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INOVA

Advanced Combustion Process for MSW

Minimum Primary Emissions – Maximum Efficiency

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Advanced Combustion Process for MSW

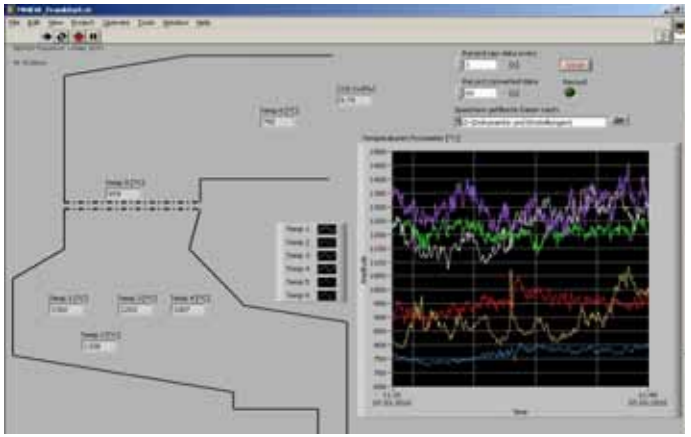
Characterization of combustion process

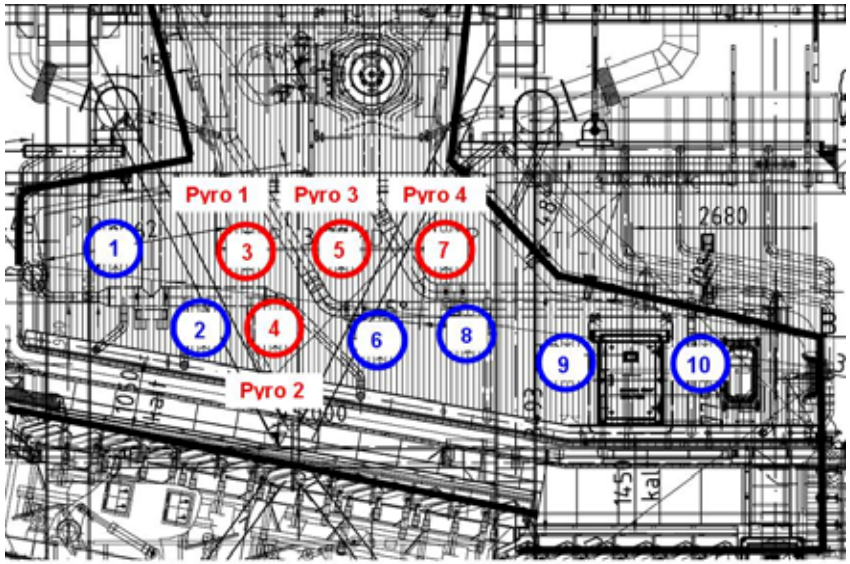
- Understand what is happening
- Improvement aspects
  - Exhaust quality
  - Efficiency (less air)
  - Controllability
  - Cost

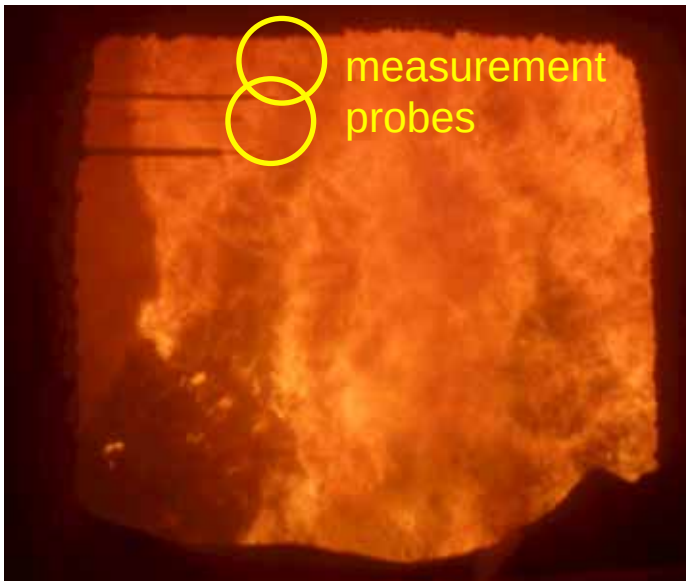
Advanced Combustion - Characterization of Combustion Process

Measurement Campaign

- Extraction Measurements: Continuous and intermittent sampling
- H2, CO, CO2, H2O, O2, CH4, higher hydrocarbons, Temperature
- Several operating conditions





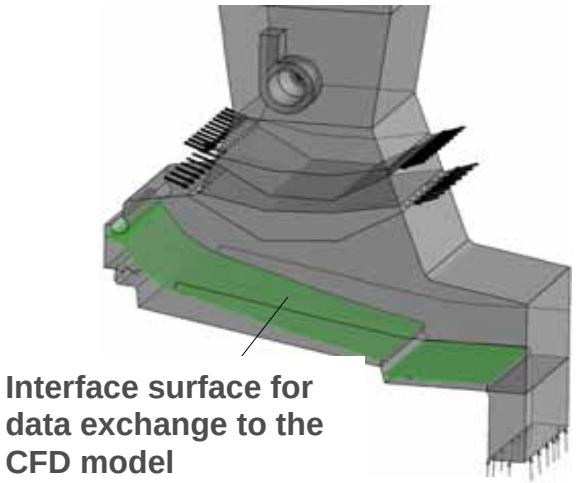


Advacned Combustion - Characterization of Combustion Process

Modelling: DEM Method
(in cooperation with LEAT / U of Bochum)

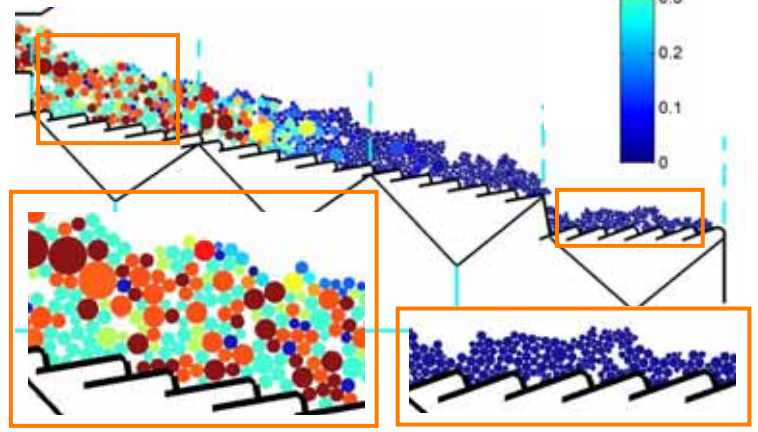
- Objective
  - Numerical model of **movement** on grate and **thermochemical processes** within particles and gas phase

- Approach
  - **DEM** Code for large number of solid particles
  - **drying**, **pyrolysis** and heterogeneous **combustion** is coupled to solid mechanics and heat transfer modules
  - **Coupled to CFD** Code for burn-out of primary combustion gases and fluid flow pattern – radiant heat transfer exchanged



Interface surface for data exchange to the CFD model

Example: content of volatiles in solid particles



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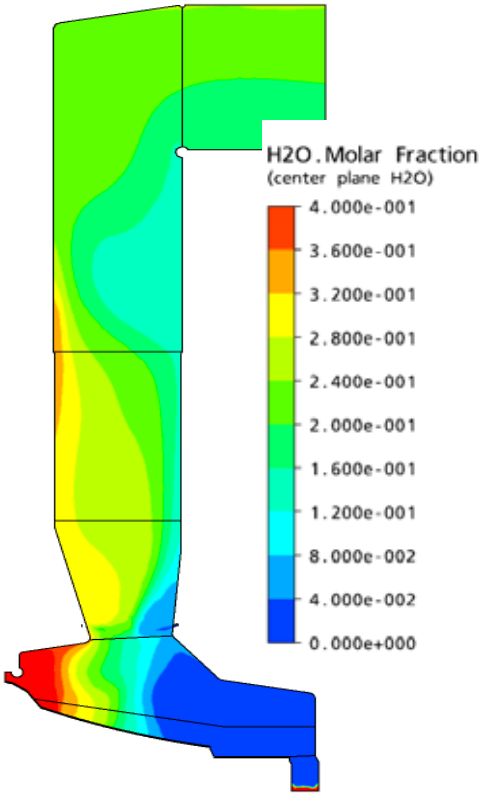
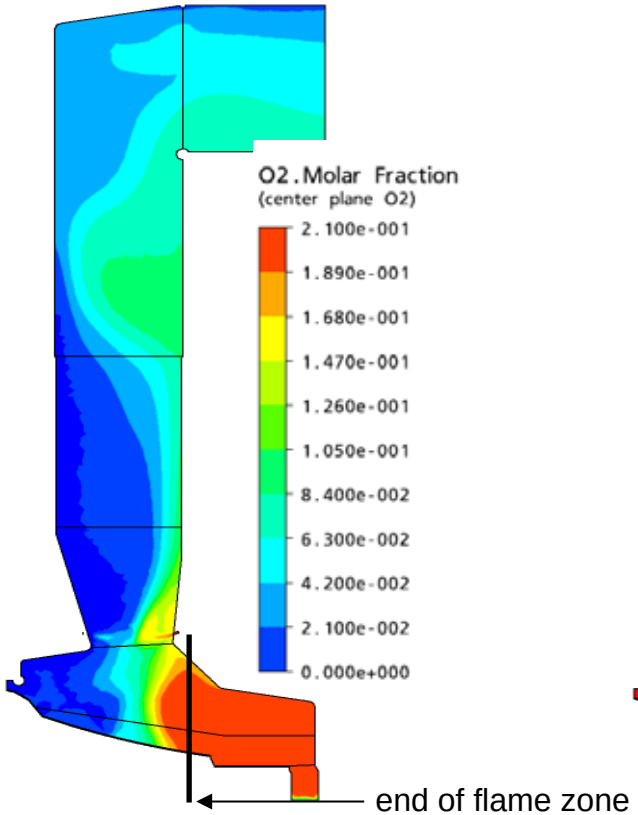
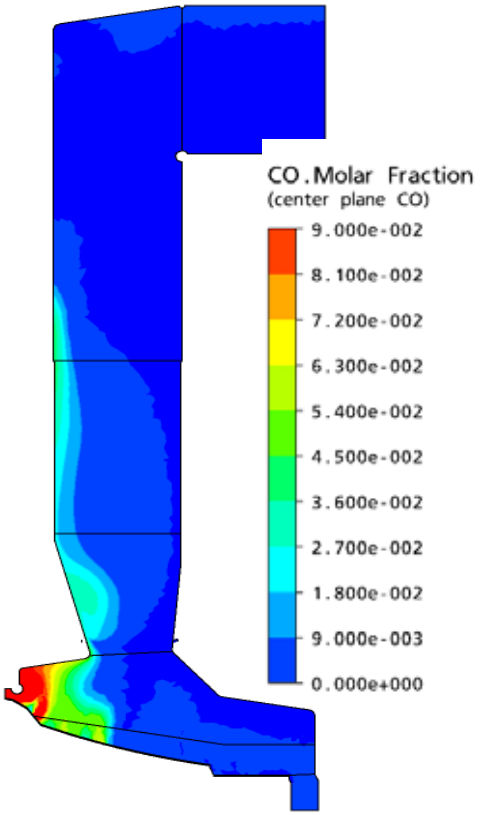
Advanced Combustion - Characterization of Combustion Process

CFD Results
Good agreement with measurements





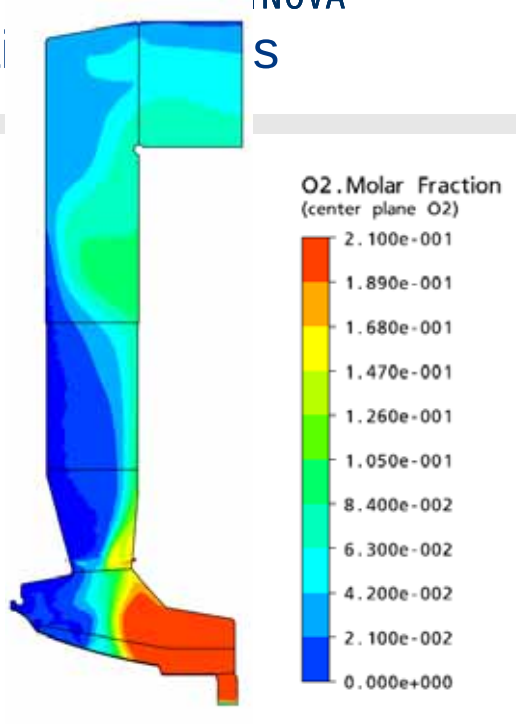


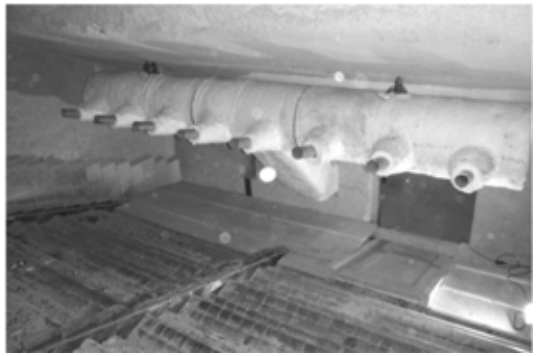
Advanced Combustion - Characterization of Combusti s

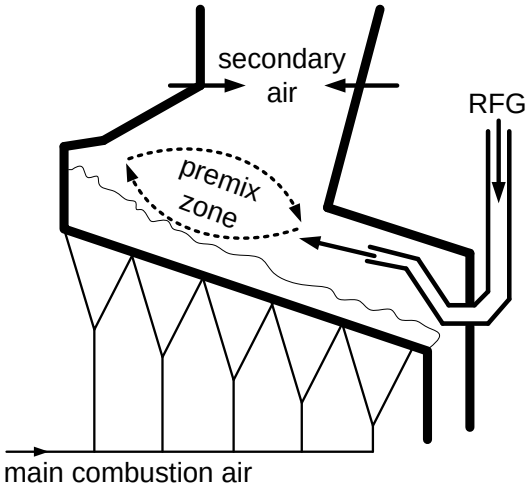
Concept for LEA combustion: Full scale test

- Two extreme conditions above grate
- Conditioning stage: premixing
- Post combustion stage

- Improved gas burn-out even at reduced oxygen levels

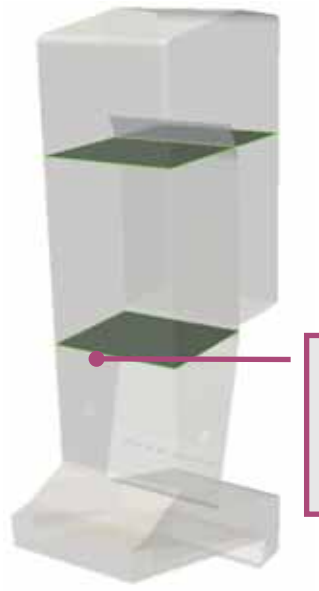




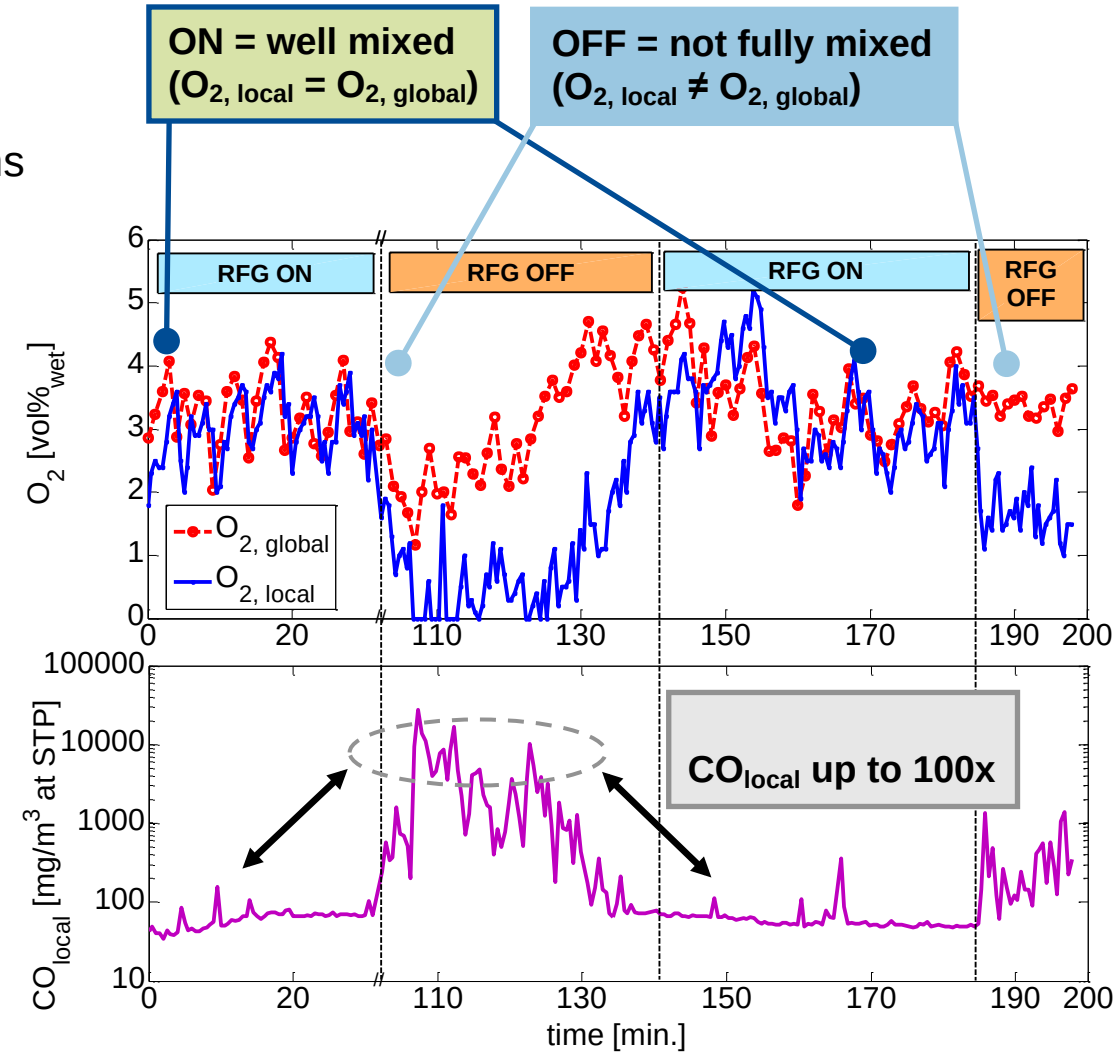


Advanced Combustion – Characterization of Combustion Process

- With premixing on
  - Homogeneous O_2 concentrations
  - CO concentrations stable and lo
- Flue gas flow – 20% ($\lambda < 1.20$)



CO measurement (locally, by FTIR)



Advanced Combustion – Characterization of Combustion Process

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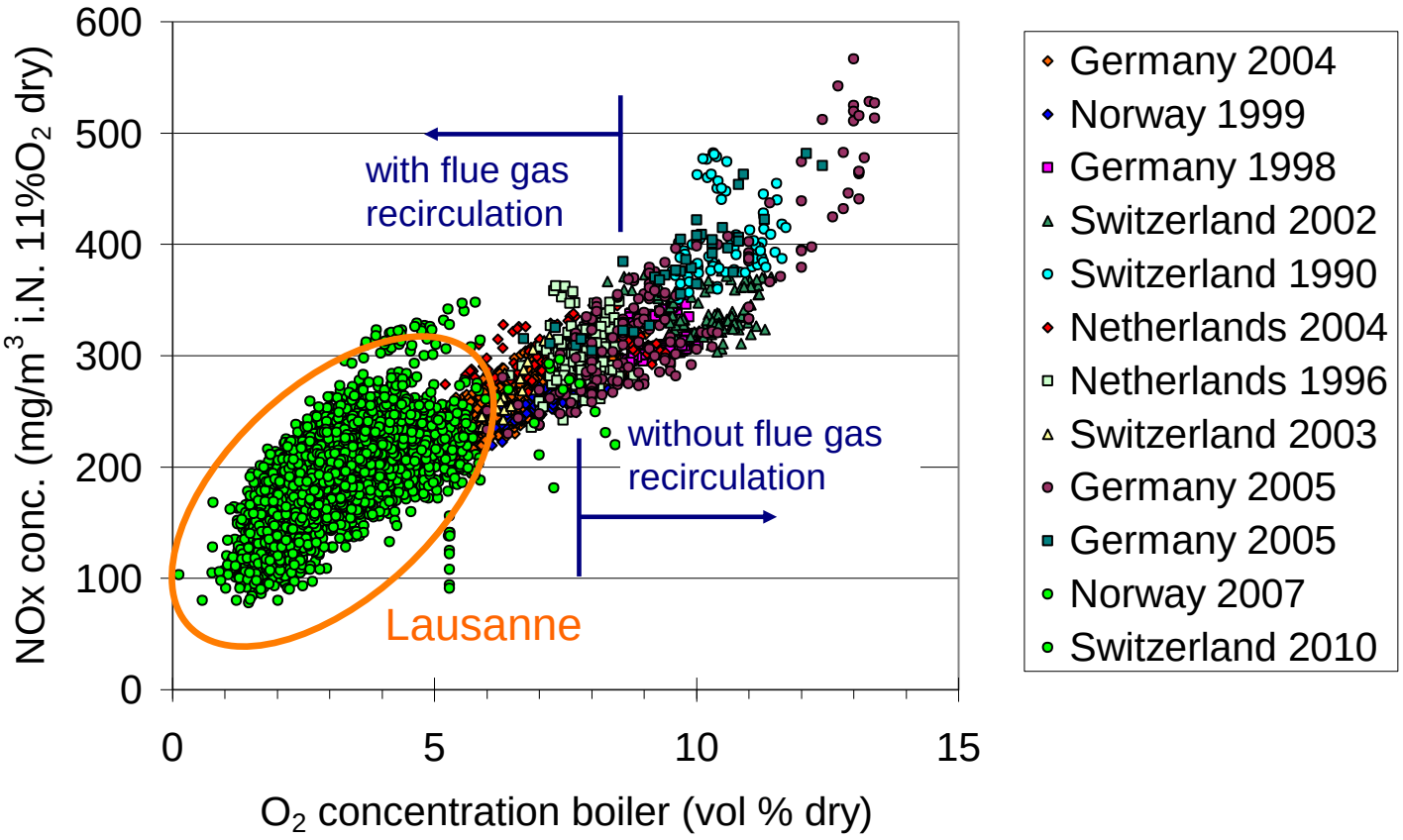
NOx generation (uncontrolled, 1-minute averages)



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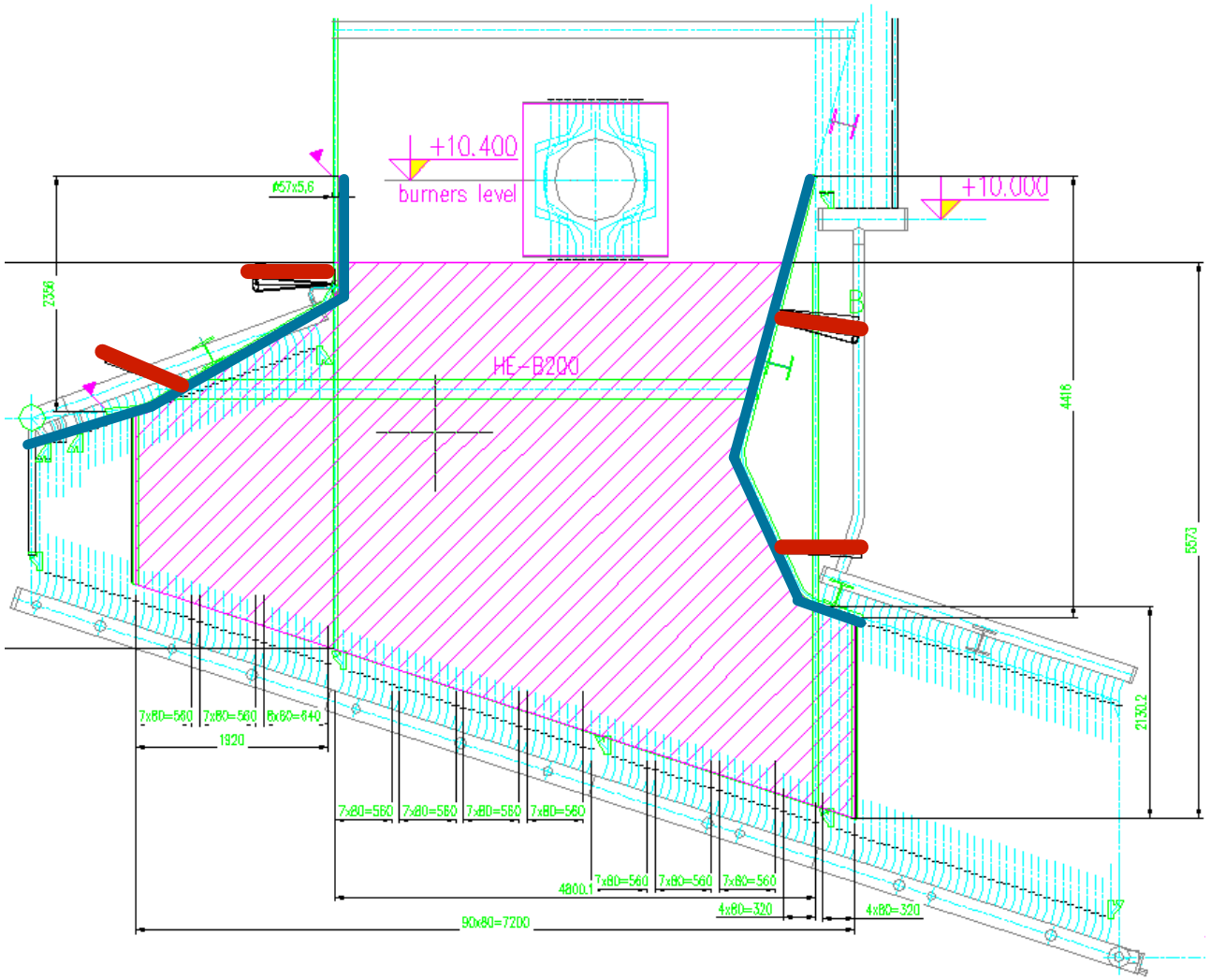
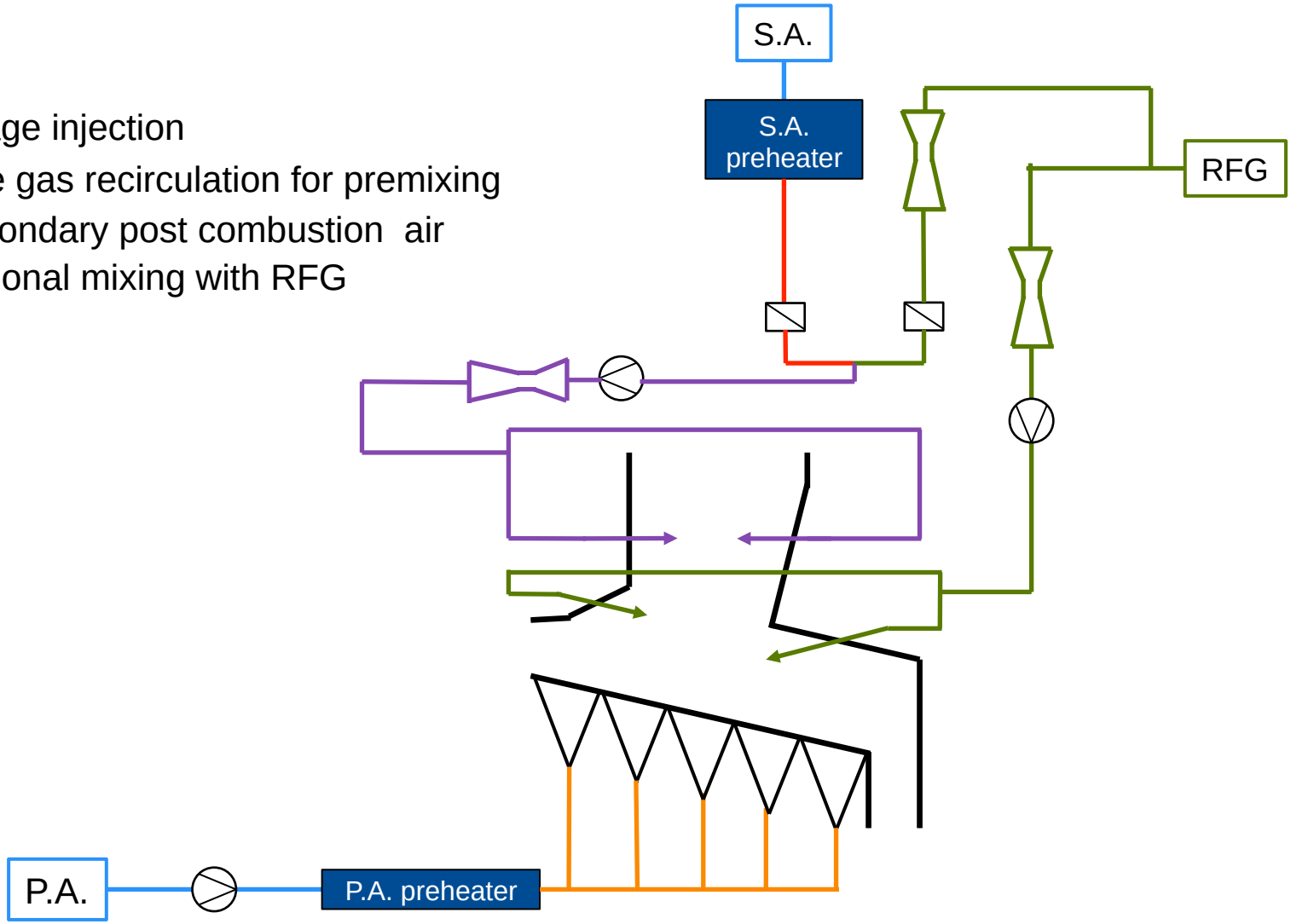
Advanced Combustion – Implementation of HZI LEAP

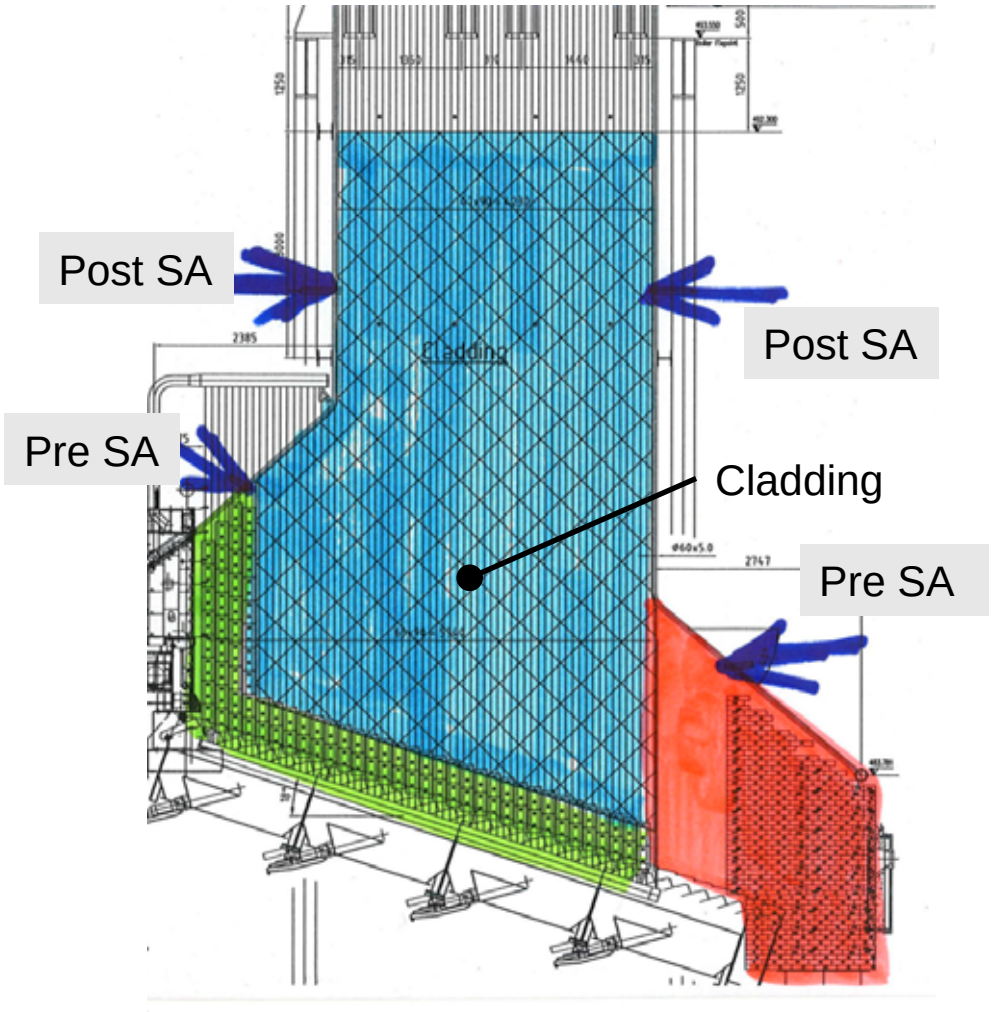


Advanced Combustion – Implementation of HZI LEAP

- Two stage injection
  - Flue gas recirculation for premixing
  - Secondary post combustion air
  - Optional mixing with RFG



Advanced Combustion – Implementation of HZI LEAP



- Premixing with secondary air
- Post combustion with secondary air vortex
- Reduced primary air flow
- Higher primary combustion temperatures
- Elevated heat transfer with cladded boiler
- Improved controllability with additional sensors

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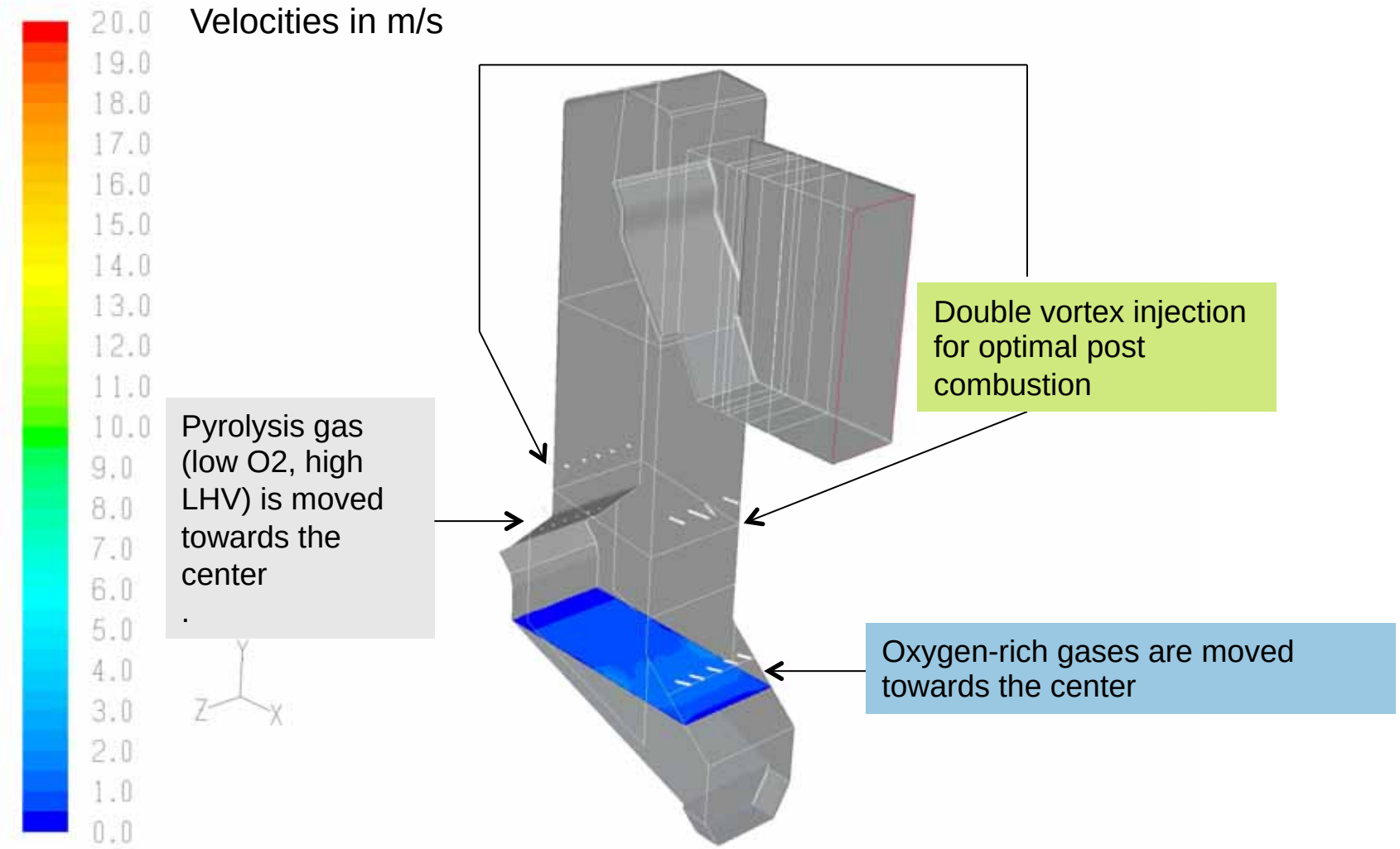
Advanced Combustion – Implementation of HZI LEAP



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Advanced Combustion Process – HZI LEAP

Expected Results

- Primary air flow - 20 %
- λ 1.6 → λ ~1.3
- O_2 6-7 % → O_2 2.5 – 4%
- Flue gas flow - 20 %
- Increased energy efficiency (electricity per ton of waste)
- Less power consumption

+ 3 %

- Smaller flue gas treatment plants - 20 %
- Homogeneous temperatures and concentrations in 1st pass
- Tendency towards reduced slagging, fouling and corrosion
- Significantly reduced NO_x generation and NH_3 consumption

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Thank you