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# COMBUSTION TECHNOLOGY

*Computational Fluid Dynamics, Chemical Kinetics, Chemistry Mechanism*

- Concept
- Ultra Low NOx Burner – TV2
- SRU Burner
- Continu's Development

## "ENVIRONMETAL PAYBACK PROJECTS"

*Transform an environmental problem into a revenue stream for our clients*

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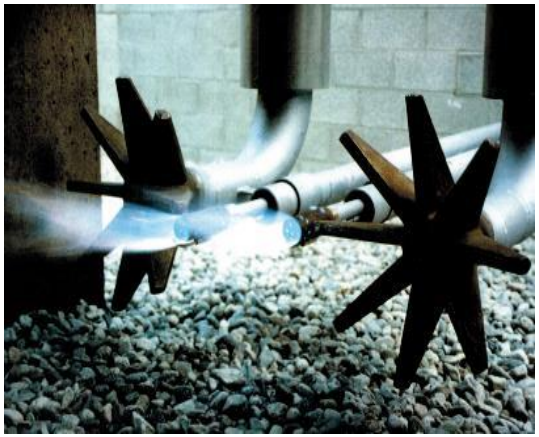
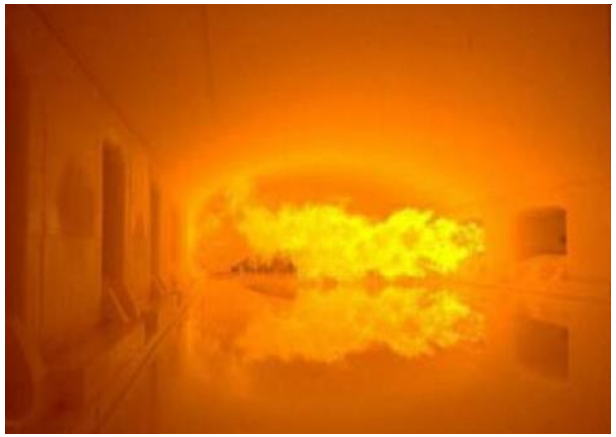
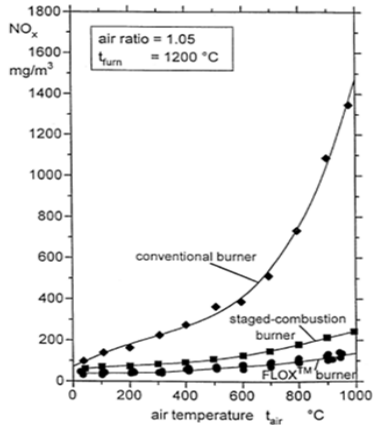
# COMBUSTION TECHNOLOGY

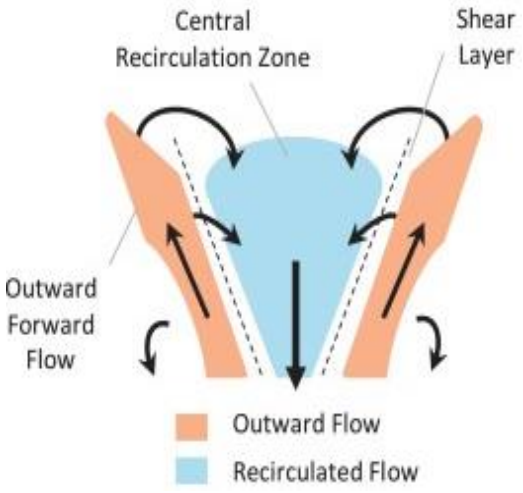
## Concept

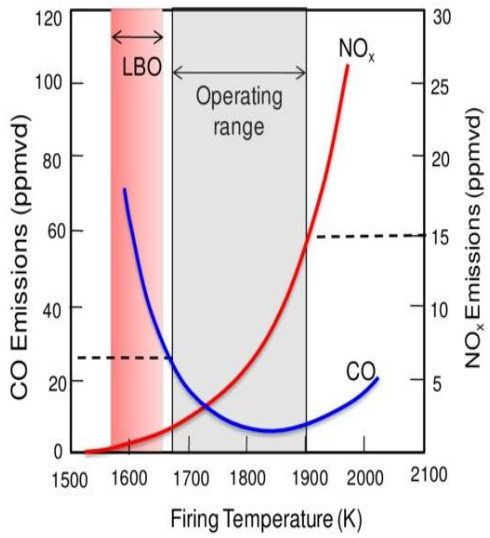







**Classic configuration**




**TIALOC configuration**

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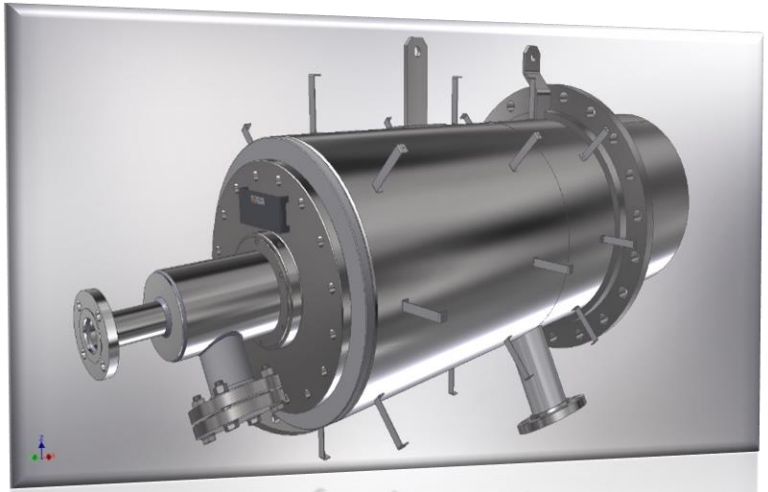
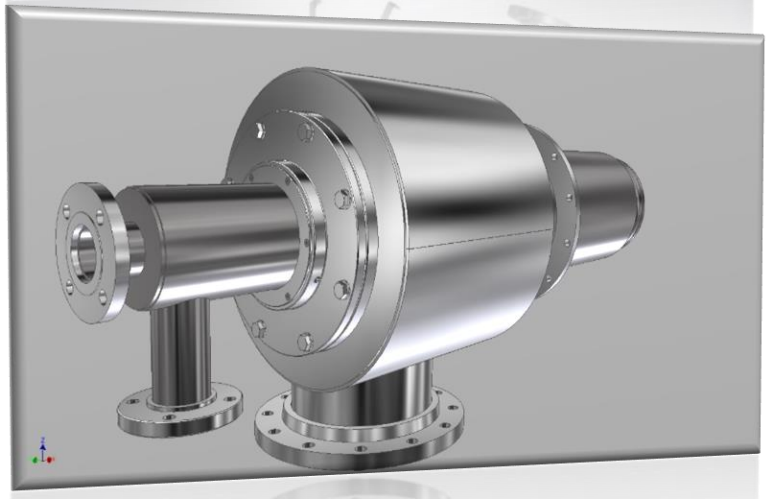
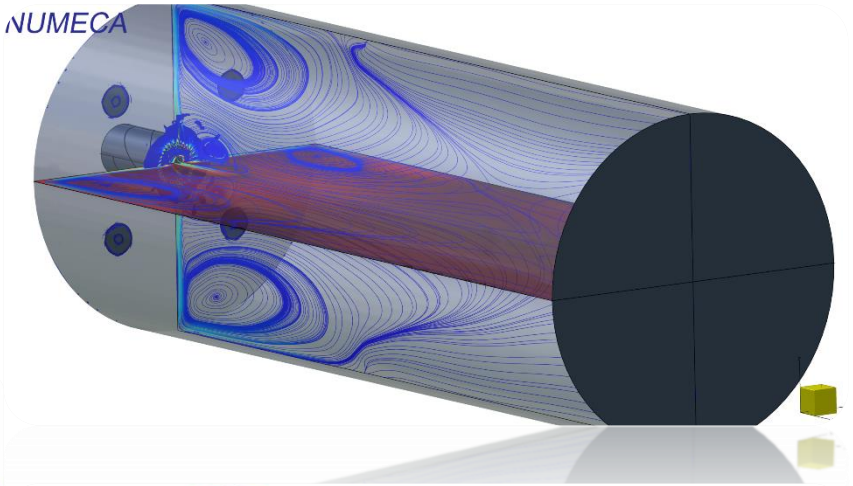
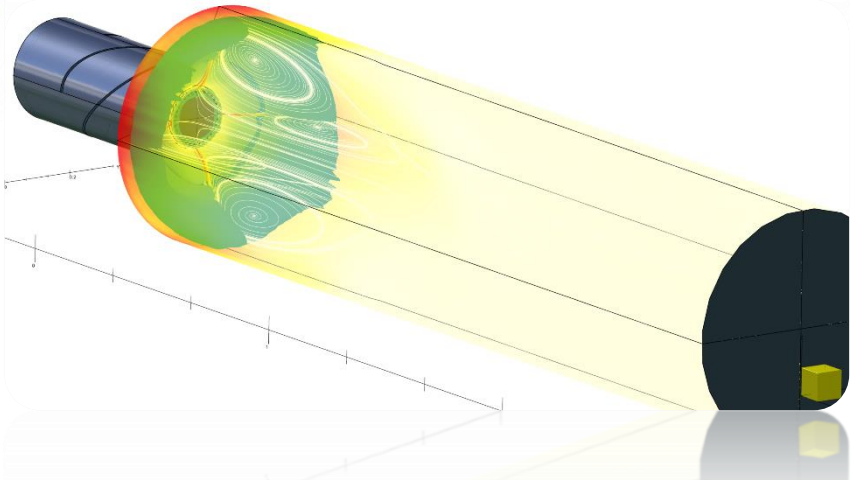
# COMBUSTION TECHNOLOGY

## Ulta Low NOx Concept (FlexiFuel & MultiFuel)





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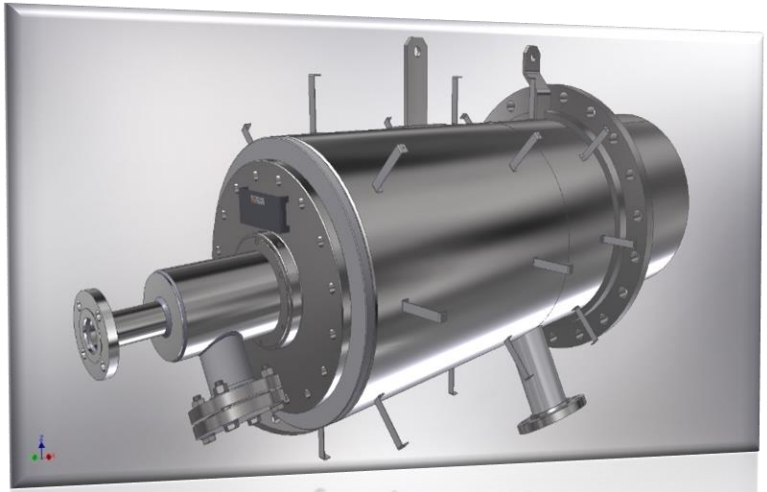
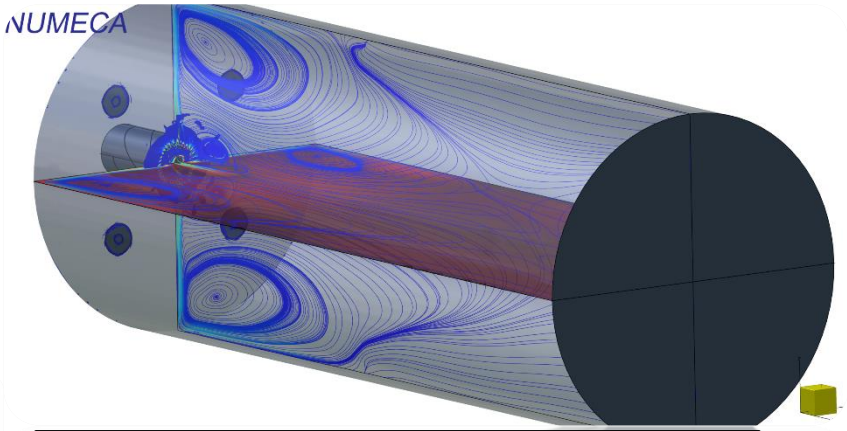
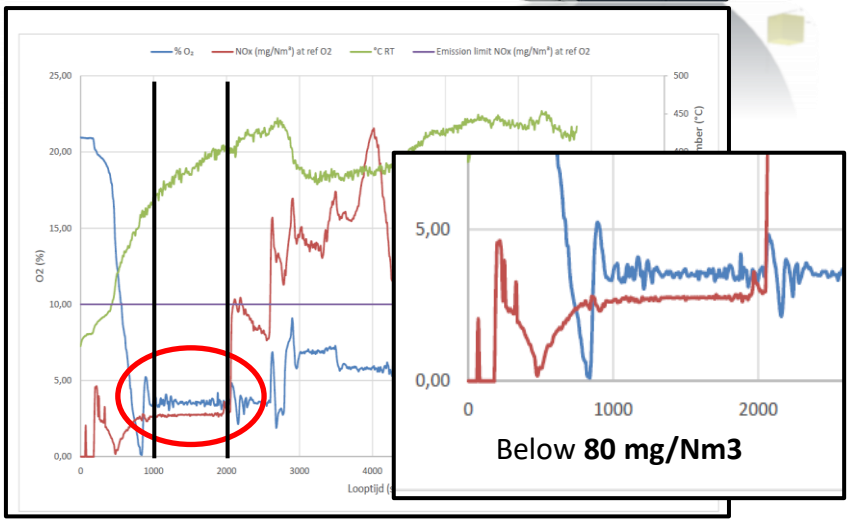
# Ulta Low NOx Concept
## Tulip Vortex Venturi Burner - TV²B - Flexifuel










- Fuel source flexibility
- Short and thin flame profile
- Swirl created by baffles in burner
- Recirculation created by high exit velocities of burner
- 10:1 turndowns
- Low NOx emissions -15-80 mg/Nm³

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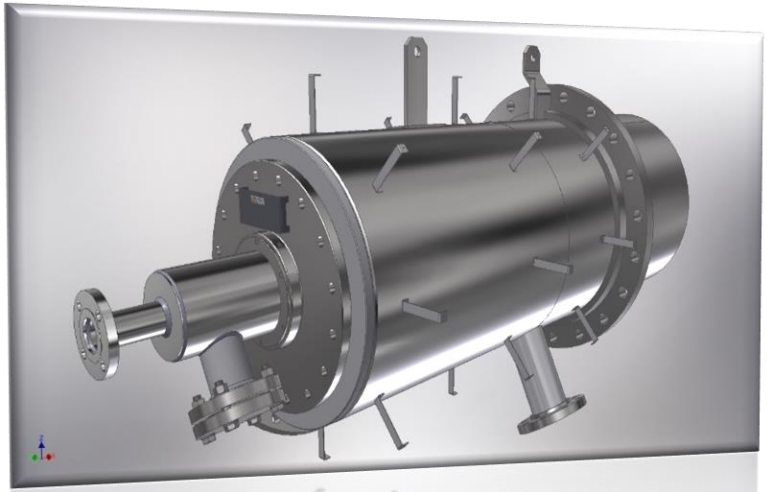
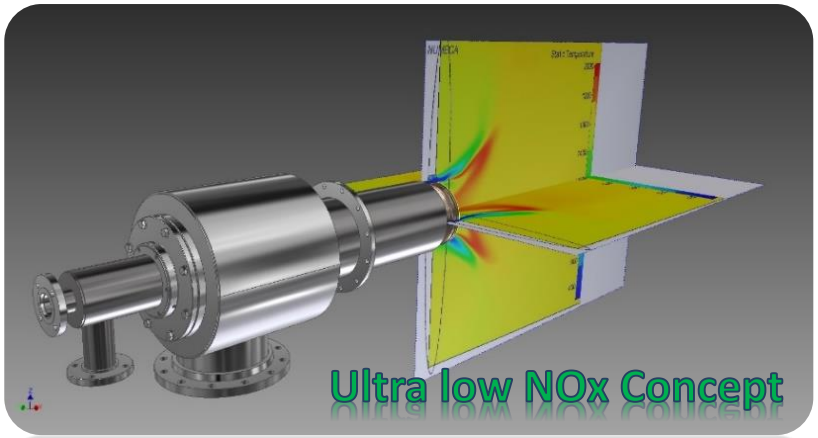
# Ulta Low NOx Concept
# Tulip Vortex Venturi Burner - TV²B - Flexifuel




| | | Natural Draft | Force Draft |
|---|---|---|---|
| Thermal Capacity (MW) | | 0.5-5 | 0.5-10 |
| Pressure Drop (mbar) | Fuel | 100-3000 | 100-3000 |
| | Air | variable | 15-100 |
| Injection speeds (m/s) | Fuel | 30-250 | 30-250 |
| | Air | variable | 5-50 |

- Fuel source flexibility
- Short and thin flame profile
- Swirl created by baffles in burner
- Recirculation created by high exit velocities of burner
- 10:1 turndowns
- Low NOx emissions -15-80 mg/Nm³



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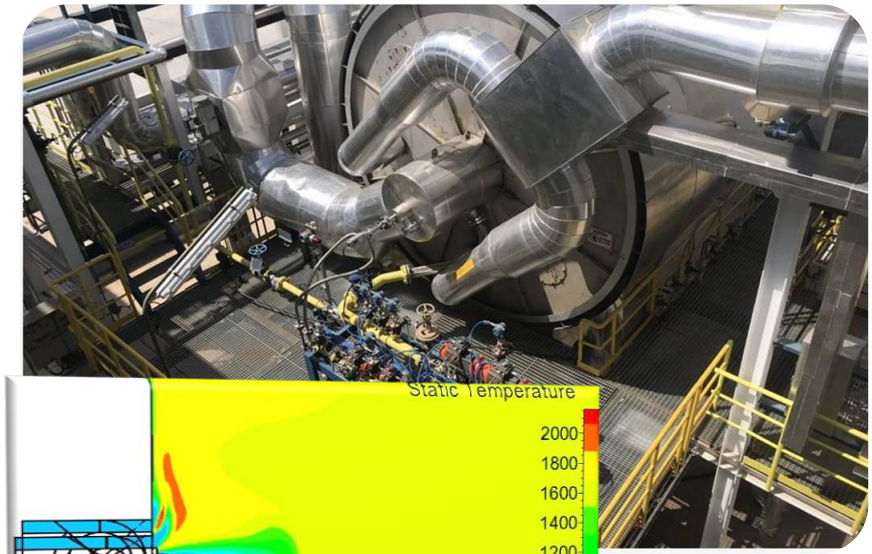
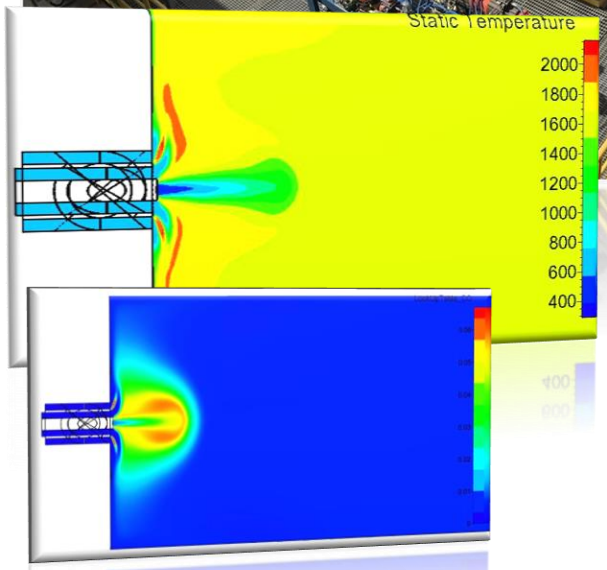
# Ulta Low NOx Concept
# Tulip Vortex Venturi Burner - TV²B - MultiFuel







1. Staged combustion by staged air
   - *Central and peripheral combustion air*
2. Excellent mixing by double swirl
   - *Combustion air and/or waste gas*
3. Internal flue gas recirculation
   - *Venturi effect at burner gun*

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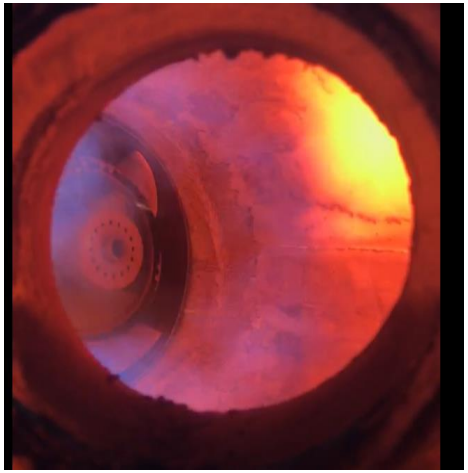
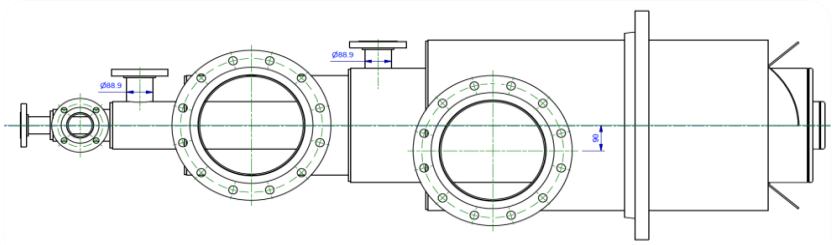
# Ulta Low NOx Concept
# Tulip Vortex Venturi Burner - TV²B - MultiFuel



| | | Force Draft |
|---|---|---|
| Thermal Capacity (MW) | | 0.5-10 |
| Pressure Drop (mbar) | Fuel | 100-3000 |
| | Air | 50-300 |
| Injection speeds (m/s) | Fuel | 30-250 |
| | Air | 25-150 |



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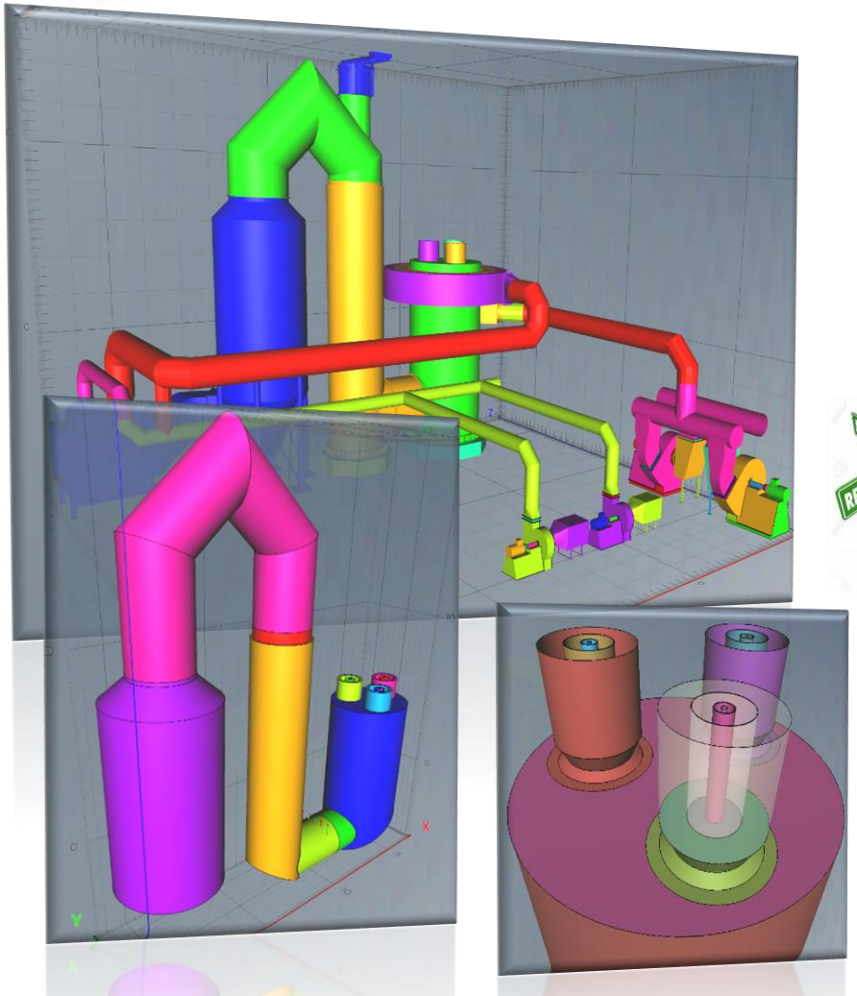
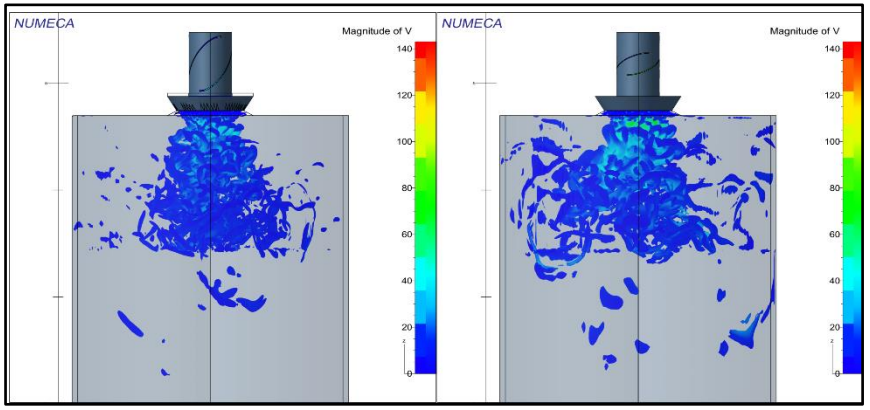
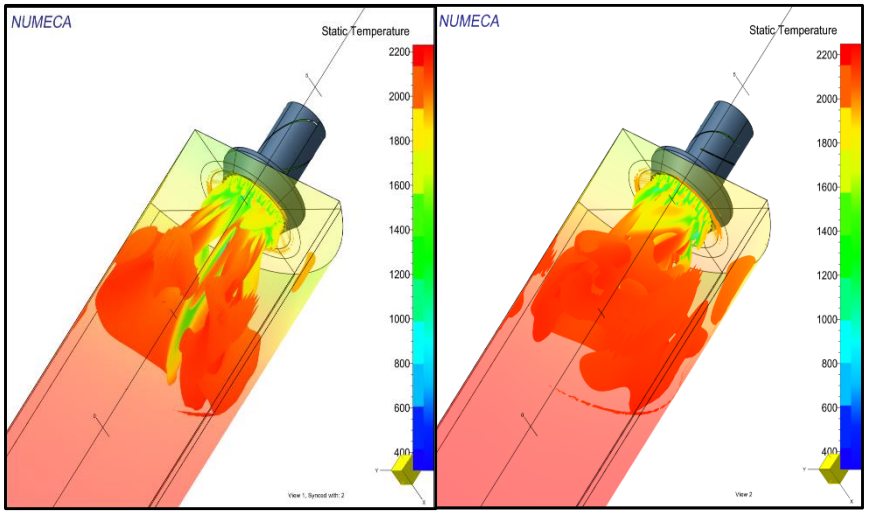
# Ulta Low NOx Concept

## Tulip Vortex Venturi Burner - TV²B – On-going R/D MultiFuel



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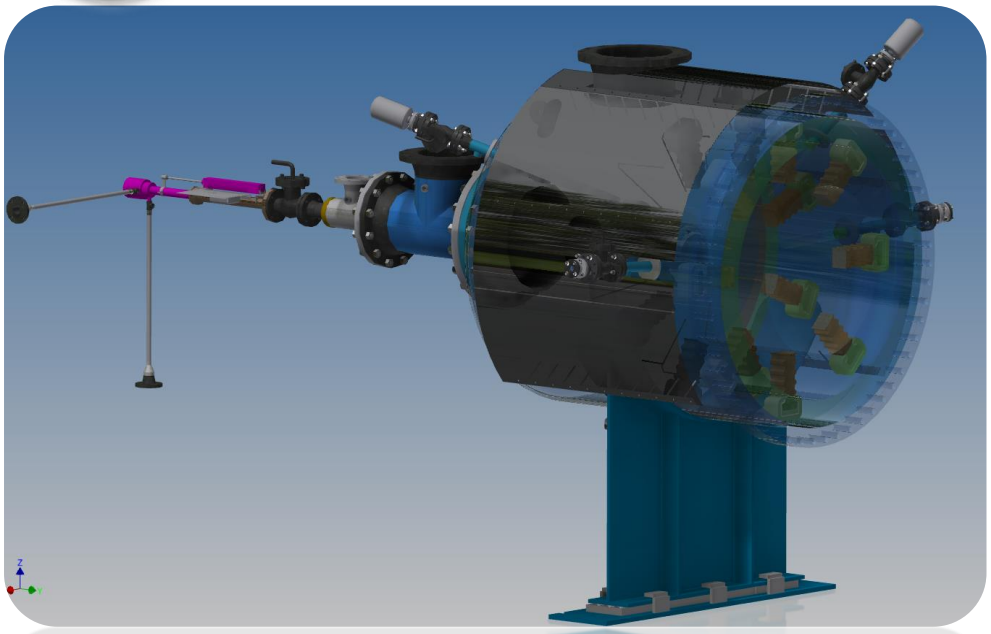
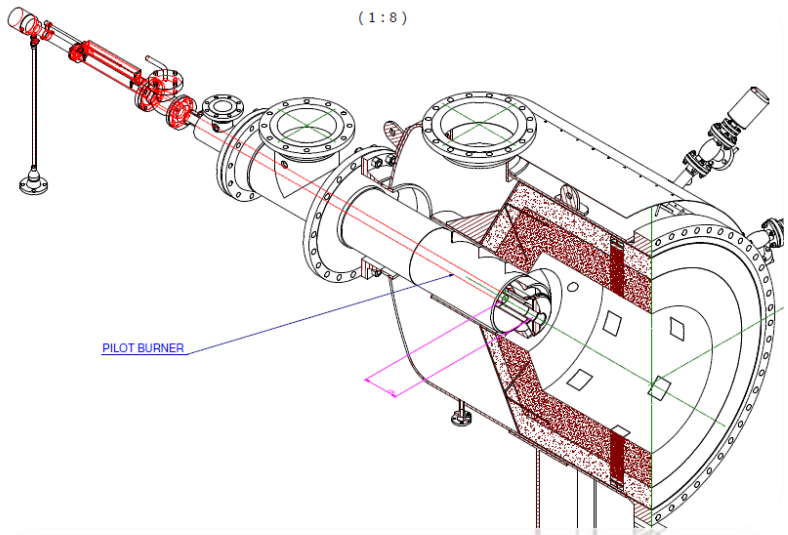
# COMBUSTION TECHNOLOGY
## SRU Concept






The primary purpose is to determine the efficacy of a system to reduce/eliminate the forming of carbonylsulfide COS and carbondisulfide CS2 during the recovering of Sulphur from a Sulphur waste comprising sulphur bound compounds and nitrogen bound compounds. However, the project also includes a design and development effort and adapt the knowledge findings into *a high technology laboratory experiment that would be used in the early stages of implementation in the industry*.

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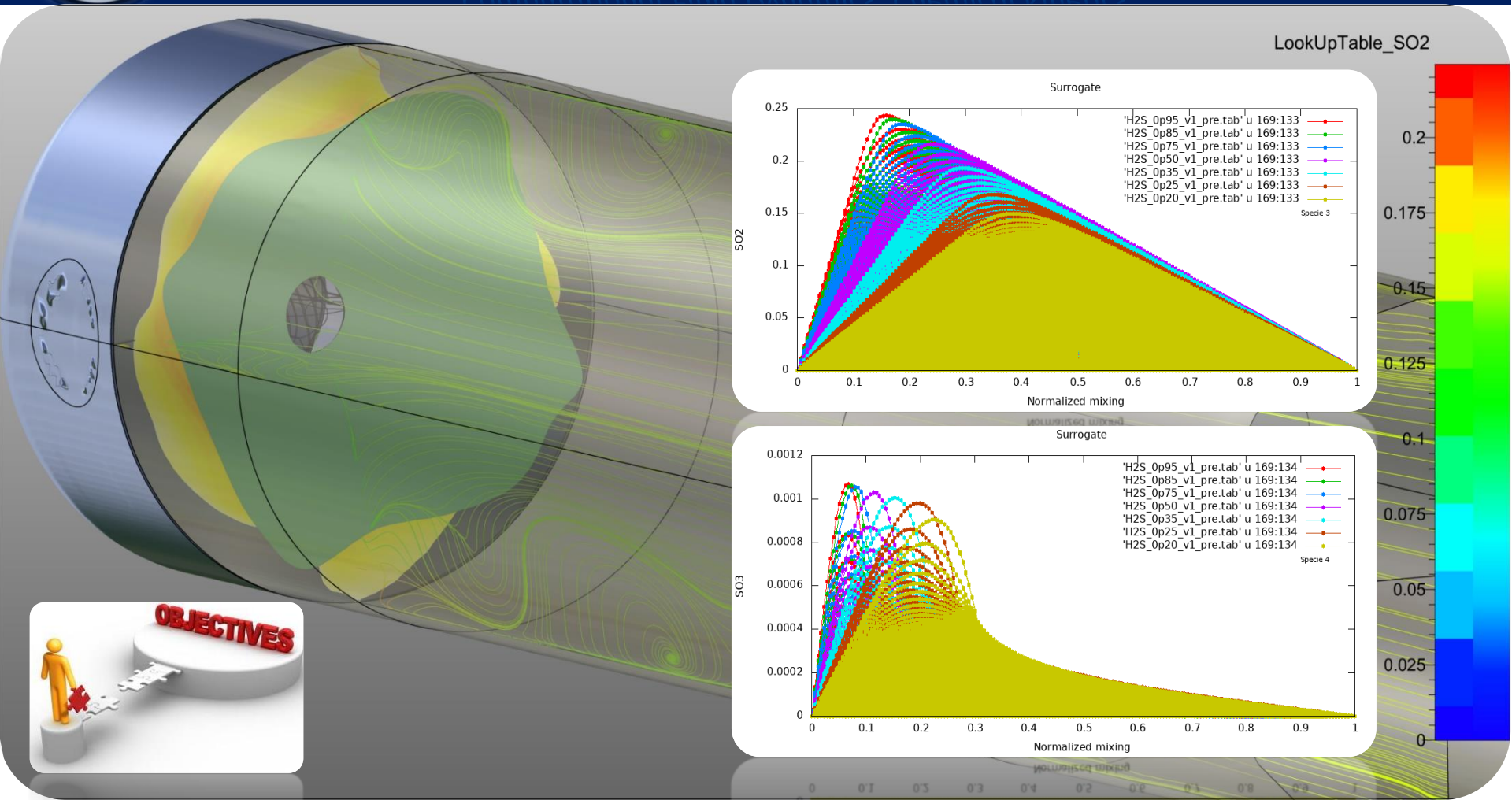
# COMBUSTION TECHNOLOGY

## SRU Burner

*Computational Fluid Dynamics, Chemical Kinetics*



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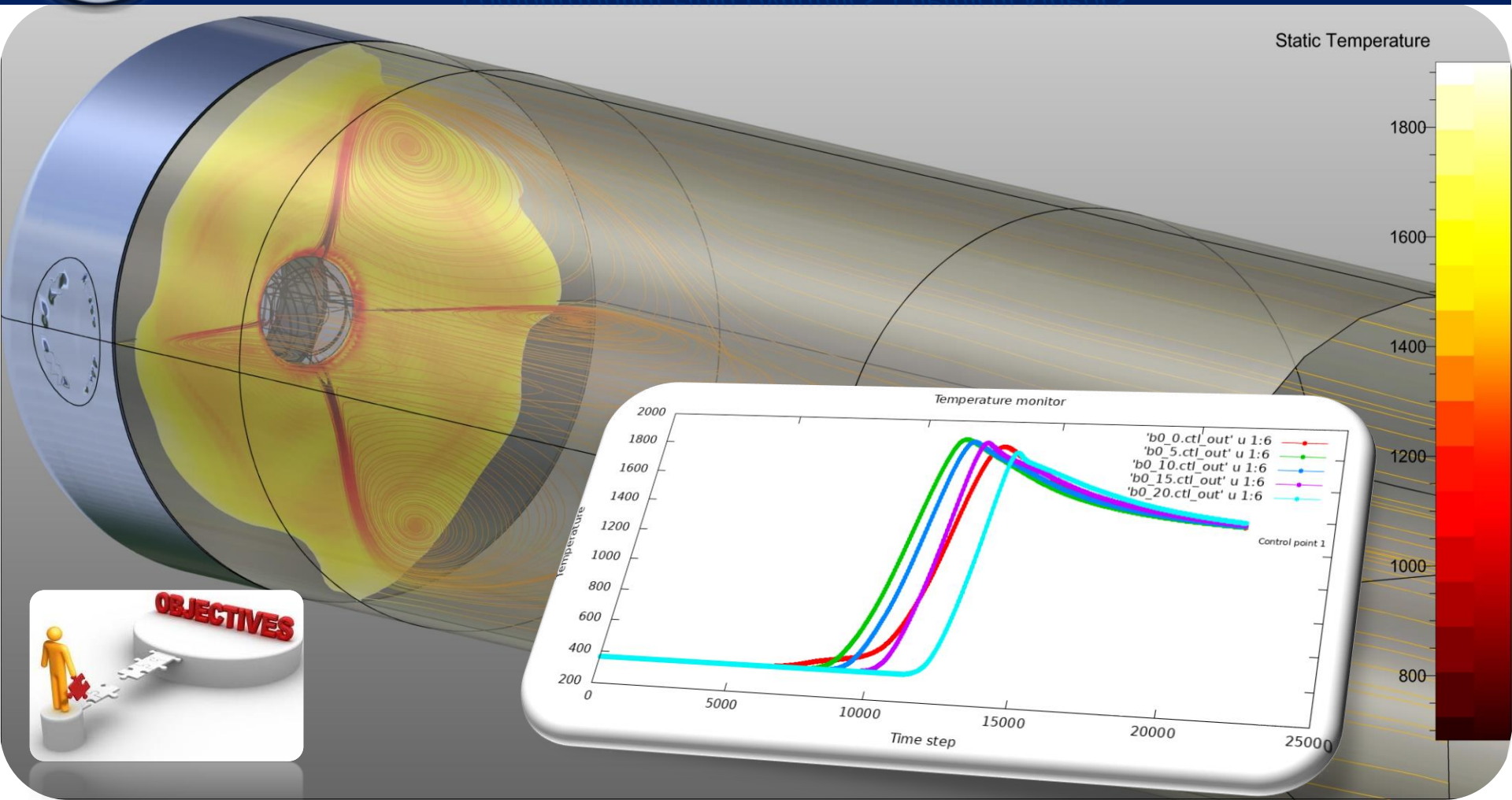
# COMBUSTION TECHNOLOGY

## SRU Burner

*Computational Fluid Dynamics, Chemical Kinetics*



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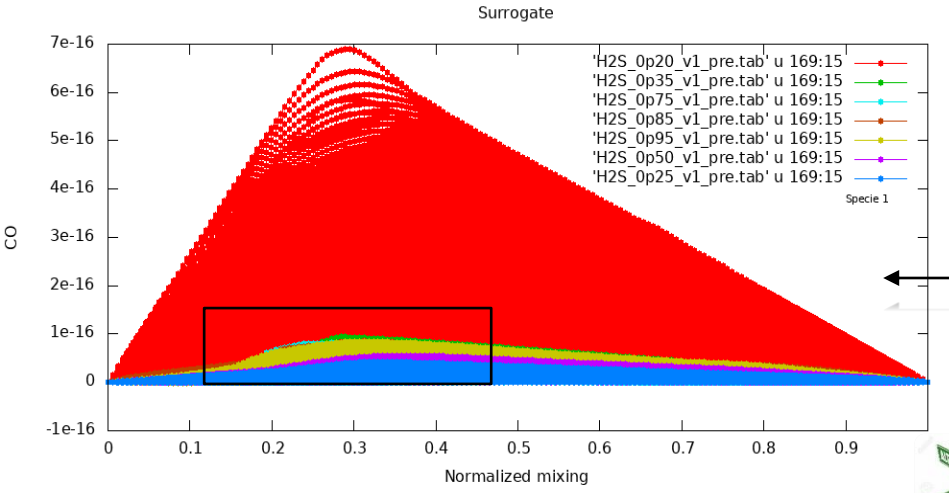
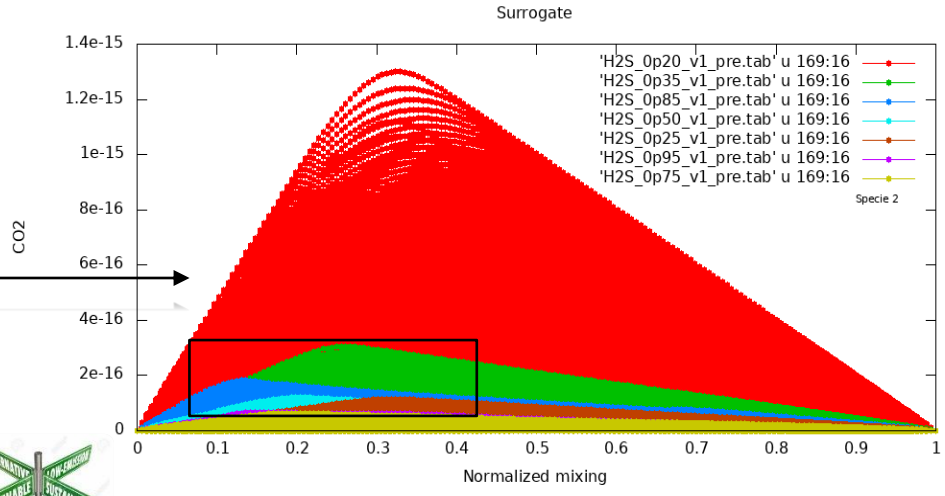
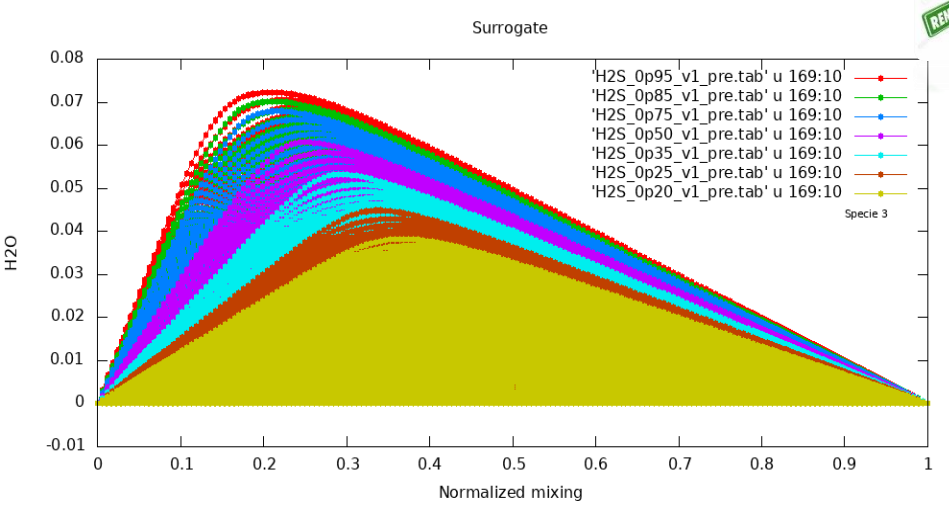
# COMBUSTION TECHNOLOGY

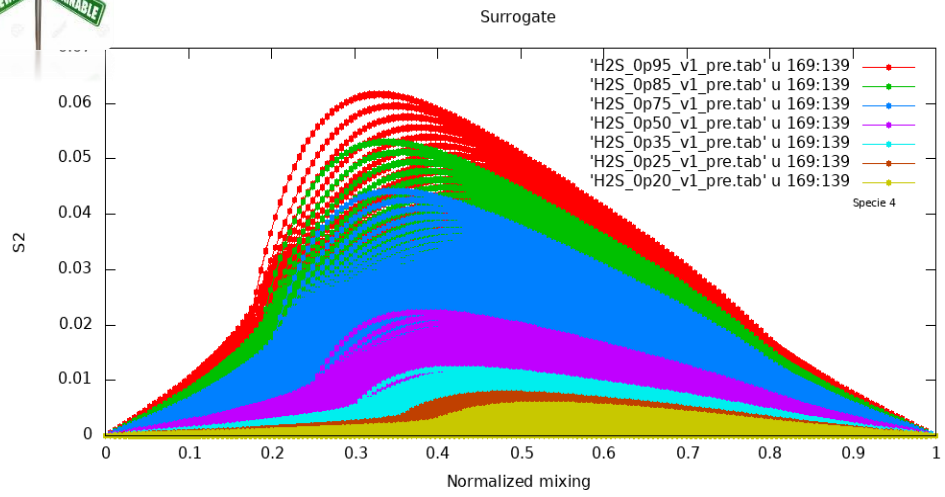
## SRU Burner

*Computational Fluid Dynamics, Chemical Kinetics*

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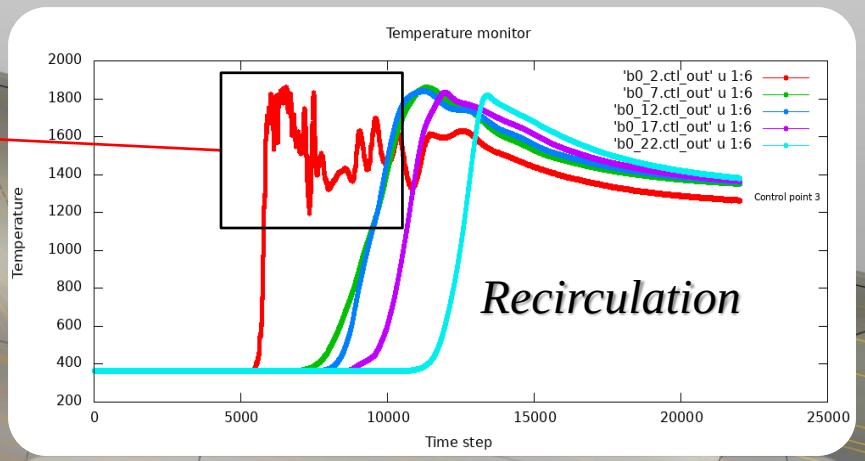
# COMBUSTION TECHNOLOGY

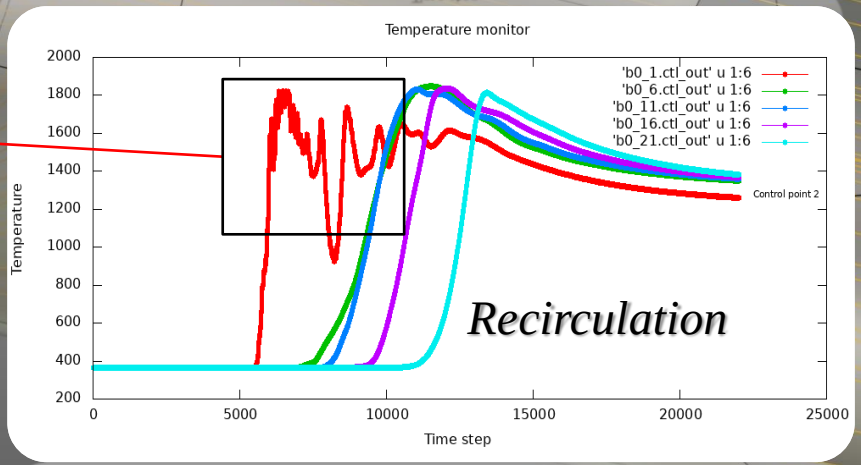
## SRU Burner

*Computational Fluid Dynamics, Chemical Kinetics*

Static Temperature




Symmetry effect

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# COMBUSTION TECHNOLOGY

## SRU Burner

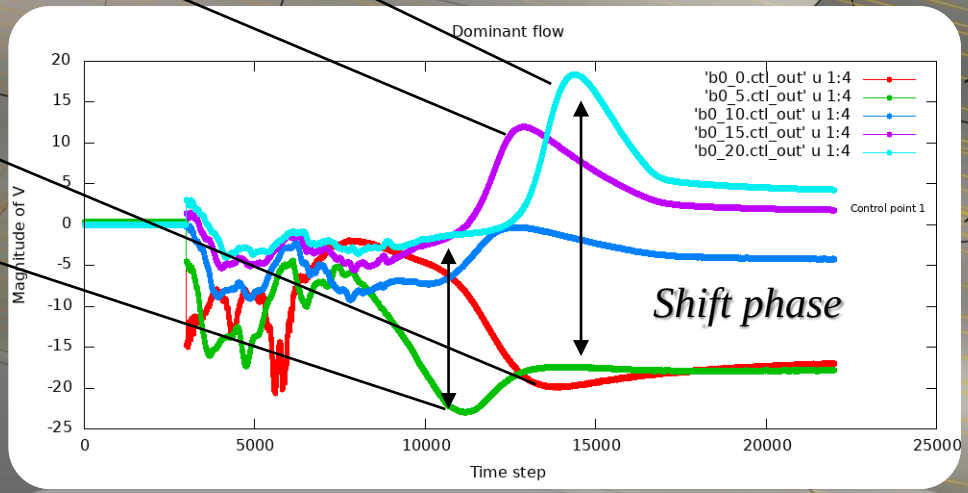
*Computational Fluid Dynamics, Chemical Kinetics*

Static Temperature

1800
1600
1400
1200
1000
800

Symmetry effect

Dominant flow

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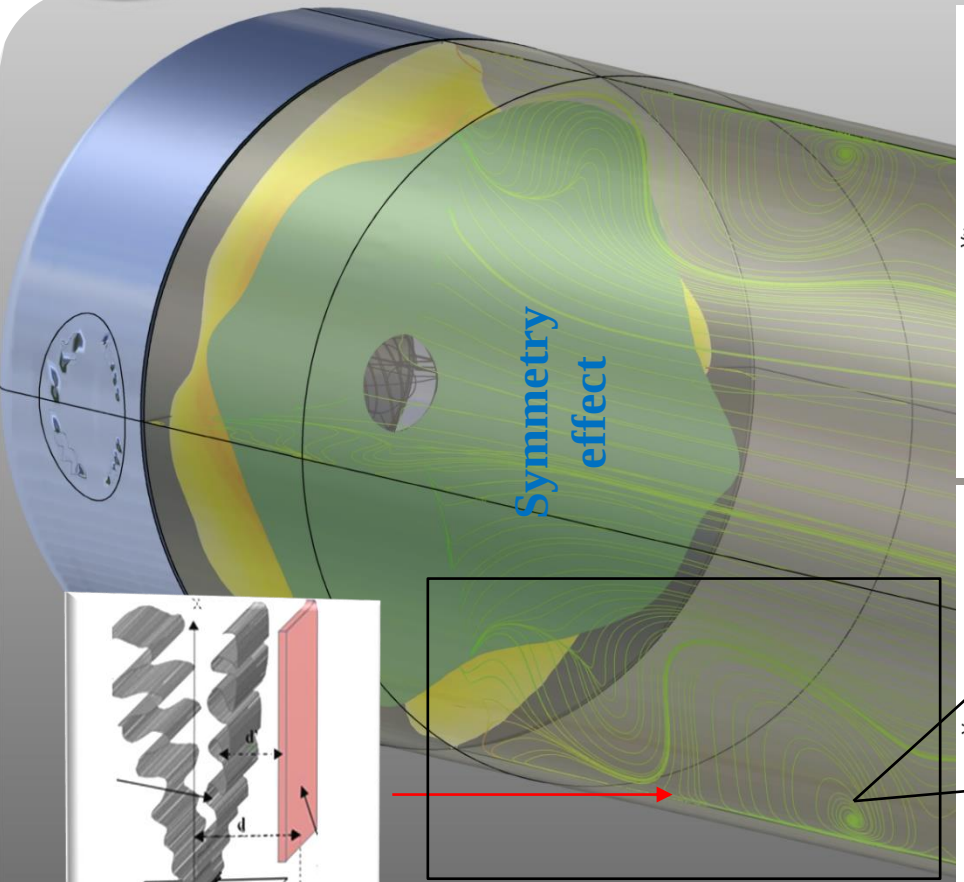
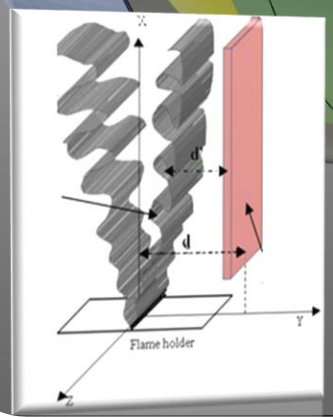
# COMBUSTION TECHNOLOGY

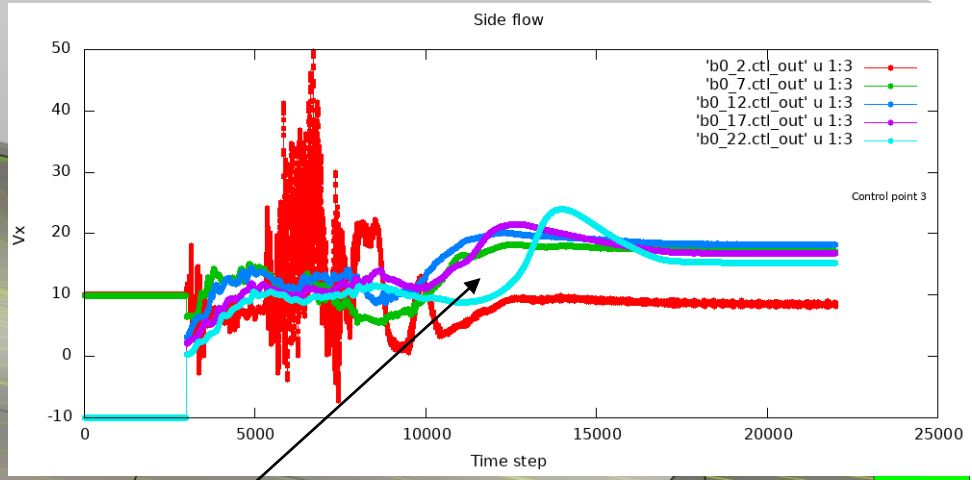
## SRU Burner

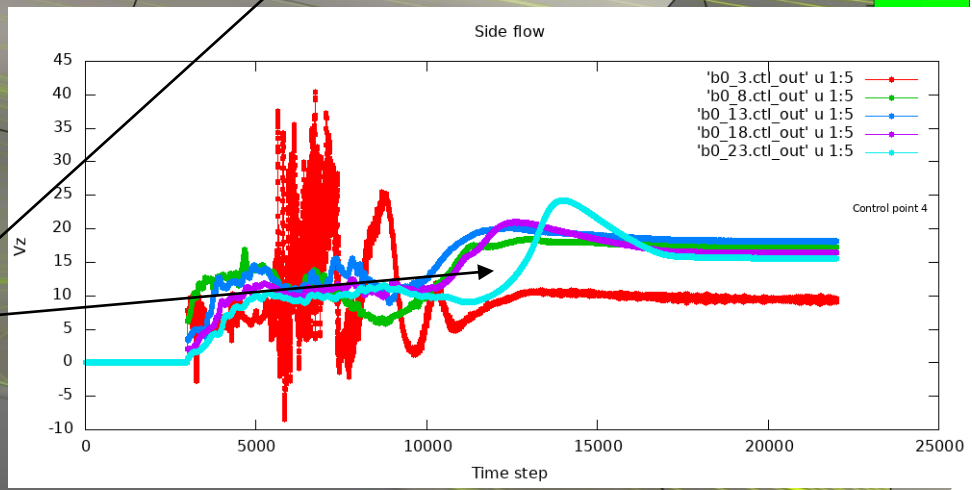
*Computational Fluid Dynamics, Chemical Kinetics*




*Flame/Wall Interaction*



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# COMBUSTION TECHNOLOGY

## SRU Burner

*Computational Fluid Dynamics, Chemical Kinetics*


| | | Force Draft |
|---|---|---|
| Thermal Capacity | All streams | 1-10 |
| Pressure Drop (mbar) | Fuel | 10-3000 |
| | Waste | 50-1000 |
| | Air/ Enriched Air | 10-100 |
| Injection speeds (m/s) | Fuel | 30-150 |
| | Waste | 15-100 |
| | Air | 15-50 |

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# COMBUSTION TECHNOLOGY

## SRU Burner – On-going R/D

*Computational Fluid Dynamics, Chemical Kinetics Mechanism*



### C/H/O/N/S mechanism

*Optimized sulfur skeleton sub-mechanism*

S2 S HSS HSSH SH H2S HSO SO SO2 SO3 HOSO HOSO2

STEP 6 5 4

H2S SO SO2 SO3 SH



### Patented

*Innovative technology*

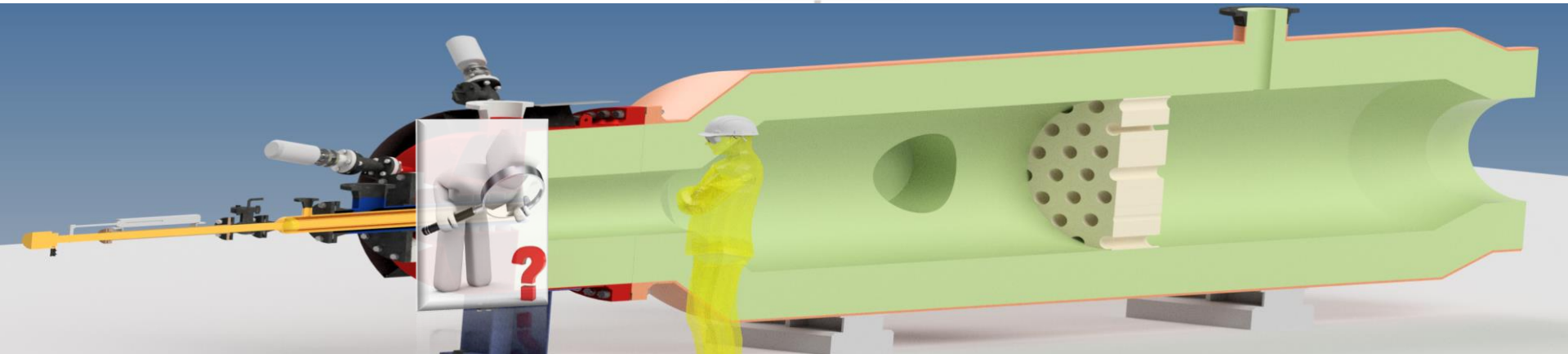
### Mechanism performance

*Combined mechanism*

*GRI-Mech 3.0*

*AramcoMech*

*Leeds*



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# COMBUSTION TECHNOLOGY

*Providing competitive and sustainable solutions*


## A reliable/robust computation/design

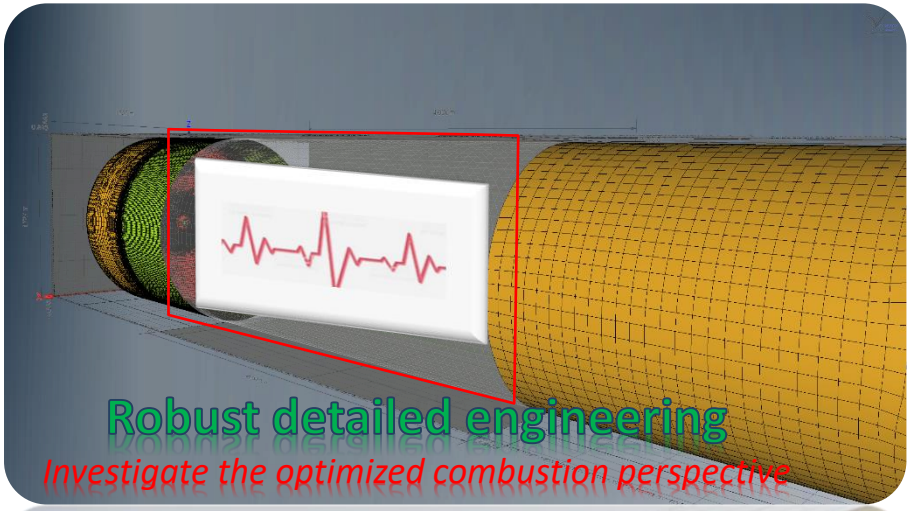
*A high-fidelity simulation*

## On-site measurements and performance tests

*Anomalies and thermodynamic instabilities*

## Uncertainty Quantification

*Operating conditions, geometrical and manufacturing tolerances*



## Robust detailed engineering

*Investigate the optimized combustion perspective*