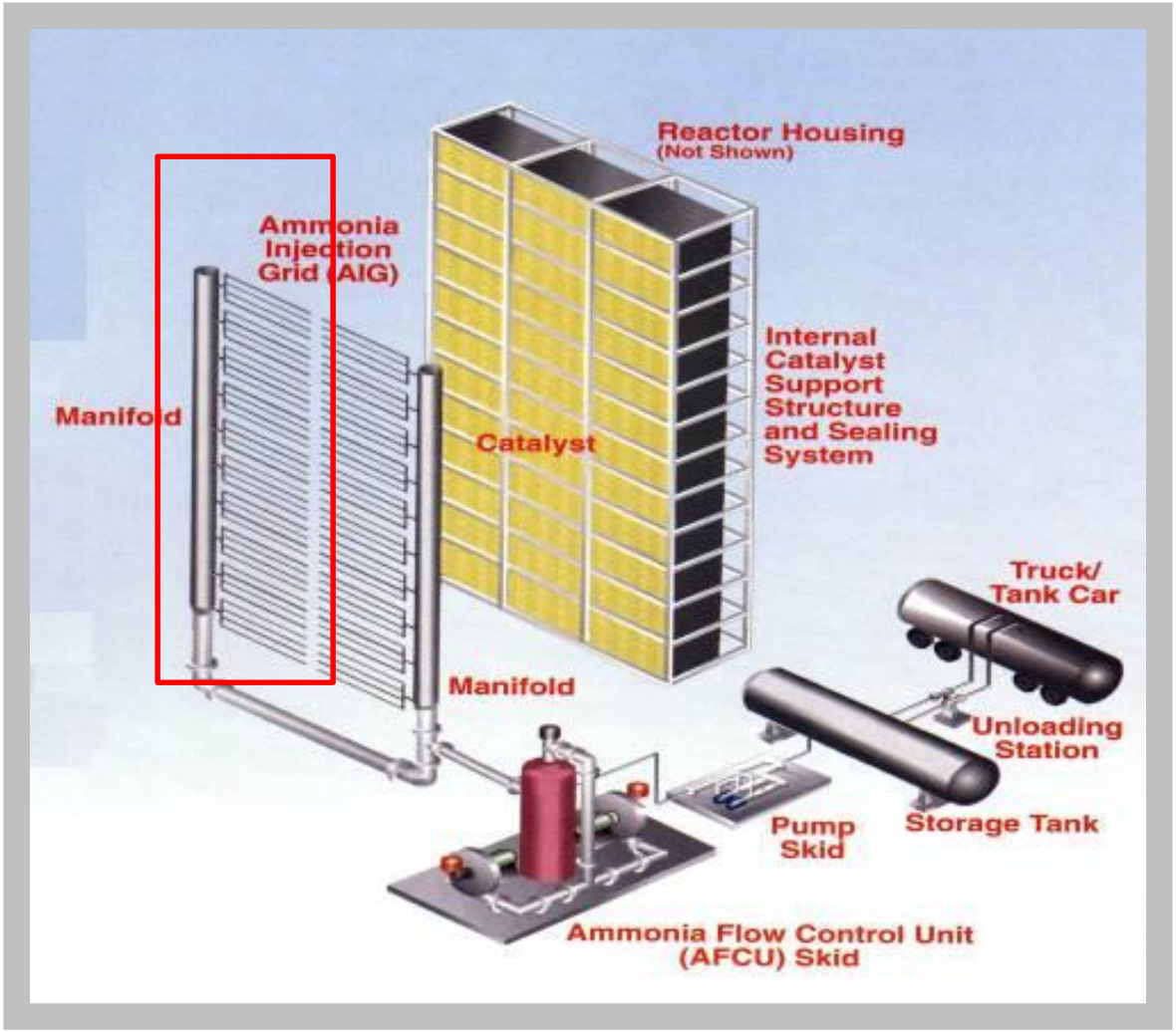
# CCA Spray Laboratory Atomizer Testing

- Liquid Fuel and Reagent Atomizer Spray Laboratory
- Data used in injector/atomizer design and as input to CFD models
- Phase Doppler Particle Analyzer (PDPA)




Atomizer Exit Velocity = 150 fps
Velocity@12” Downstream= 80 fps
(Measured by PDPA)

# Major Components of Traditional Ammonia Based SCR



# Reagent Options for SCR

**Anhydrous Ammonia**

- Concentrated Ammonia ($NH_3$) with a Purity Level of 99.95%
- Stored as a Liquid Under Pressure
- Lowest Equipment and Operating Costs
- Safety Concerns

**Aqueous Ammonia**

- Mixture of Ammonia with Water  Vaporized Onsite to Ammonia Gas
- Usually 19% to 29% Ammonia by Weight
- The Most Common Alternative
- Higher Equipment and Operating Costs than Anhydrous

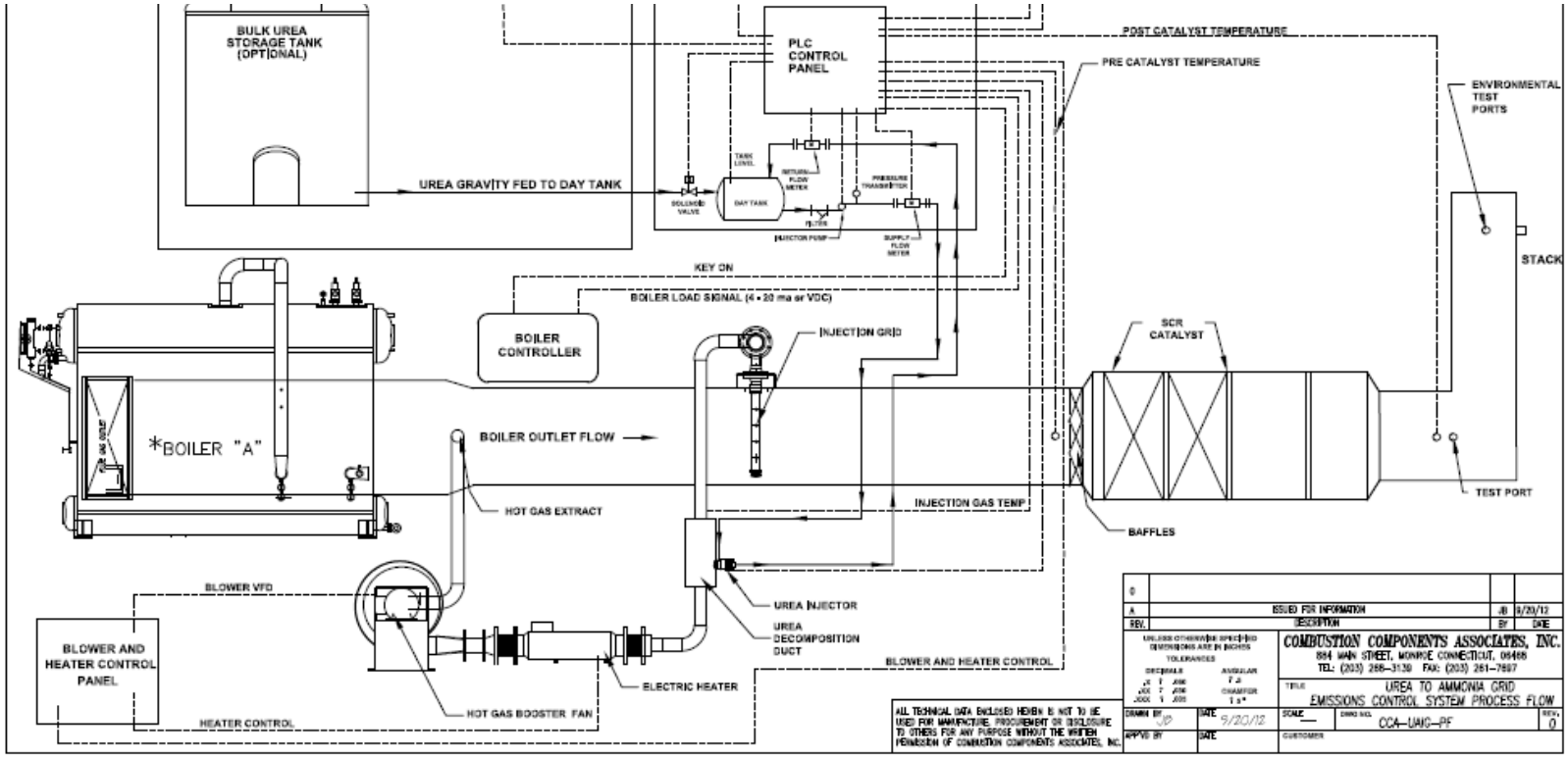
**Urea Systems**

- Less Transportation and Permitting Risk
- Traditionally Uses Onsite Conversion of Urea to Ammonia Gas for Injection
- Traditionally Higher Equipment and Operating Costs than Ammonia
- Direct Injection as a Potential Lower Cost Option

# Urea to Ammonia Decomposition or Ammonia Vaporization Process

**Advantages of Vaporization to Ammonia Gas SCR**

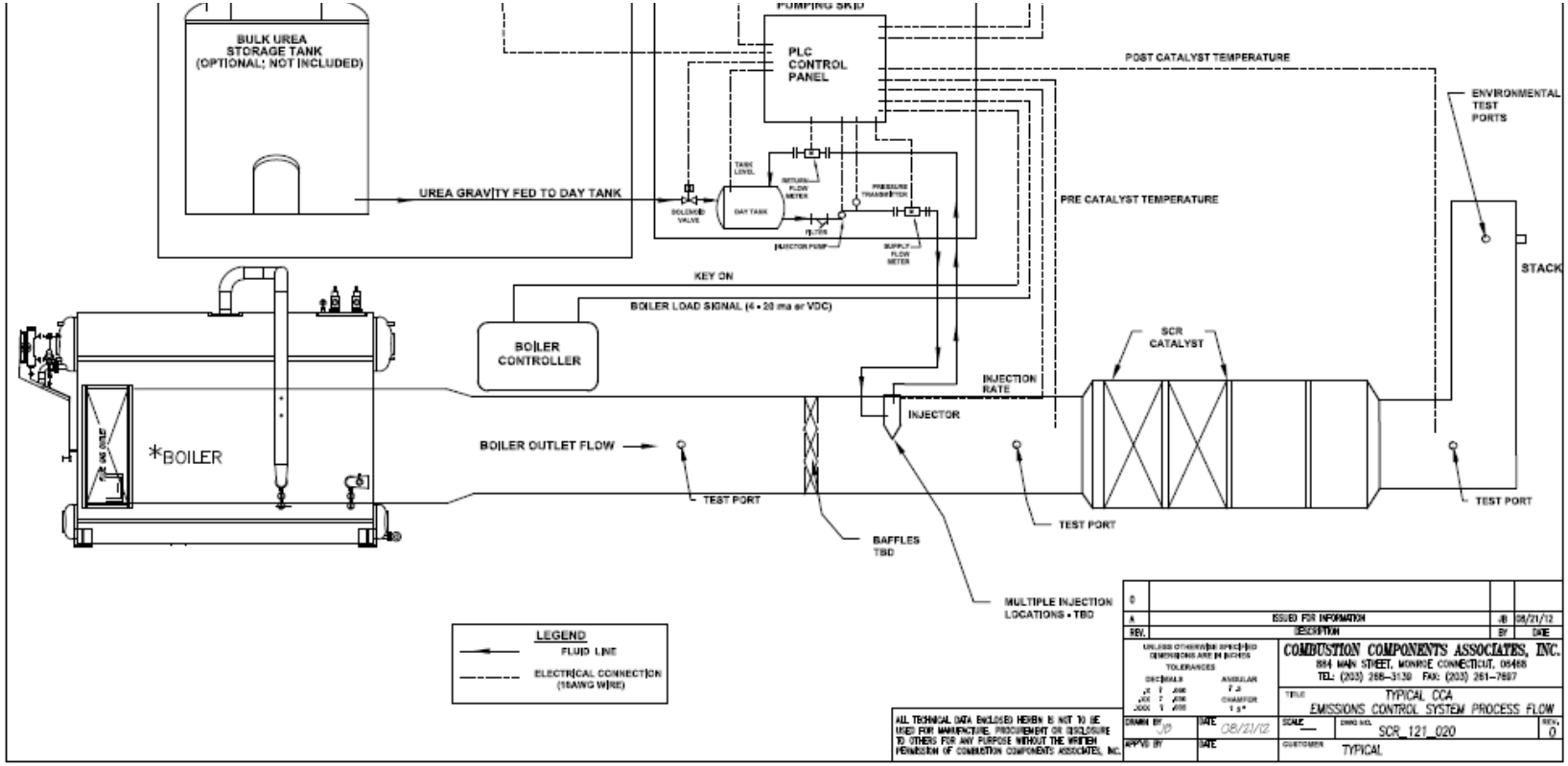
- Requires Less Mixing Space
  - Reduces Duct Length from injection point to Catalyst Face
- Typically allows for better mixing, resulting in lower NOx and NH3 Slip emissions



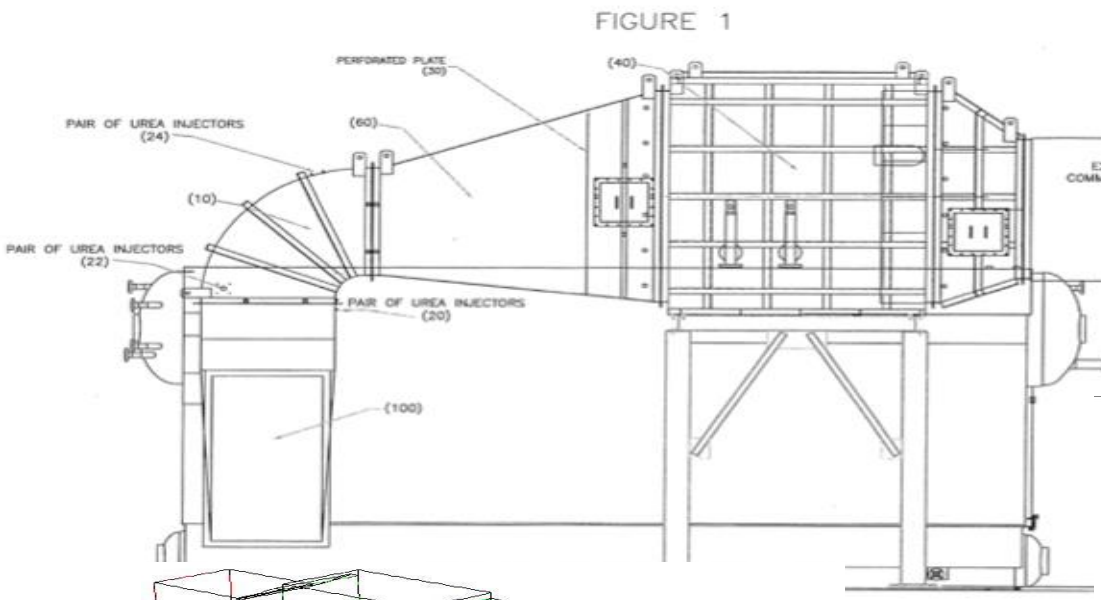
# Direct Injection Process-Ammonia or Urea

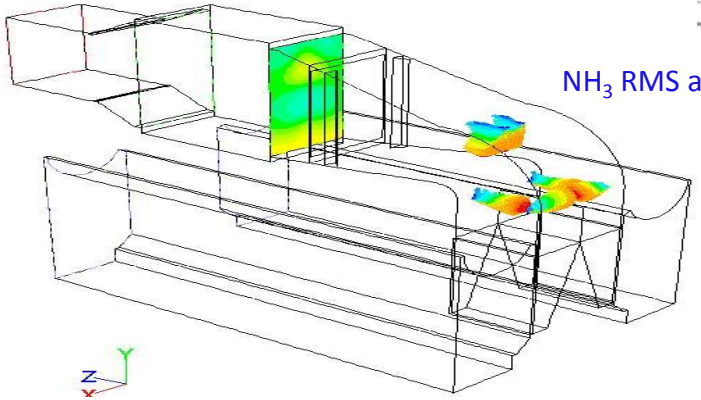
**Advantages of Direct Injection SCR**

- Lower Capitol and Operating Costs
  - Eliminates the need for vaporization equipment such and fans and electric heaters
- Ease of Operation / Installation

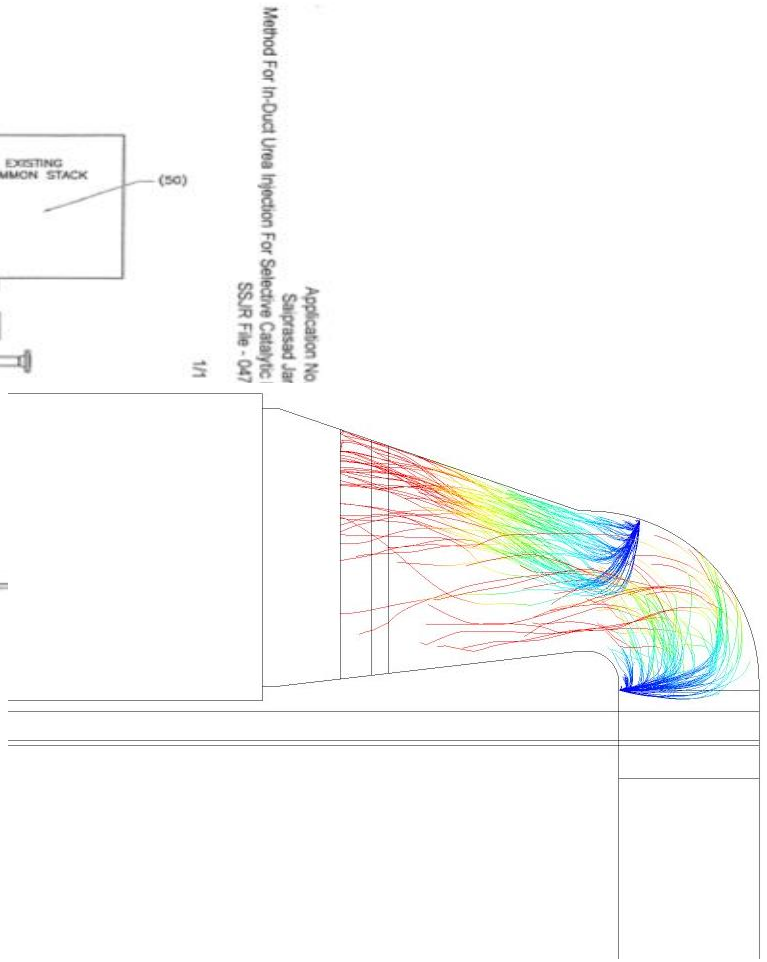


# Patented In-Duct Reagent Injection Using CFD to Locate Wall Injectors



$NH_3$ RMS at SCR inlet = 6.1%



# TRIM-NOX® LT Injection System Application on (2) 55,000 lb/hr Boilers

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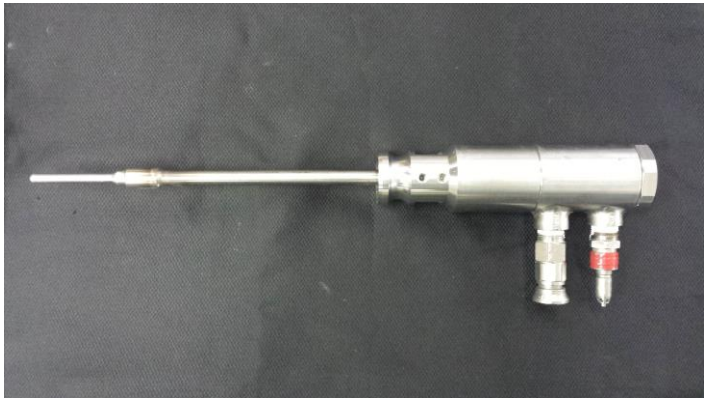
# TRIM-NOX® Urea Injection for SCR System Components

Urea Bulk Tank

PLC Based Injection Skid

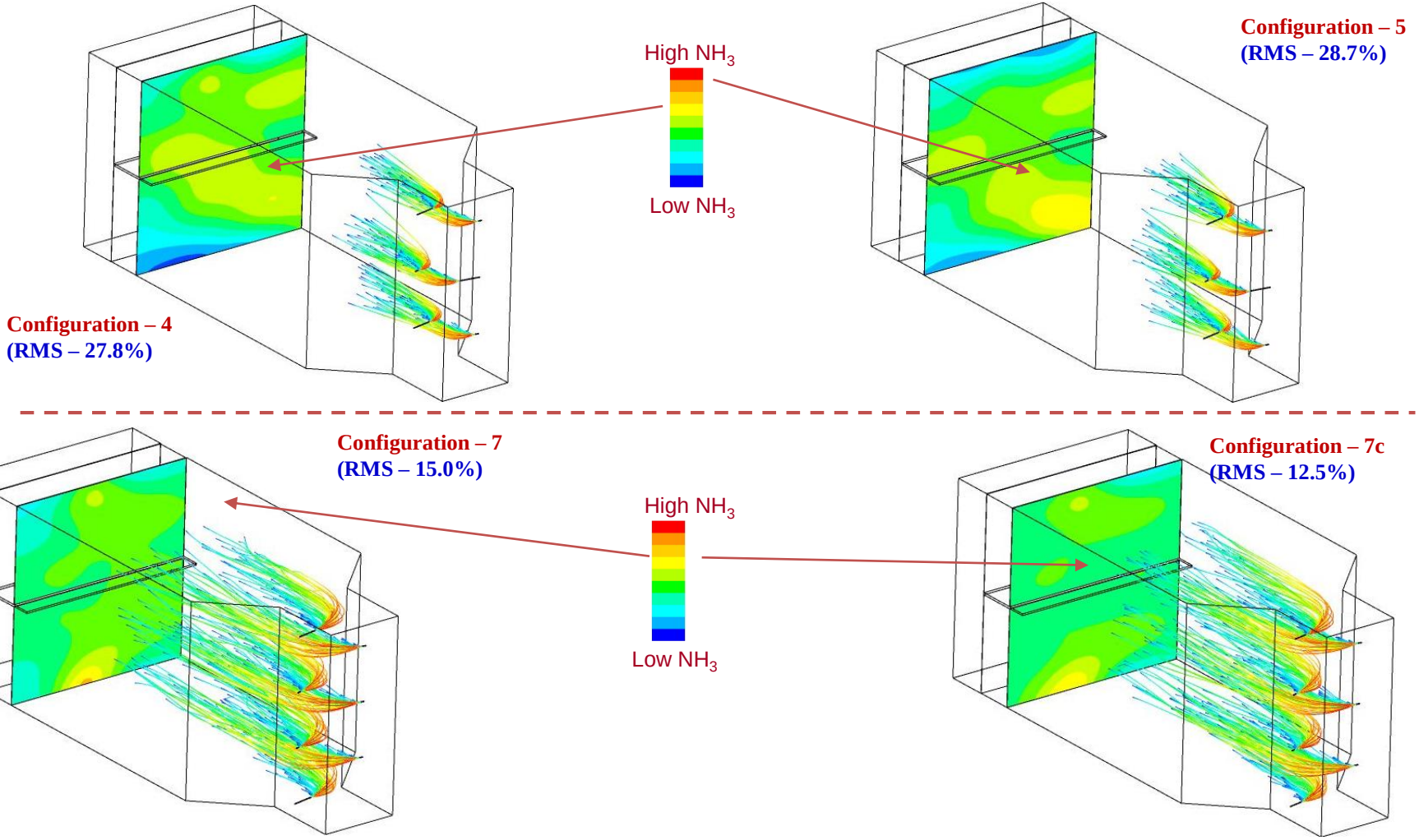


Urea/Ammonia Injector

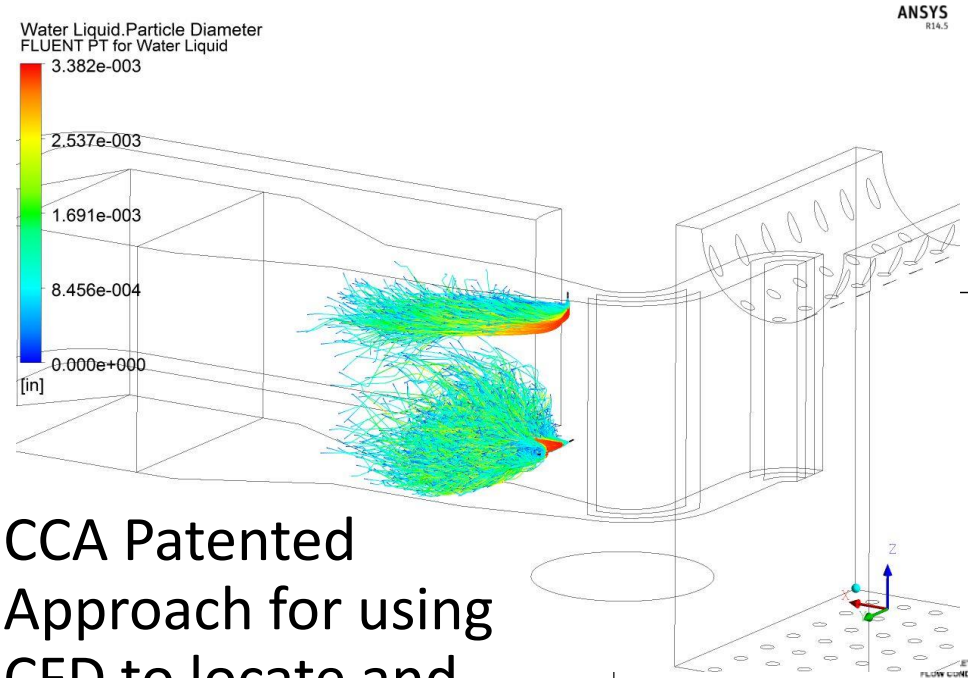
Catalyst Module

Catalyst & Reactor

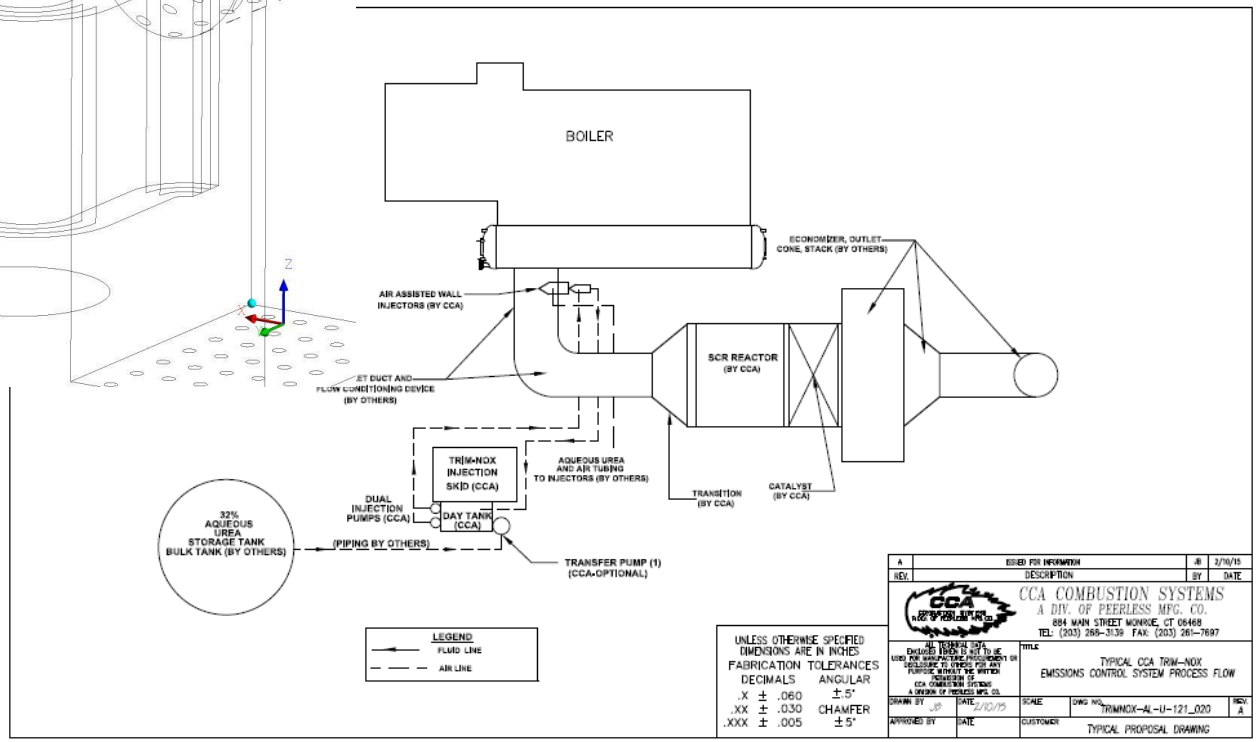
# Direct Injection - Ammonia – 300 KPPH Package Boiler



# Direct Injection – Urea SCR – Horizontal Layout




CCA Patented Approach for using CFD to locate and design SCR Direct Injection Systems



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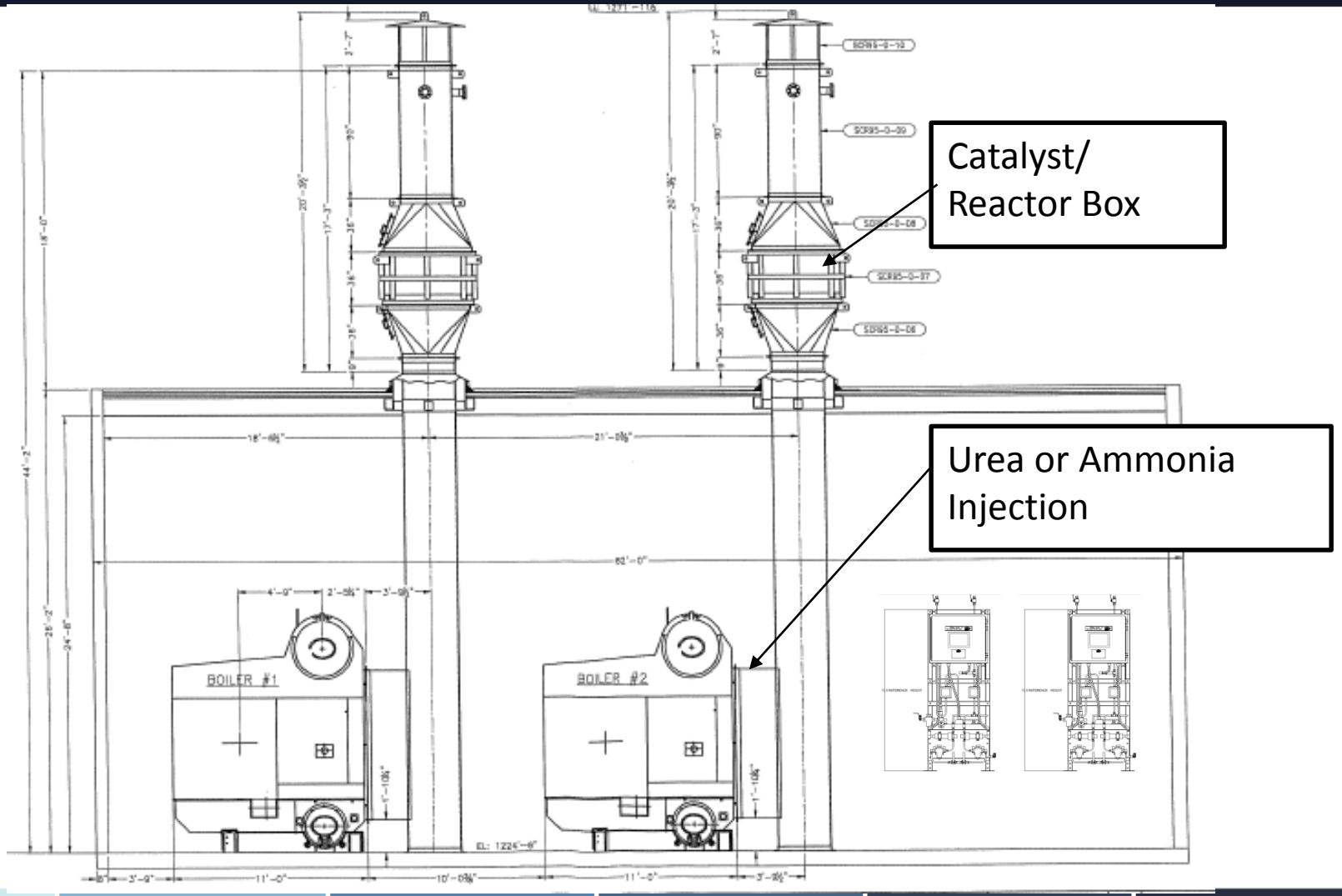
# Direct Injection – Urea SCR – Vertical Layout



# Advanced Engineering Services

CCA has TWIC certified experienced engineers can perform a wide range of services on utility, field erected power boilers, industrial boilers, package boilers, turbines, HRSG's, recovery boilers, thermal oxidizers and auxiliary equipment.

- FIELD TESTING / OPTIMIZATION ON ALL TYPES OF COMBUSTION SYSTEMS
  - NOx Reduction and Optimization Testing
  - Opacity, CO and LOI Reduction Testing
  - Emissions Measurement for Diagnostic Evaluation
  - Flame Pattern Optimization
  - Boiler MACT inspection, tuning and compliance reports
  - SNCR + SCR Tuning and Troubleshooting
  - AIG Tuning and Balancing

# *Contact Information*

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