



**BURNERS**

**FLARES**

**THERMAL OXIDIZERS**

**VAPOR CONTROL**

**RENTALS**

**AFTERMARKET**



# ZEECO

## 2019 International Sales Meeting

Process Burner Division

Eric Pratchard – General Manager

# Process Burners



## Agenda

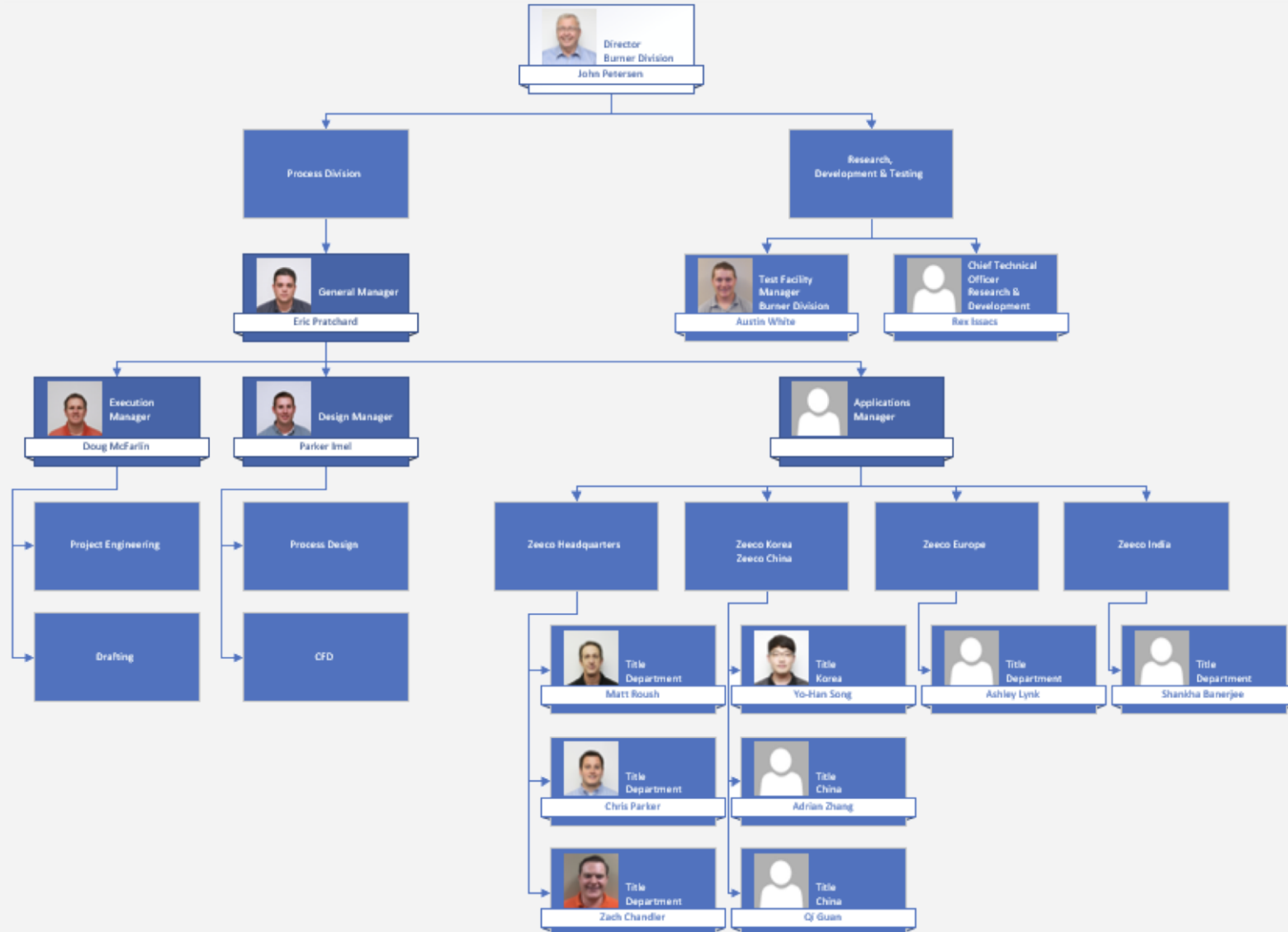
- Organizational Chart
- Burner Technology Advancements
  - Free Jet G2
  - Zenith
- Existing Product Line
  - Single Jet
  - Radiant Wall
- Test Facility

# Organizational Chart

Global Representation



# Process Burner Organization – Global



# Burner Technology Advancements



GLSF FREE-JET G2

Zeeco Zenith

# GLSF FREE-JET G2

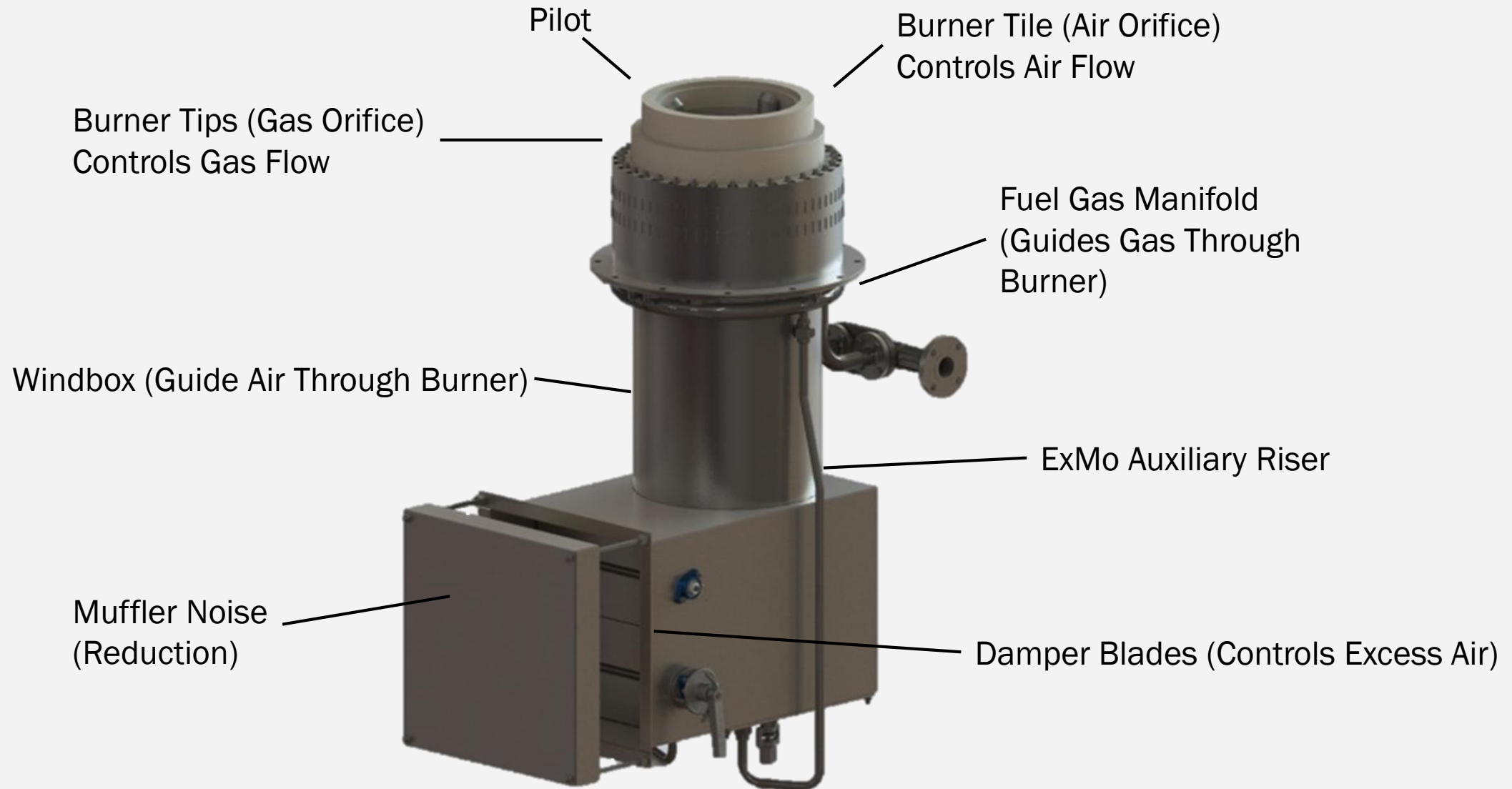
The Second Generation



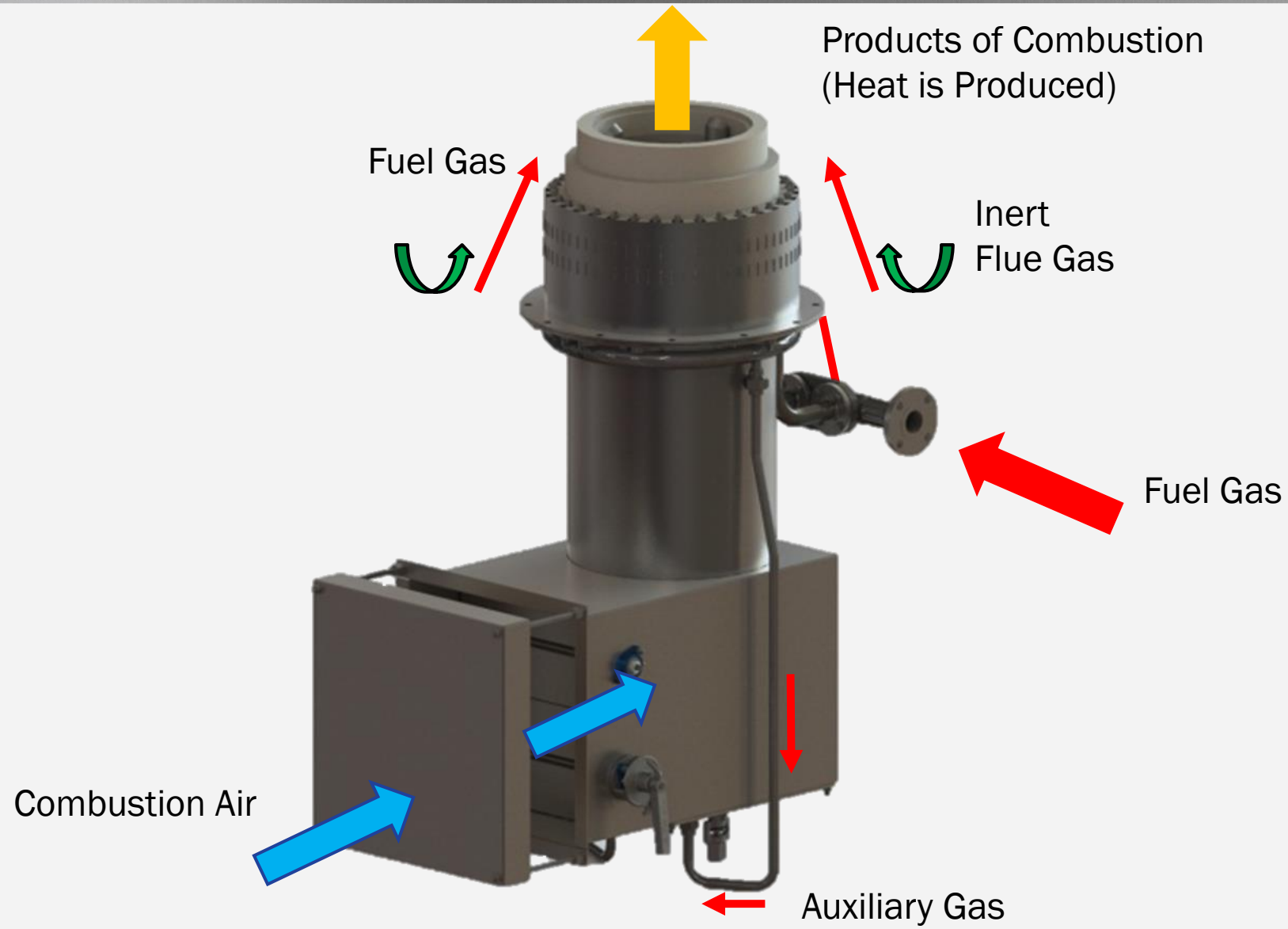
## ➤ Customer Feedback

- Our fuel supply does have liquid carry over. Can you design tips with larger orifices?
- What happens if the primary tips plug?
- What percentage of primary tips can plug before we have to shut down?
- Why do you need so many secondary tips?
- Why can't all secondary tips have the same drill size and angle?

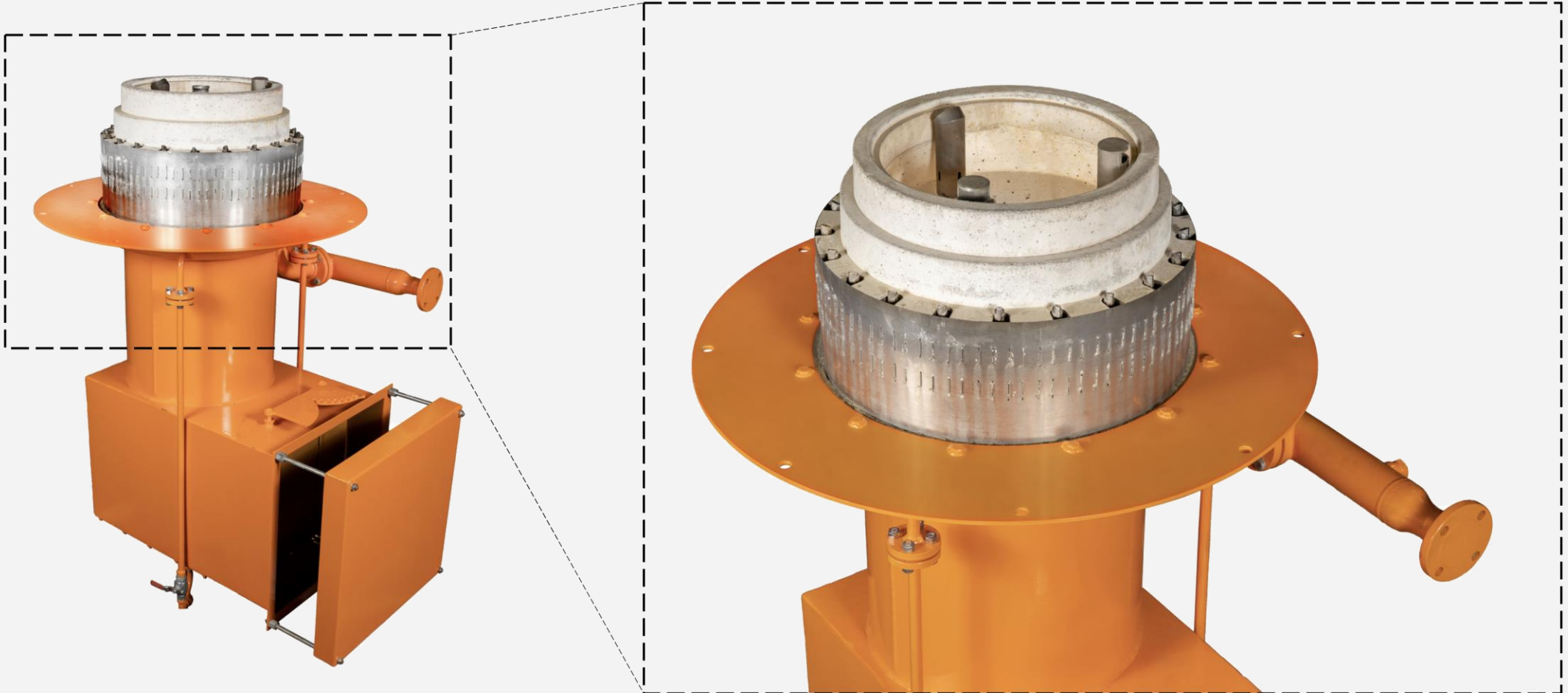
# Generation 1 Design



# How It Works



# Minimal Change – Major Impact



# Mechanical Impact



- Primary Orifice  $\Phi$ 
  - Gen 1: .0625"
  - Gen 2: .0937"
- Secondary Orifice  $\Phi$ 
  - Gen 1: .0937"
  - Gen 2: 0.144"

| Size | Primary Tip Qty |       | Secondary Tip Qty |       |
|------|-----------------|-------|-------------------|-------|
|      | Gen 1           | Gen 2 | Gen 1             | Gen 2 |
| 6    | 2               | 2     | 22                | 11    |
| 8    | 2               | 3     | 26                | 13    |
| 9    | 2               | 3     | 28                | 14    |
| 10   | 2               | 3     | 30                | 15    |
| 12   | 2               | 4     | 34                | 17    |
| 13   | 2               | 4     | 38                | 16    |
| 14   | 2               | 4     | 42                | 21    |
| 15   | 3               | 4     | 46                | 23    |
| 16   | 3               | 5     | 48                | 24    |
| 18   | 4               | 5     | 54                | 27    |

# Proven Test Results

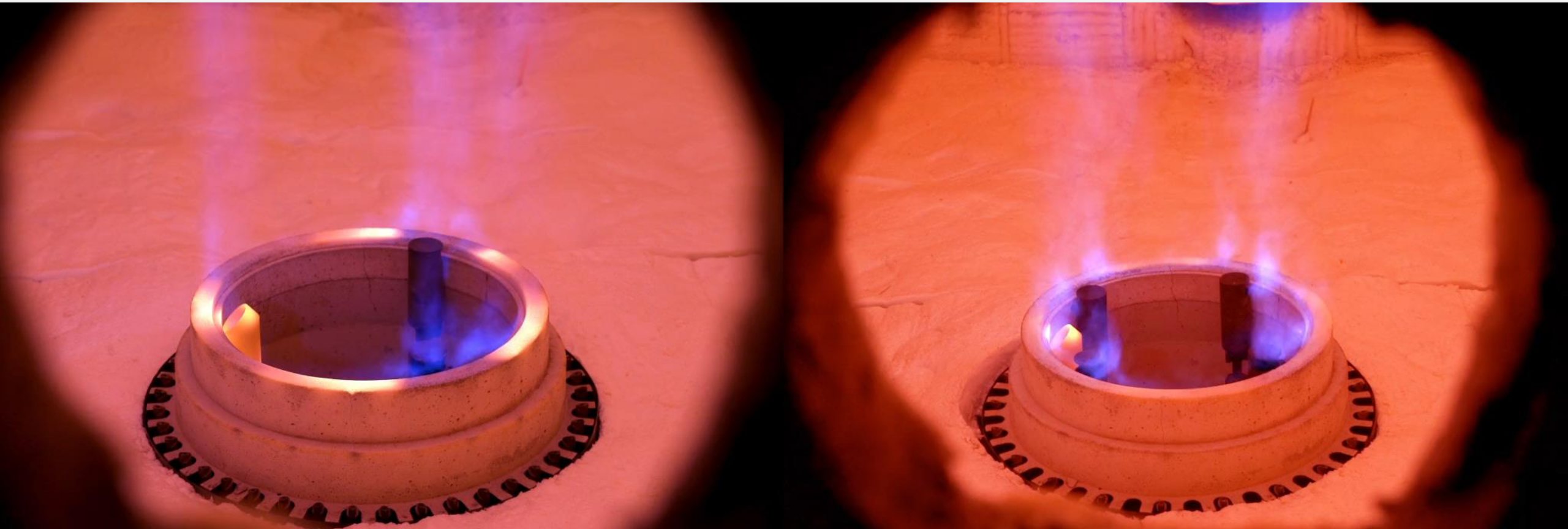


| Fuel Component       |                    |                   | Test Pt. 1 | Test Pt. 2 | Test Pt. 3 | Test Pt. 4 | Test Pt. 5 | Test Pt. 6 |
|----------------------|--------------------|-------------------|------------|------------|------------|------------|------------|------------|
| Nat Gas, Vol %       |                    |                   | 100        | 100        | 50         | 50         | 40         | 40         |
| H2, Vol %            |                    |                   |            |            | 25         | 25         | 40         | 40         |
| Propane, Vol %       |                    |                   |            |            | 25         | 25         | 20         | 20         |
| Secondary Tip Design | Primary Tip Design | Primary Tip Count | NOx, ppm   | NOx, ppm   | NOx, ppm   | NOx, ppm   | NOx, ppm   | NOx, ppm   |
| Gen 1                | Gen 1              | 2                 | 10.4       | 10.9       | 12.0       | 12.7       | 12.2       | 12.8       |
| Gen 1                | Gen 2              | 2                 | 10.4       | 10.0       | 11.6       | 10.2       | 12.3       | 12.3       |
| Gen 2                | Gen 2              | 2                 | 8.8        | 8.0        | 11.9       | 13.8       | 13.4       | 13.9       |
| Gen 2                | Gen 2              | 3                 | 9.8        | 9.8        | 14.0       | 15.9       | 16.5       | 16.5       |
| Gen 2                | Gen 2              | 4                 | 13.4       | 15.6       | 16.7       | 17.0       | 18.6       | 20.0       |

# GLSF FREE-JET G2



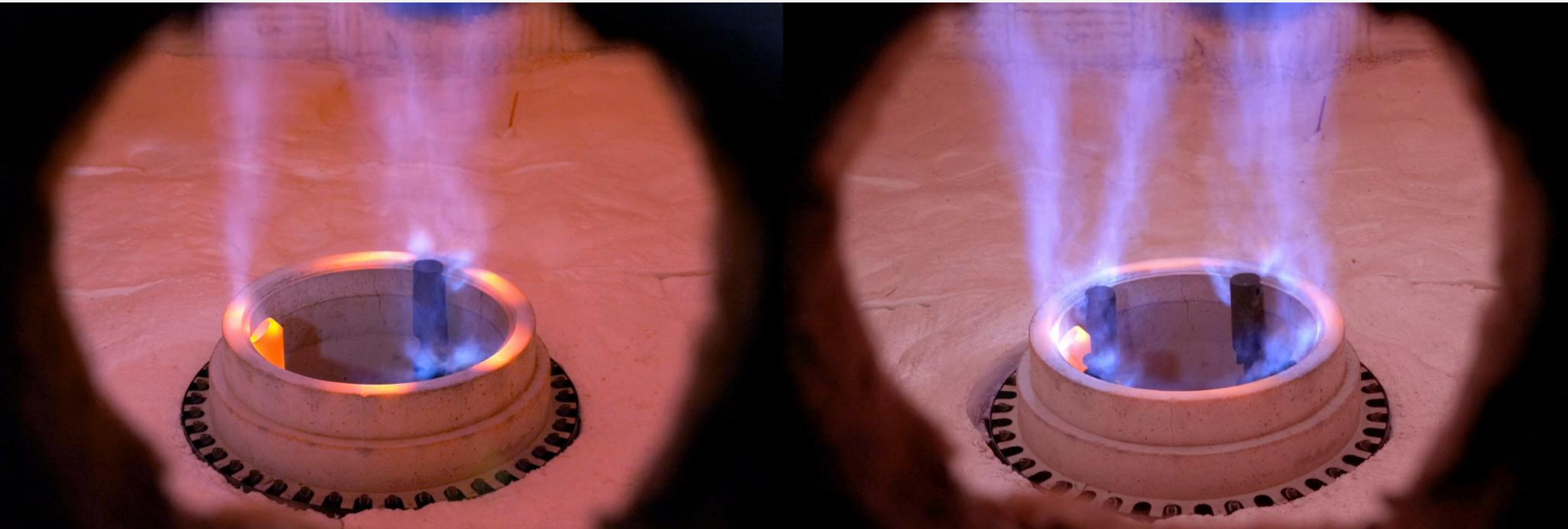
**100% Nat Gas – Design Heat Release**



# GLSF FREE-JET G2



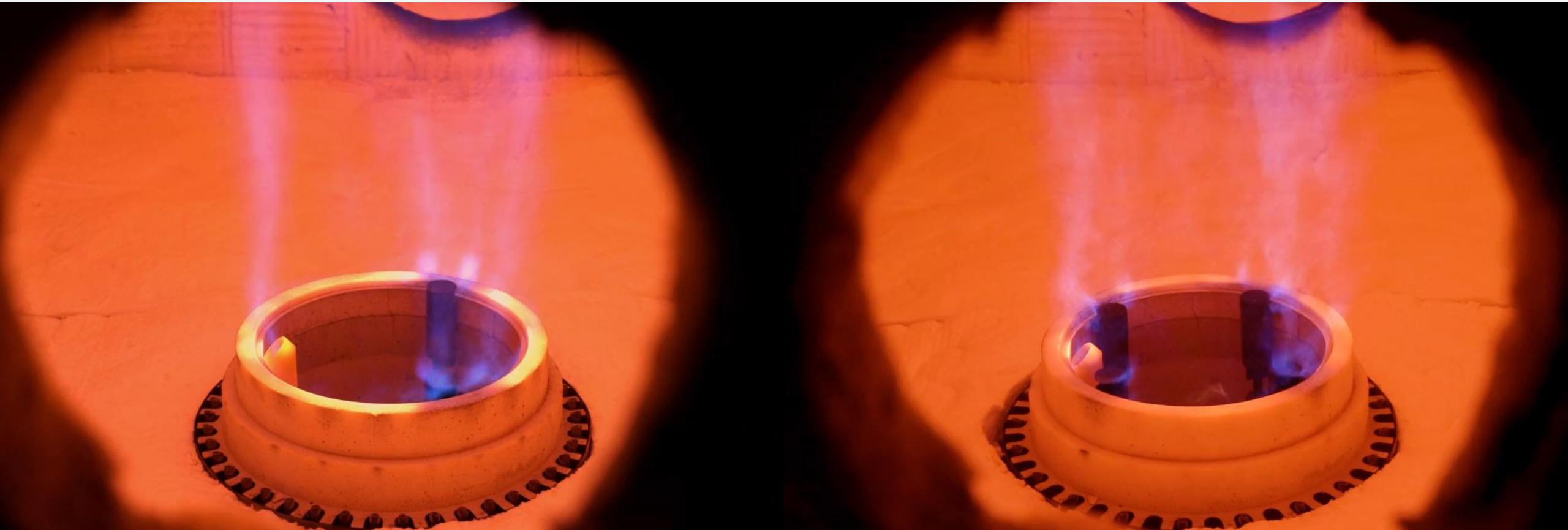
**100% Nat Gas – 2:1 Turndown**



# GLSF FREE-JET G2



50% NG / 25% C<sub>3</sub> / 25% H<sub>2</sub> – Design Heat Release



# Selling Points



## ➤ New Heater Installations

- Increased Primary Tip Count Improves Stability, Reliability & Safety
- Reduced Secondary Tip Quantity Lowers Maintenance Cost
- Increased Tip Diameter Reduces Maintenance Interval
- 3/32" Minimum Primary Firing Diameter

## ➤ Retrofit Opportunities

- Two Options
  - Replace Existing Quantity of Primary Tips and Risers
  - Provide New Front Plate with Increased Primary Tip Count
- Replacement Secondary Tips and Risers
- Plugs for Manifold Locations No Longer in Use
- Revalidate Original Process Warranty for 12 Months

# Zeeco Zenith

Cold Furnace Emissions Compliance

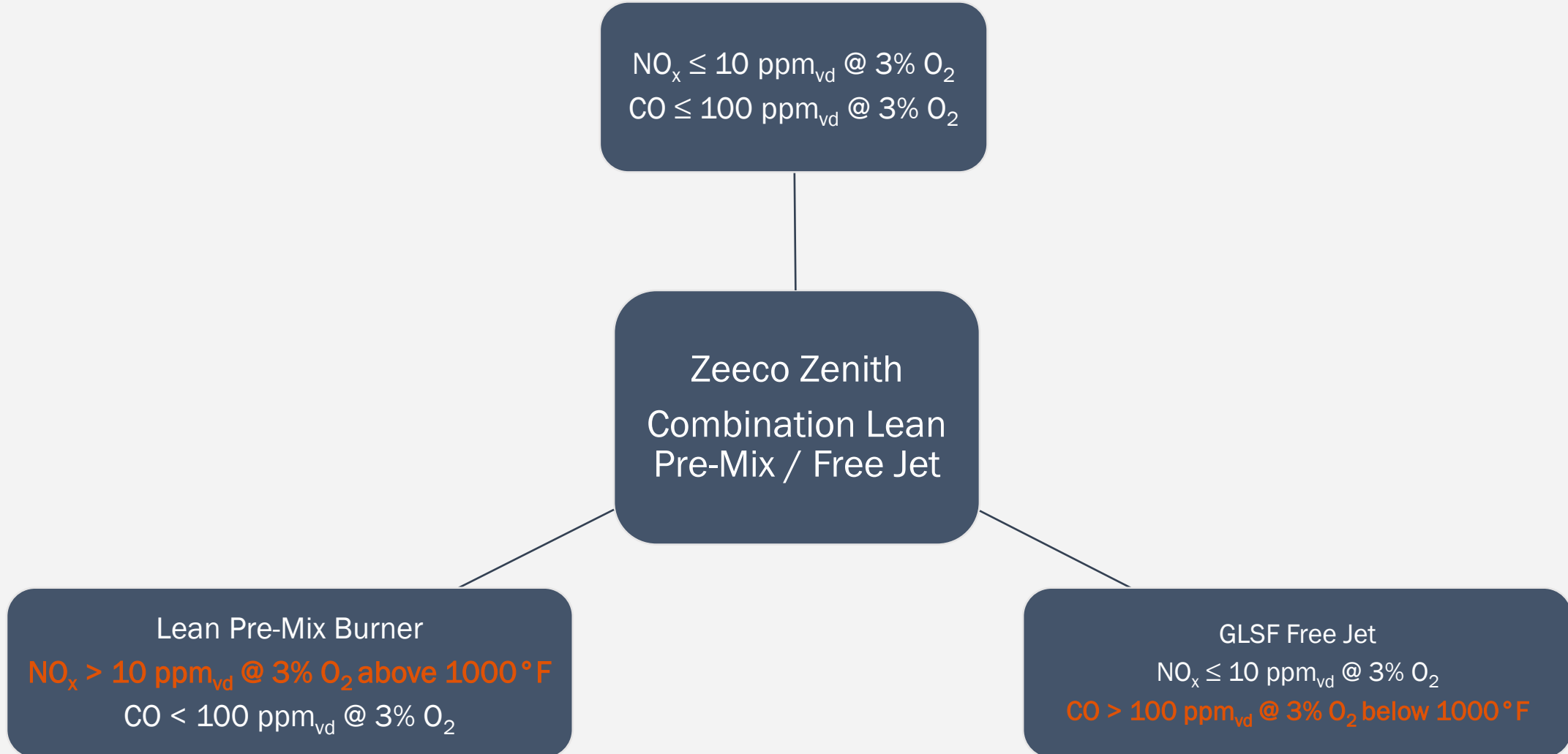


# Customer Challenge

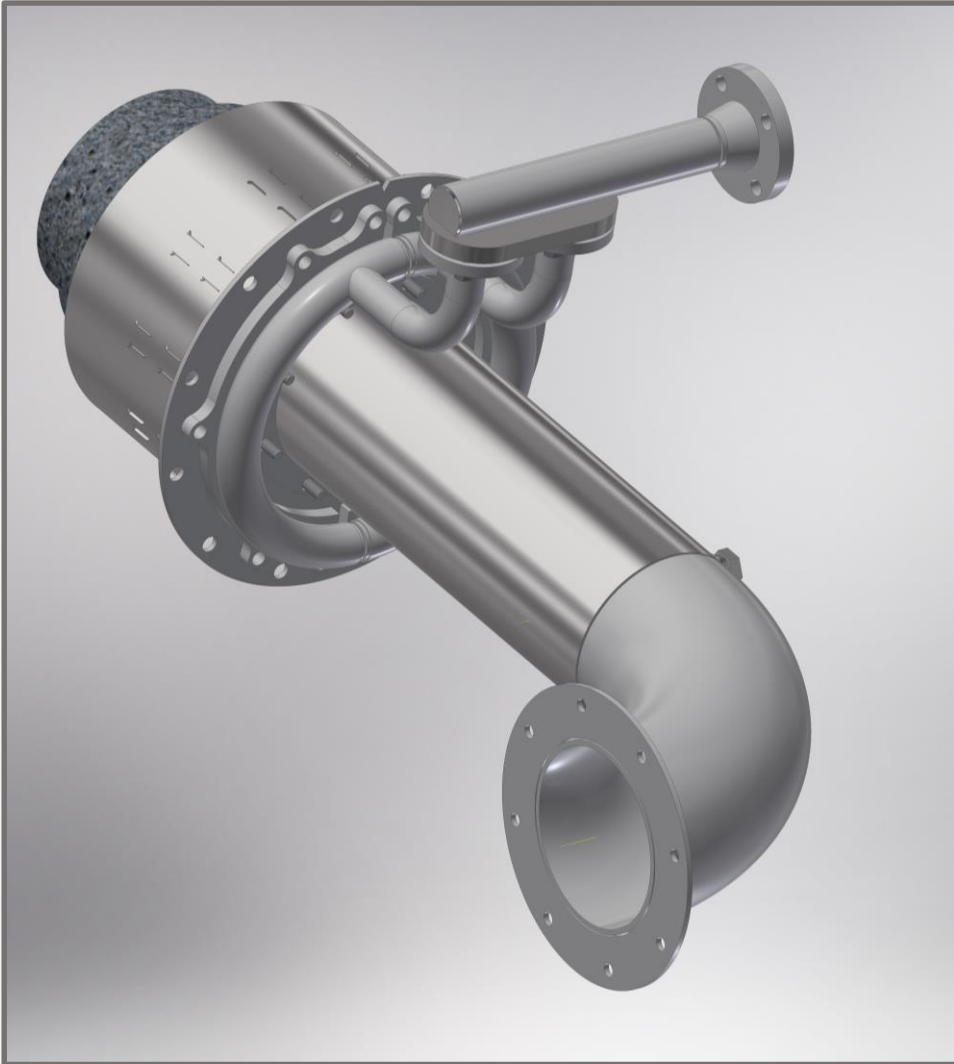


- Satisfy emissions through the heater's full operational range. CO and NO<sub>x</sub>
- Allowances
  - Forced draft system with no pressure limitation
  - Contribute to instrument & control design
  - Contribute to control narrative and operational philosophy

# Development Process



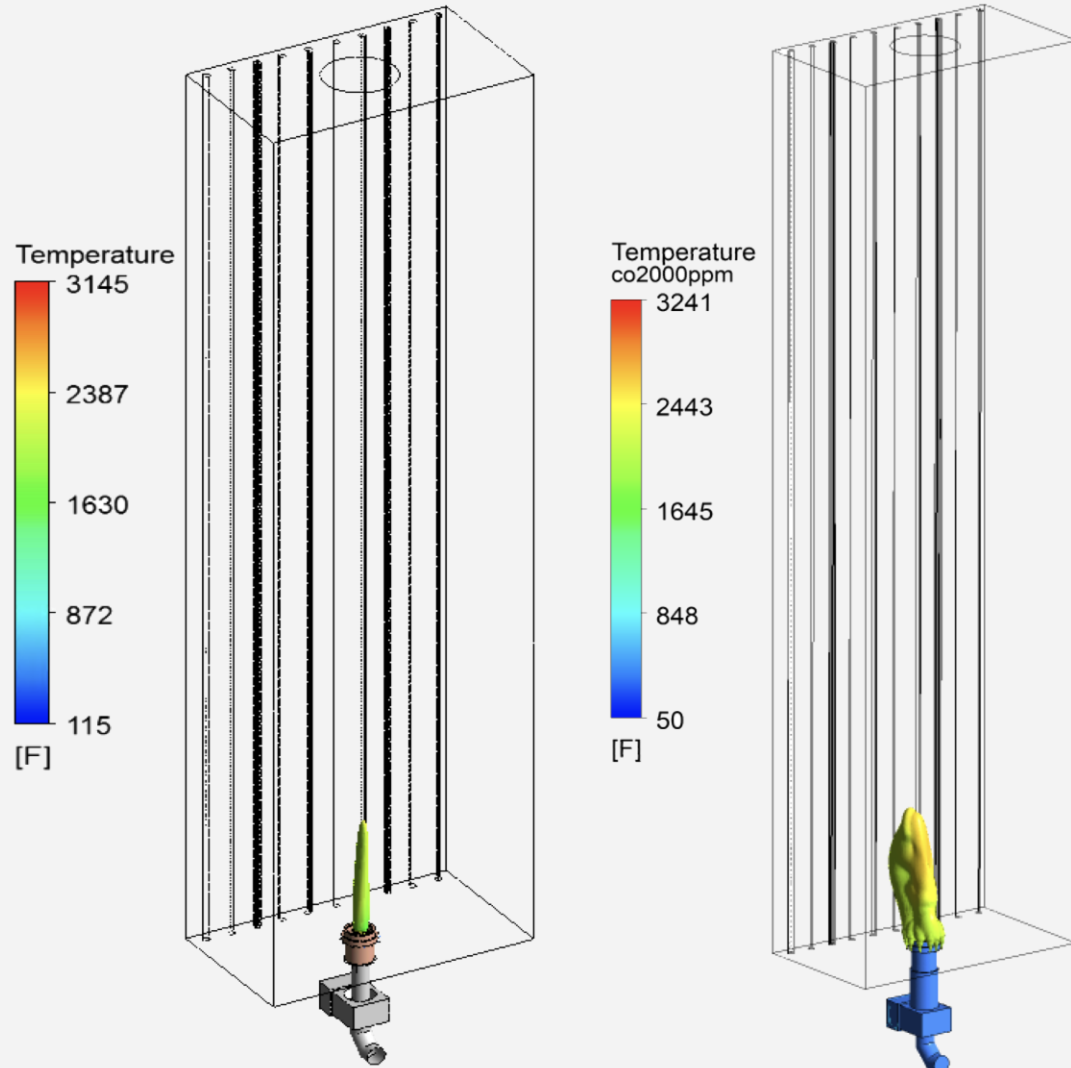
# 3D Representation



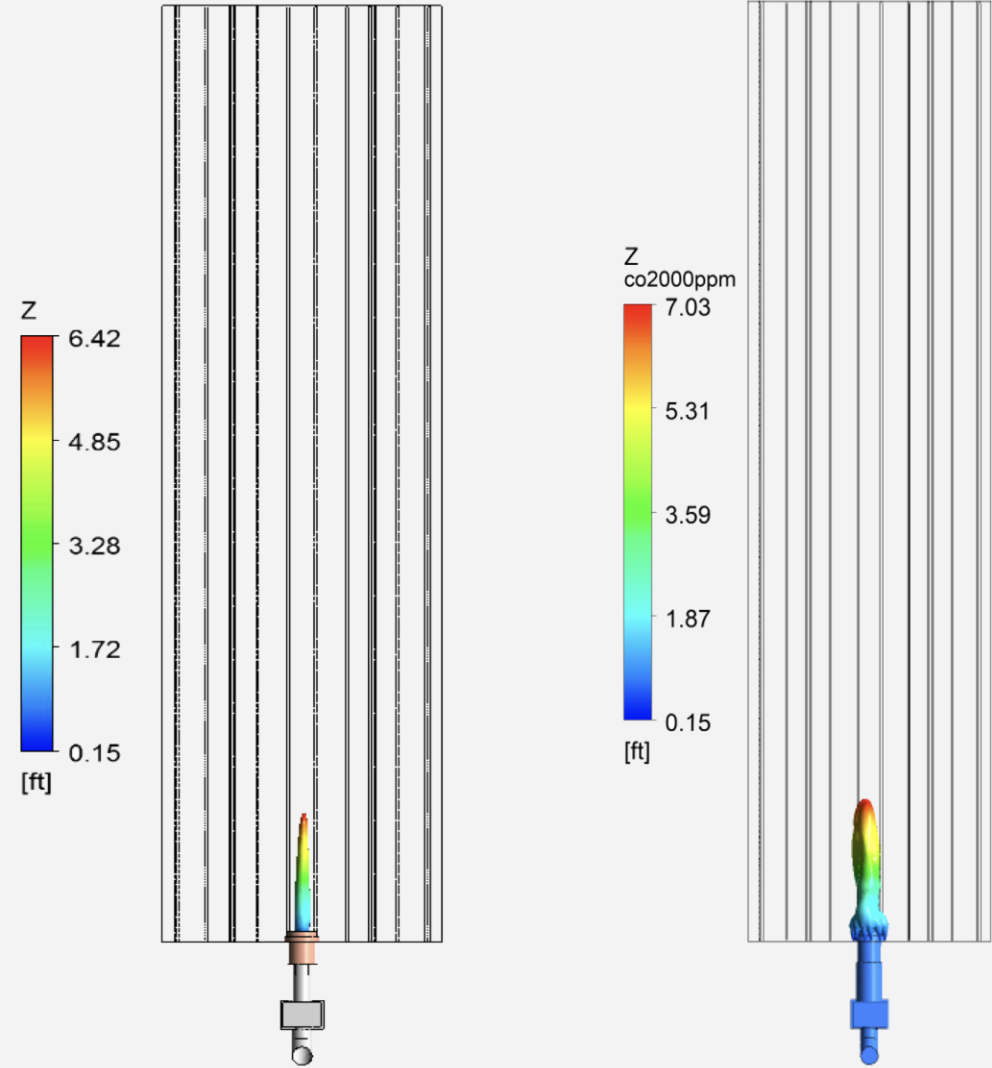
# Flame Length



Isometric View



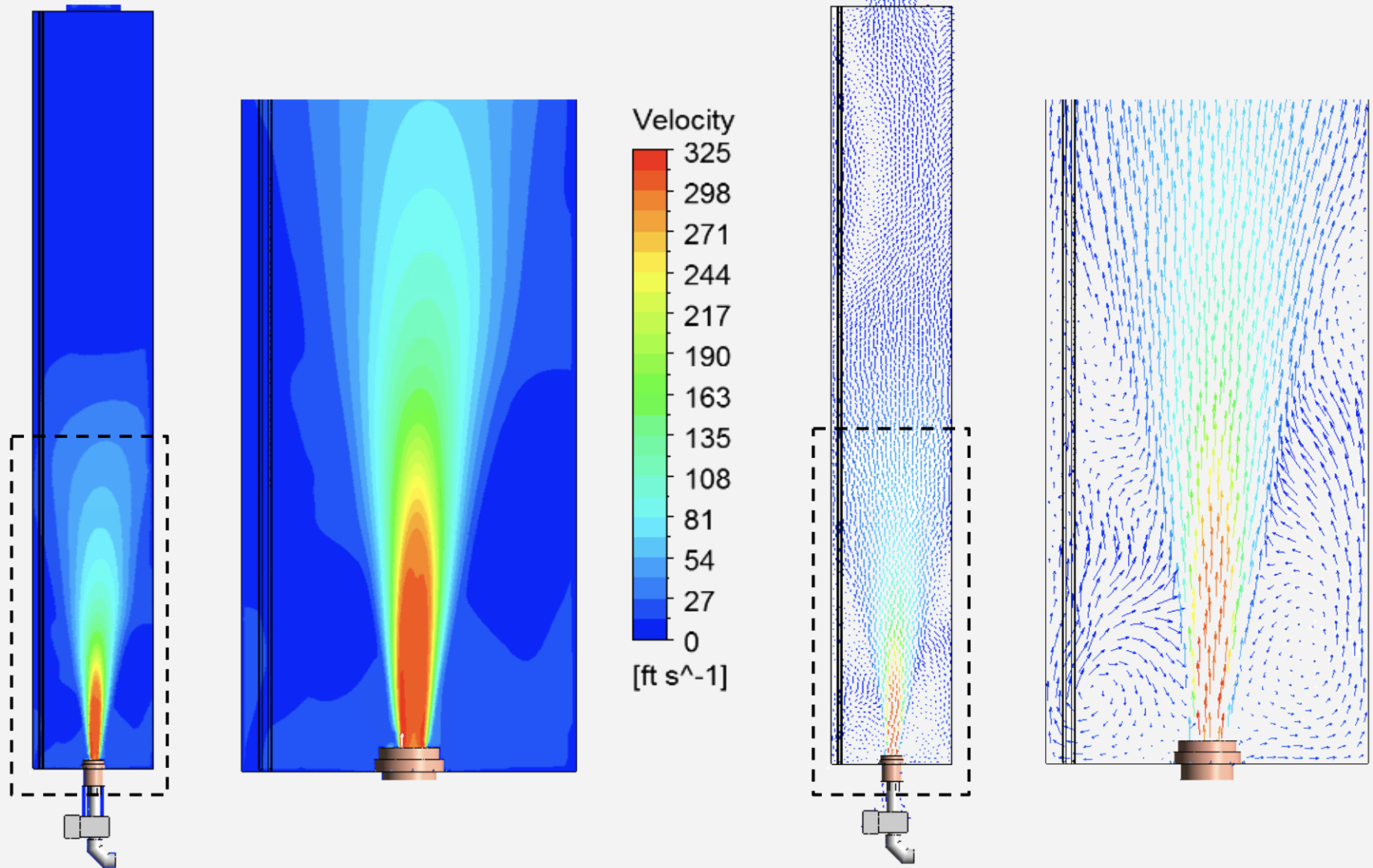
Side View



# Velocity Magnitude & Vectors – Side View



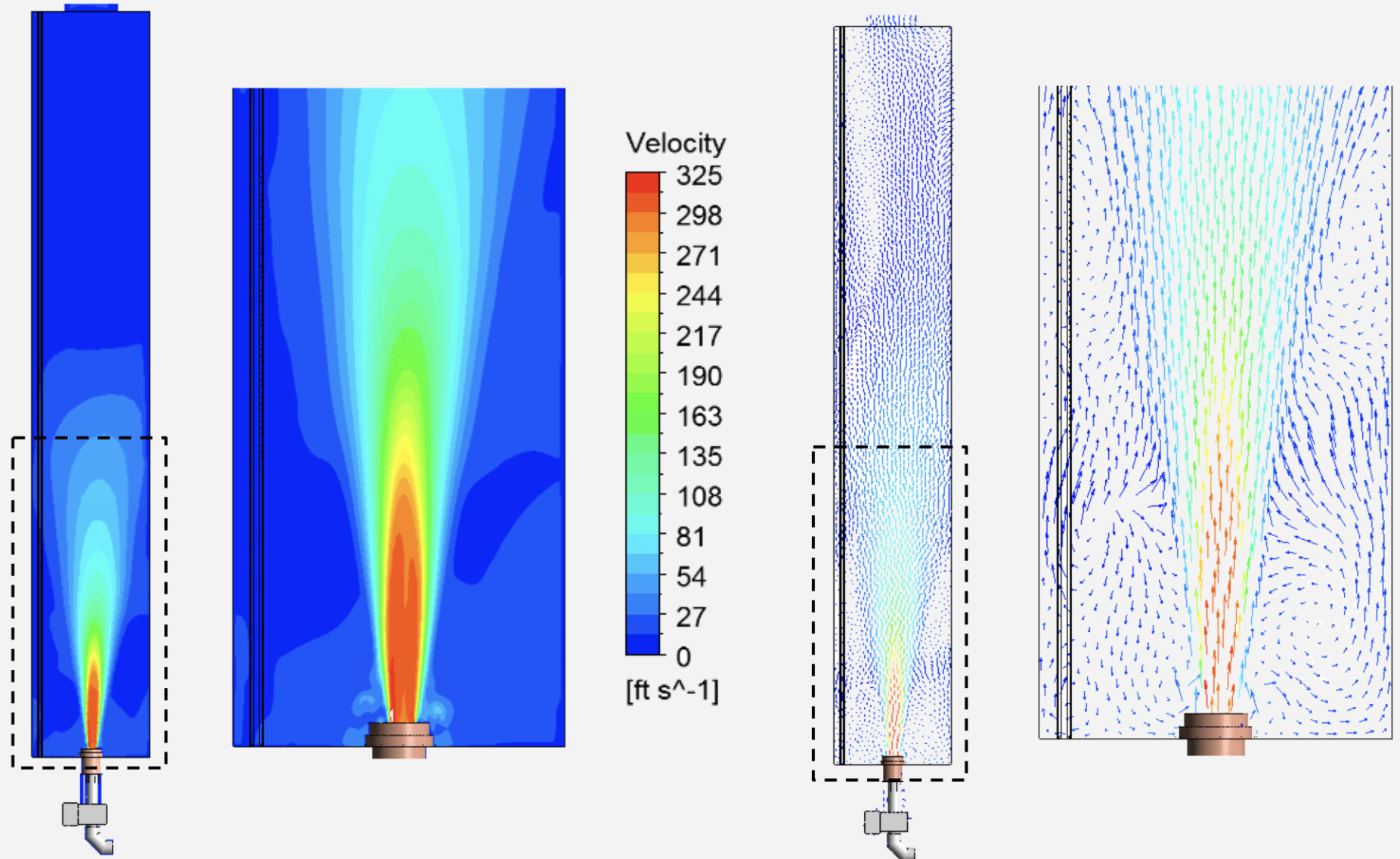
➤ Lean Pre-Mix  
Stage



# Velocity Magnitude & Vectors – Side View



➤ FREE-JET  
Stage



# Lean Pre-mix Stage



# FREE-JET Stage



# Proven Test Results

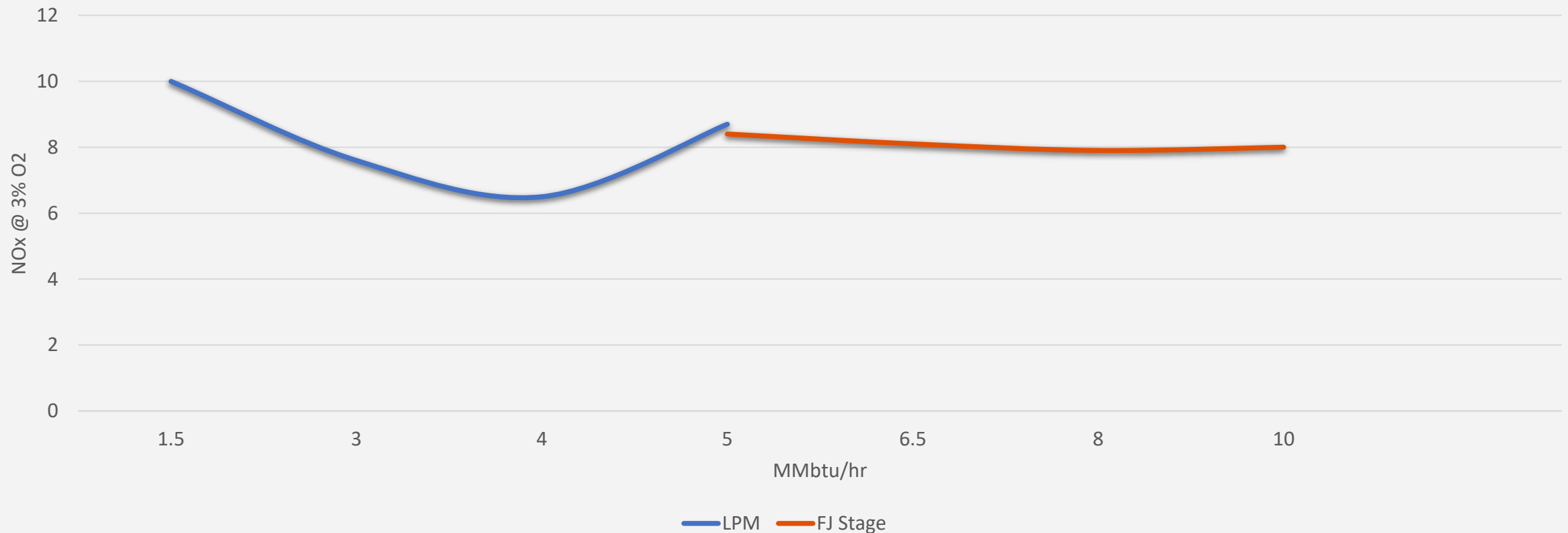


|                             | Point 1 | Point 2 | Point 3 | Point 4 | Point 5 |
|-----------------------------|---------|---------|---------|---------|---------|
| Natural Gas                 | 100     | 100     | 100     | 100     | 100     |
| LPM Heat Release (MMbtu/hr) | 1.5     | 3.0     | 5.0     | 5.0     | 3.0     |
| FJ Heat Release (MMbtu/hr)  | -       | -       | -       | 3.0     | 5.0     |
| Furnace Temperature ( ° F)  | 887     | 1120    | 1278    | 1606    | 1626    |
| Floor Temperature ( ° F)    | 600     | 795     | 932     | 1168    | 1192    |
| Oxygen %                    | 8.1     | 8.5     | 9.6     | 3.1     | 1.9     |
| CO (ppmv)                   | 63.7    | 4.4     | 17.5    | 0.0     | 0.0     |
| NOx (ppmv)                  | 6.4     | 4.9     | 5.5     | 6.7     | 8.4     |
| CO (ppmv @ 3% O2)           | 89      | 6.4     | 27.6    | 0.0     | 0.0     |
| NOx (ppmv @ 3% O2)          | 10      | 7.6     | 8.7     | 6.7     | 7.9     |

# Proven Test Results



NOx vs. Heat Release



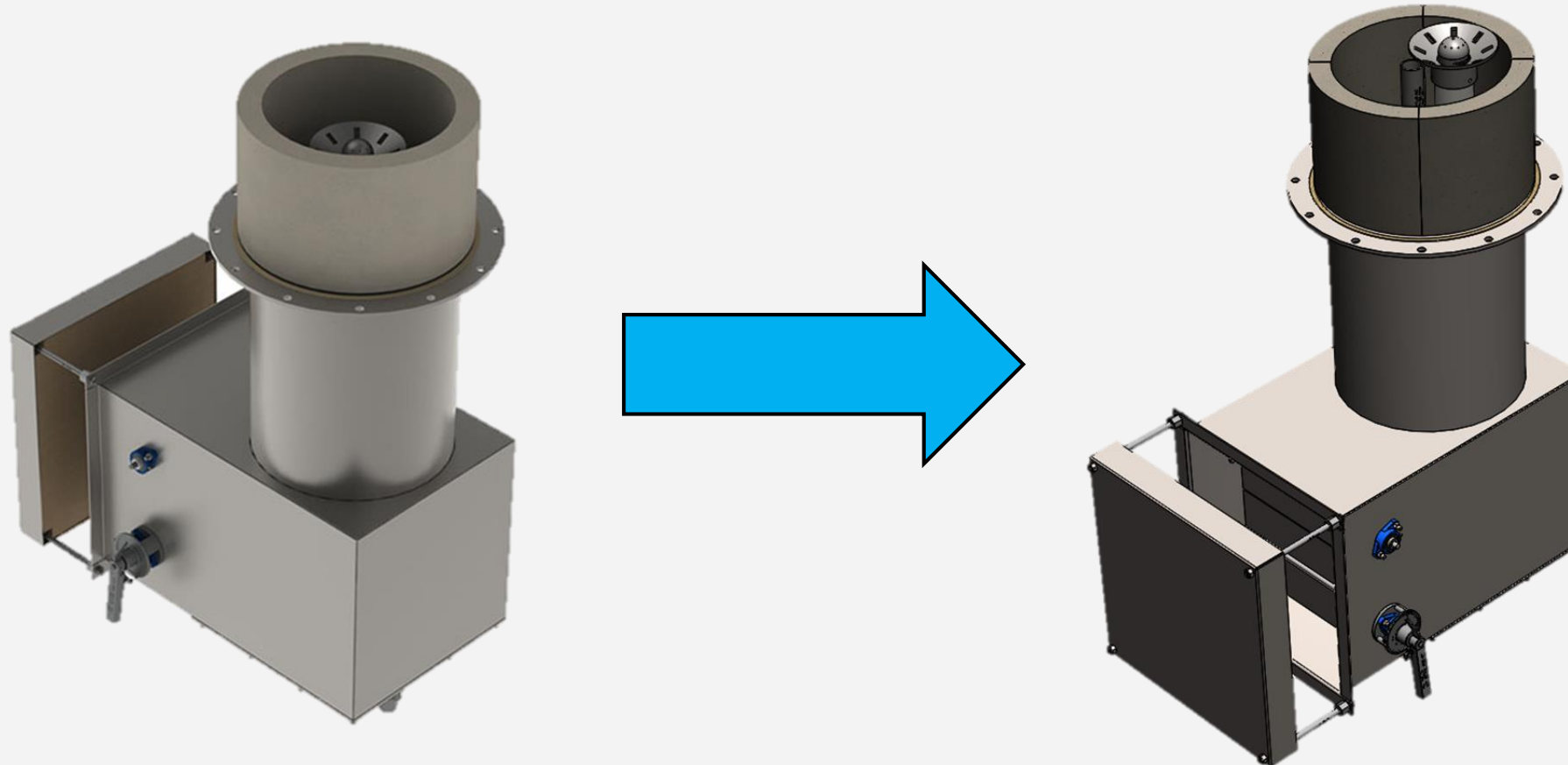
# Existing Product Line



# GB Single Jet

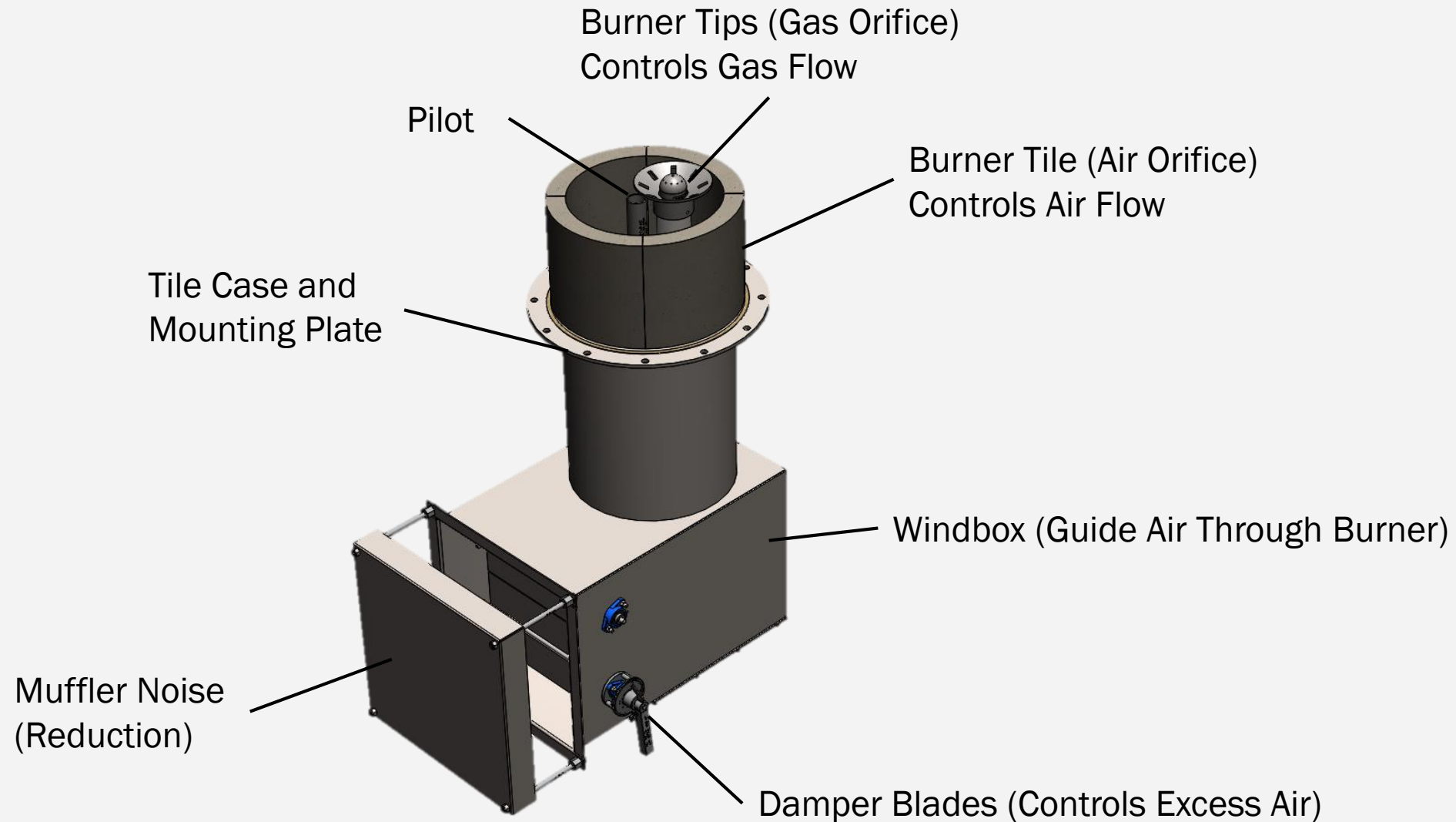


# GB Single Jet

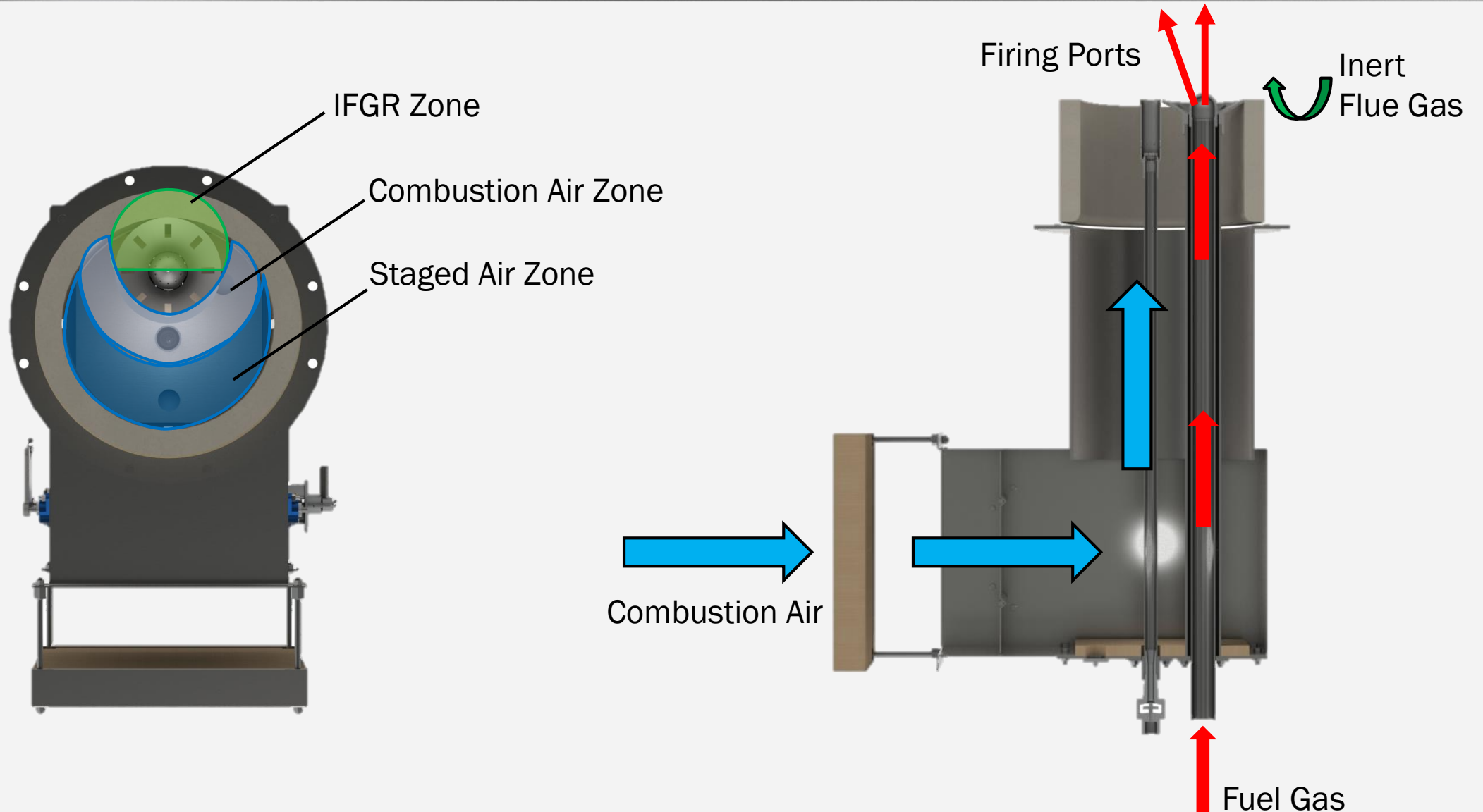


Zeeco has taken a conventional single tip with a cone design burner and enhanced the concept using the same, tip, cone and tile, to achieve Low NOx emissions.

# Overall Design Concept



# How It Works



# Design Summary



- Round flame or Flat flame gas burner design
- NOx reduction method: Internal Flue Gas Recirculation (IFGR), staged fuel, and staged air. Combustion air induction: natural, forced, induced and balanced draft, or turbine exhaust
- Mounting options: up-fired, side-fired and down-fired



# Performance Summary



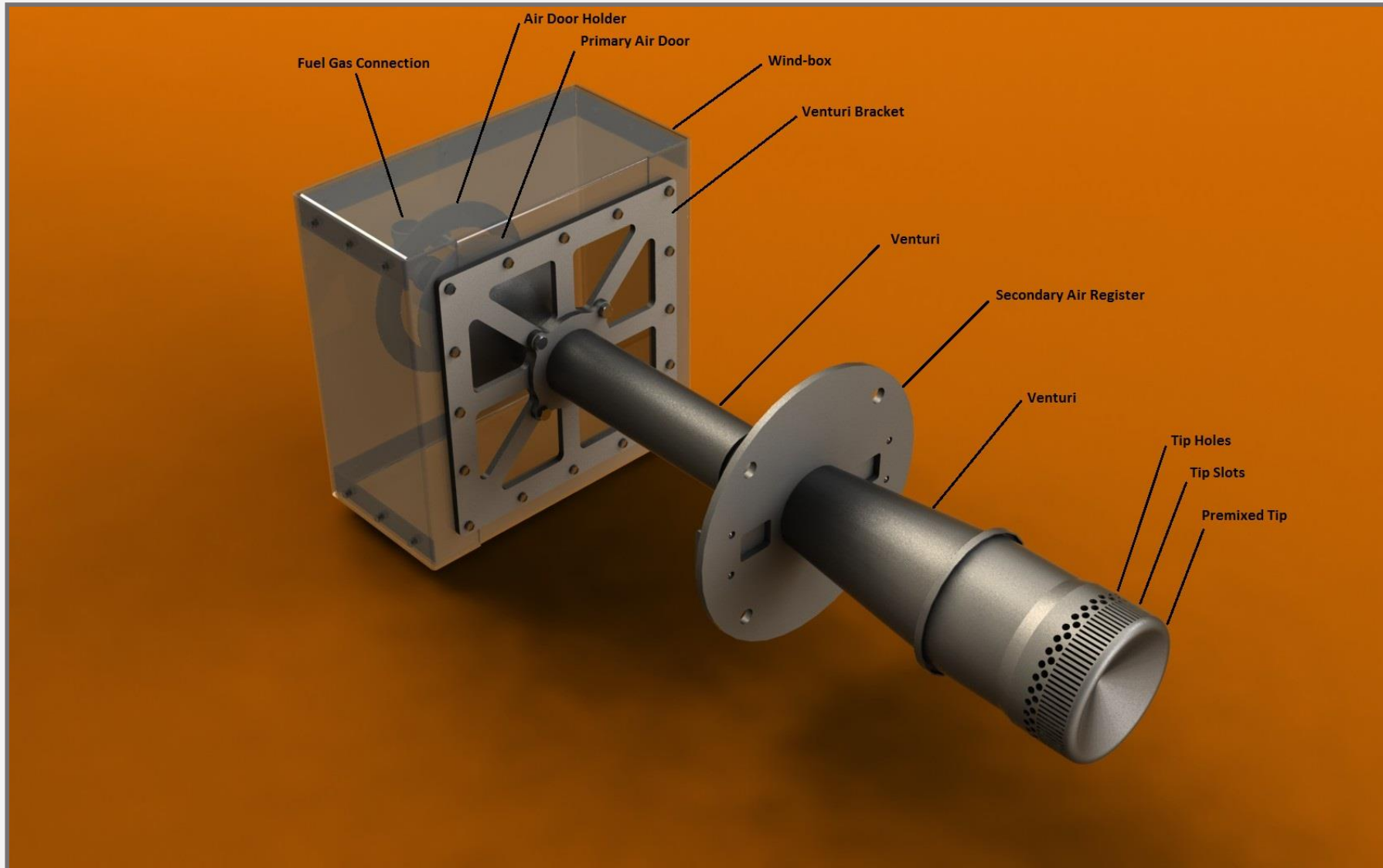
- Ultra Low NOx Emissions:
  - NOx (Gas Fired) Range (Natural Draft): 20 to 49 ppmv
- Heat Release Range:
  - Nat. Draft: 1 to 20 MM Btu/hr
  - F.D.: 1 to 20 MM Btu/hr Turndown: 10:1 or greater for most cases
- Design Excess Air Range: 10% to 25% for most cases
- Combustion Air Pressure Drop:
  - Natural Draft: 0.2" to 1" (5 to 25 mm) H2O
  - Forced Draft: 0.5" to 2" (12.7 to 51 mm) H2O



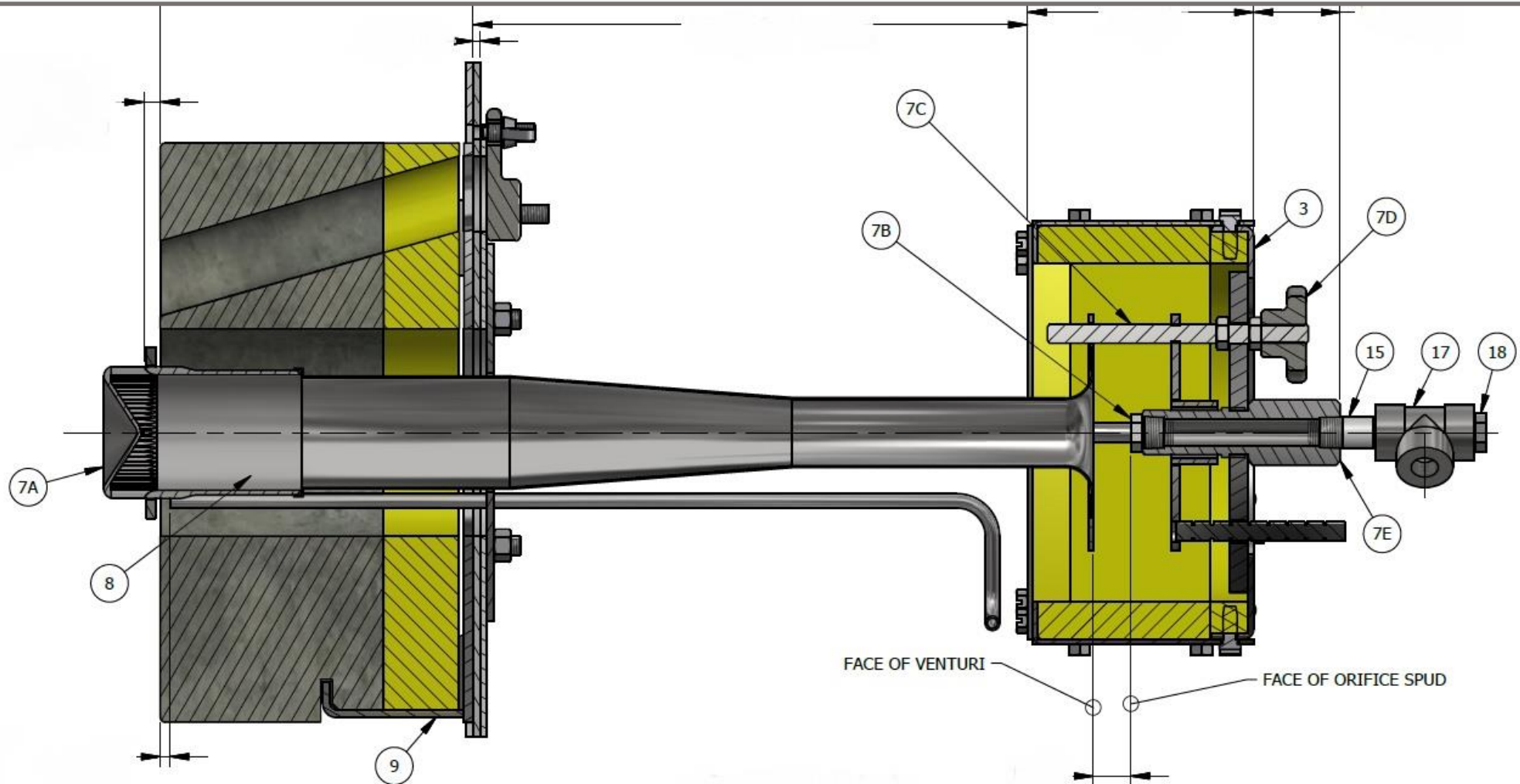
# Radiant Walls

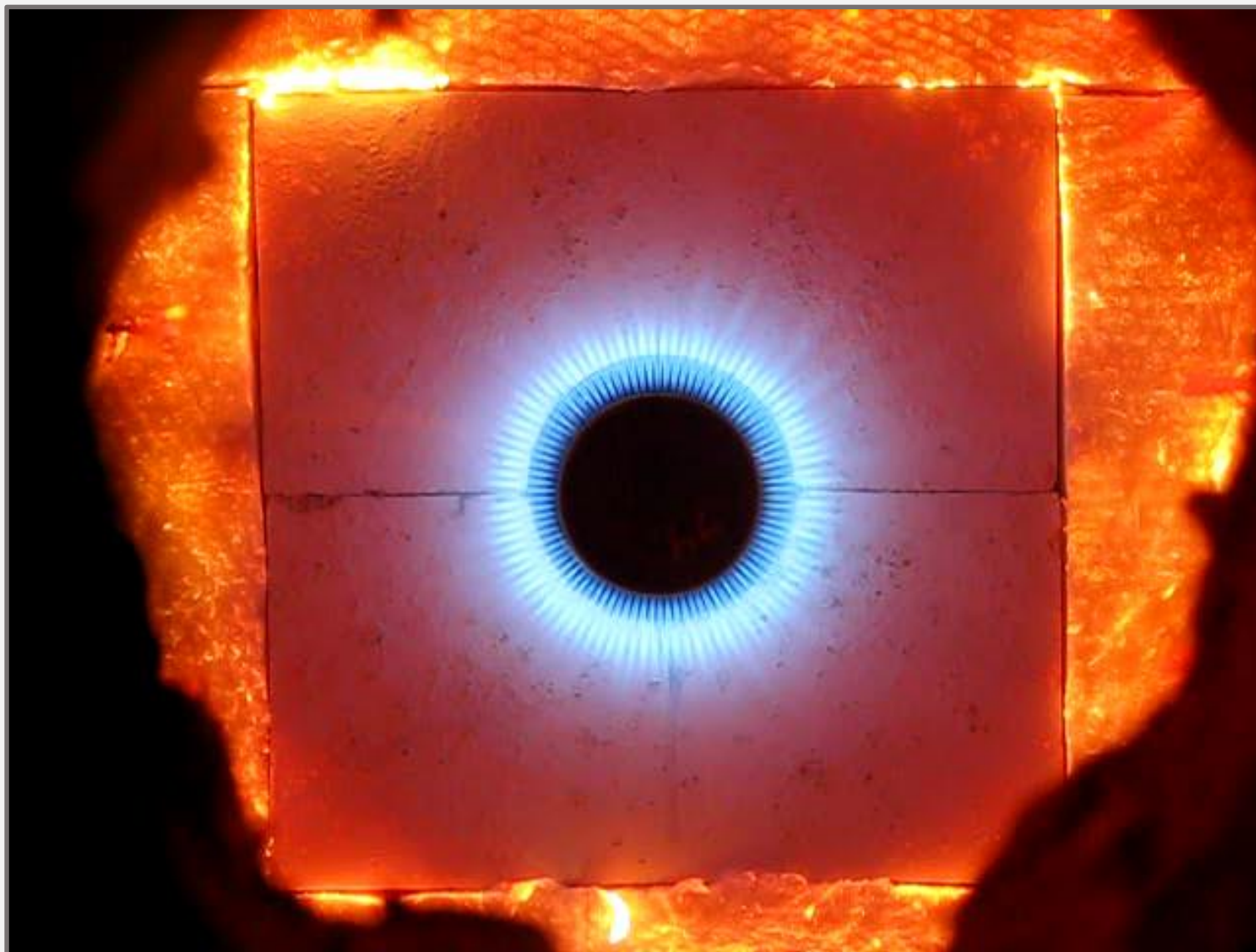


# Radiant Wall



# How It Works





# Design Summary



- Radiant wall, gas only burner design
- NOx reduction method: lean pre-mixing of the gas and air.
- Combustion air induction: natural draft or forced draft
- Mounting options: horizontally-mounted
- 310 stainless steel cast gas tip
- 304 stainless steel venturi mixer
- 60% alumina tile assembly pre-fired

# Performance Summary



- Ultra-Low NOx Emissions:
  - NOx Range (Natural Draft): 40 to 70 ppmv
- Heat Release Range:
  - Nat. Draft: 0.25 to 1.4 MM Btu/hr
- Turndown: 3:1 or greater for most cases
- Design Excess Air Range: 10% for most cases

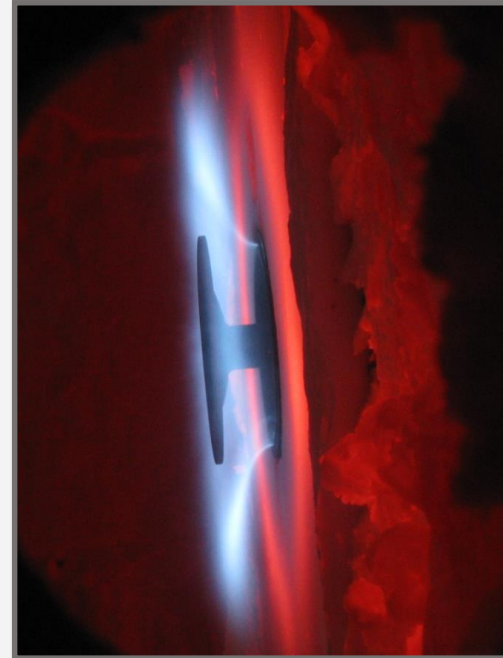
# Test Facility



# Test Facility Capabilities



- 17 test furnaces
- Capable of firing:
  - Down-fired
    - Dual Burner Potential
  - Up-fired
    - Multi Burner Potential
  - Horizontal-fired
  - Multiple burners
    - Dual Hearth Burners with Radiant Walls
- Draft Options
  - Natural
  - Forced
  - Balanced



# Test Facility Capabilities

- Standard Fuel Components
  - Natural Gas
  - Hydrogen
  - Propane
  - #6 Oil
  - Nitrogen
- Customer Fuel Components
  - Carbon Dioxide
  - Butane
  - Diesel
- Firing Capacity
  - 60 MM btu/hr continuous operation on Natural Gas
  - Furnace capability up to 100 MM btu/hr
  - Boiler capability up to 200 MM btu/hr
- Pre-Heat Maximum: 500° F



# Test Facility Flyover





**BURNERS**

**FLARES**

**THERMAL OXIDIZERS**

**VAPOR CONTROL**

**RENTALS**

**AFTERMARKET**