EUtech Scientific Engineering

Cost-effective flexibilisation of fossil-fired power plants

Operation and boiler performance enhancement using online monitoring instruments

Dr. Francesco Turoni

Content

- Power generation in India
- Flexible operation
- Online monitoring instruments
  - EUcoalflow
  - EUcoalsizer
  - EUsoft air
  - EUflame 2D
- Best practices / Results
- Summary and outlook

Power generation in India

Power generation in India

Status

- Steady economy growth requires more capacity
- NTPC plans doubling of coal-fired capacity to 85 GW by 2032[1]
  - Existing plants are designed for base-load
  - Varying fuel types and blends
  - Almost no online and reliable information of fuel, air flows, particle size distribution and FEGT available
- New record for renewable energy sources (wind, solar and hydro) in Q1&Q2, 2019[2]

Challenges

- Inherent intermittencies of wind and solar resources
- Dynamic, flexible and new minimal operation requirements for fossil fuels base-load plants
- Compliance of emission limits (NOx & CO), improvement of plant efficiency and plant reliability

1) NTPC Ltd.
2) Central Electricity Authority (CEA)

Flexible operation

Flexible operation

How to achieve/enhance flexible operation?

- Pulverizer fineness and load range optimization with pipe specific dynamic mass flow measurement
- Robust measurement and control of primary, secondary and overfire air flow
- Balancing fuel and air distribution into the burner belt (AFR management)
- Control of temperature and burnout distribution in vertical and horizontal domain
- Control of SH and RH steam temperatures
- Continuously utilizing available data with online analysis (e.g. condition-based maintenance)

...and why that matters!

- Increase operational flexibility (fuel flexibilisation, min. load & load swing flexibilisation)
- Increase flame stability and thus reduce SH & RH water spray injection and thermal stresses
- Reduce unburned carbon (LoI, slagging and fouling minimization)
- Improve overall plant efficiency and minimize flue gas losses
- Comply with emissions legislation (NO_x, Co, GHG, particulates)
- Increase operational reliability

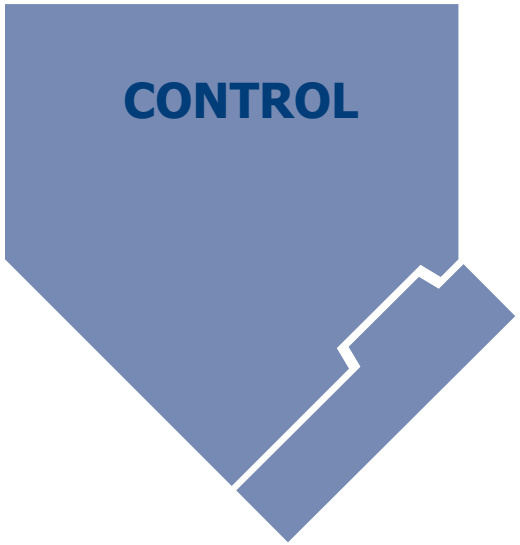
Online monitoring instruments

Motivation

Step by step to success

Coal mass flow
Coal fineness
Air mass flow
2D Temperature Distribution

Air Fuel Ratio
Advanced Control Strategies
Model Predictive Control

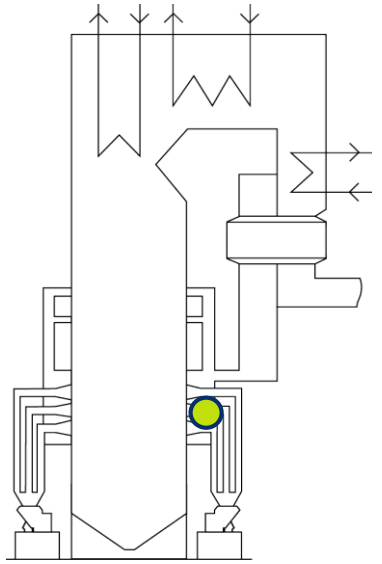


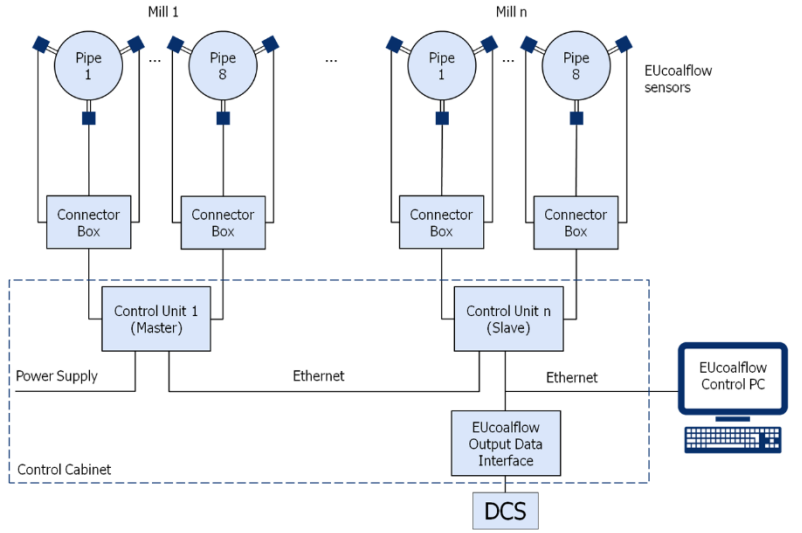
Efficiency
Emissions
Slagging
FEGT

EUcoalflow

Online fuel mass flow measurement

- Absolute mass flow and velocity measurement
- Stationary and mobile ECF System
- Plug and play solution
- Comfortable user interface (ECF Software)
- Full integration to DCS

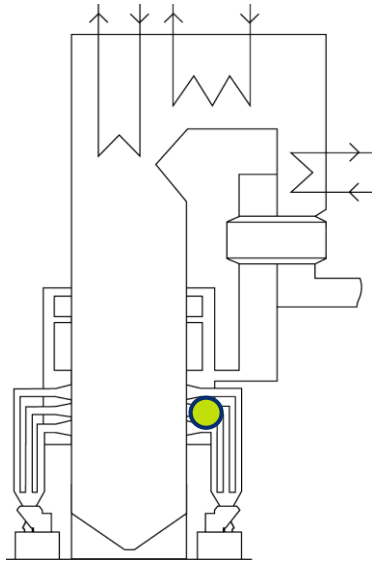


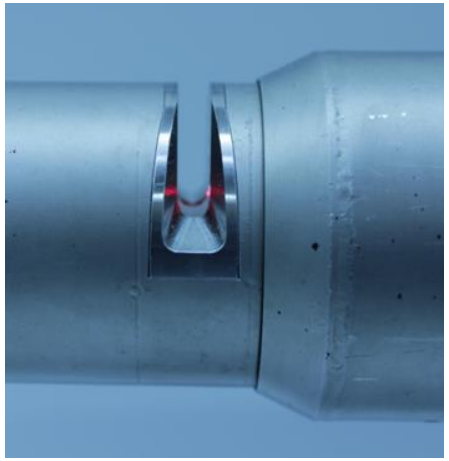


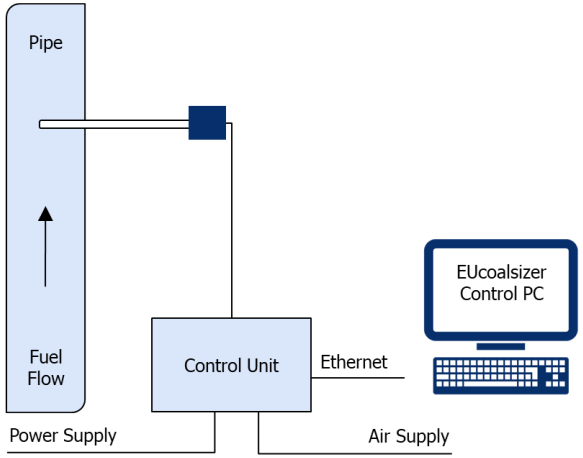
EUcoalsizer mobile

Immediate coal flow readings

- Online coal flow analysis with direct results
  - Particle fineness
  - Air flow
  - Coal mass flow
  - Air-fuel ratio
- Immediate results & online reporting
- Built for everyday use



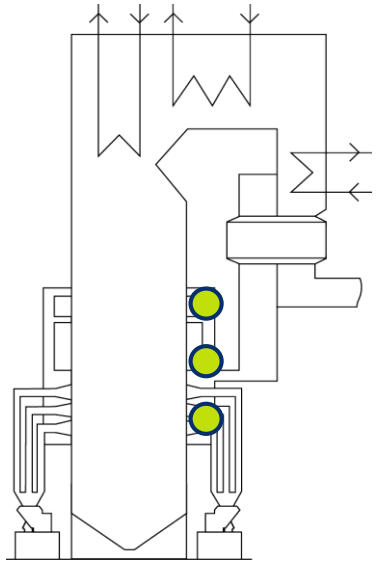


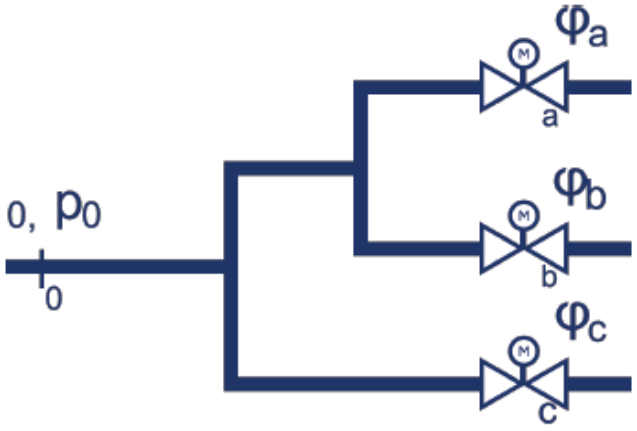


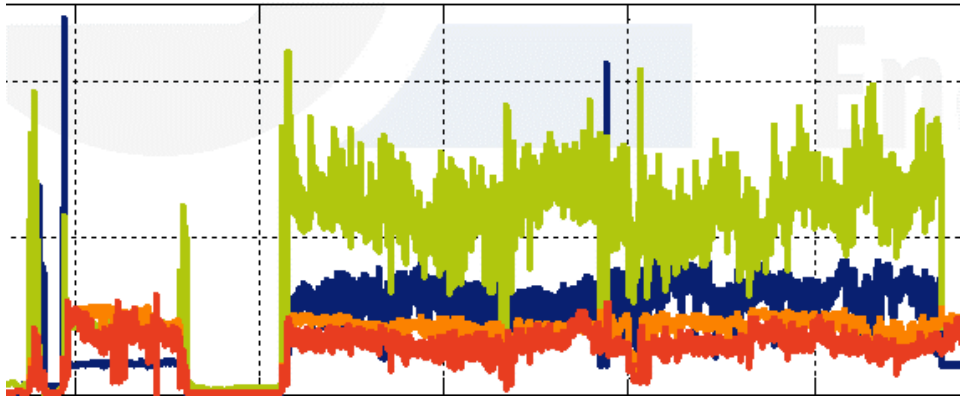
EUsoft air

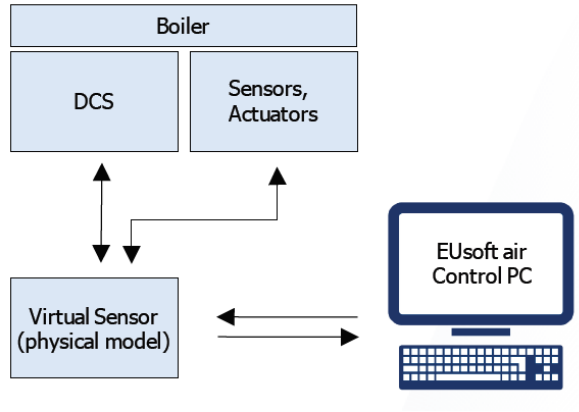
Complete air management

- Flow measurement with virtual sensors
- Reliable and accurate mass flow values
- All air flows (PA, SA, OFA)
- No maintenance, auto-control
- Easy to implement into DCS
- No footprint, windbox compatible





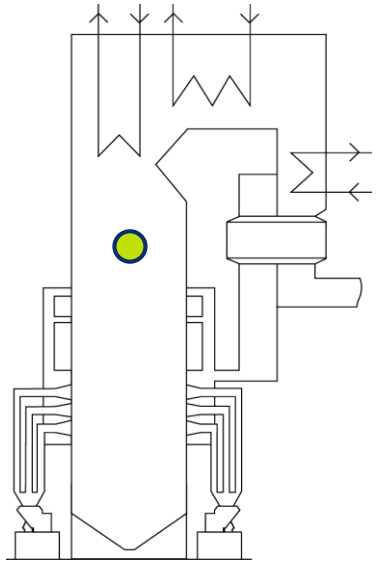


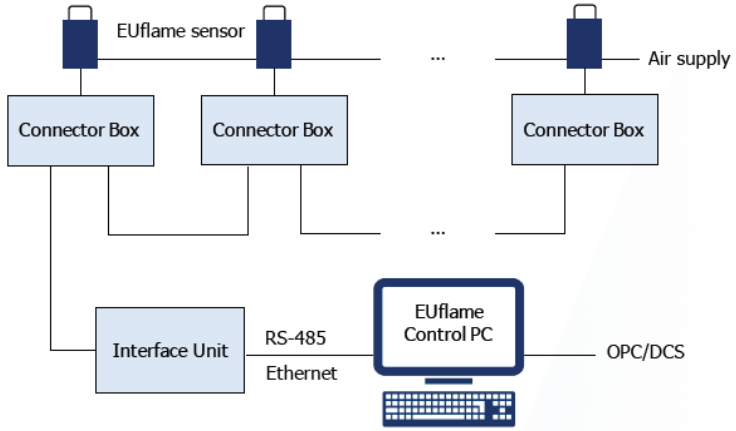


EUflame 2D

Flame temperature and burnout

- Online flame temperature and burnout measurement (2D/3D)
- Sensor based on optical measuring technique
- Single-point and net-measurements
- Designed for different scales of combustion chambers
- Precise measurement of FEGT distributions
- Stationary or mobile system available

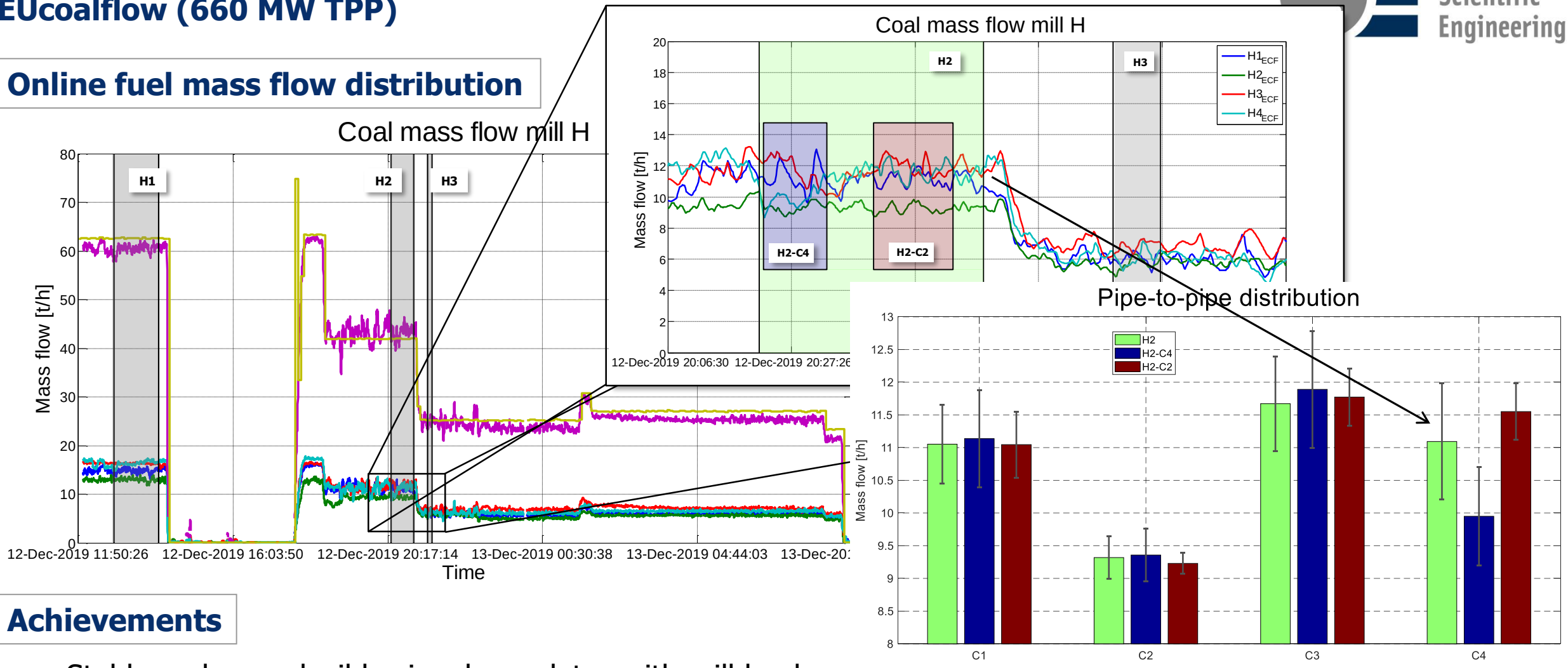




Best practices / Results

EUcoalflow (660 MW TPP)

Online fuel mass flow distribution

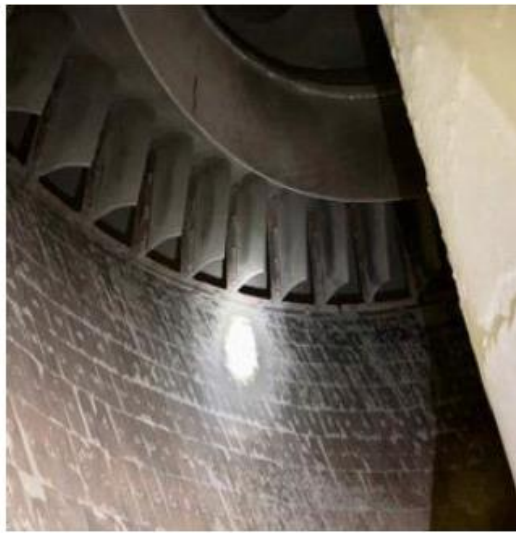


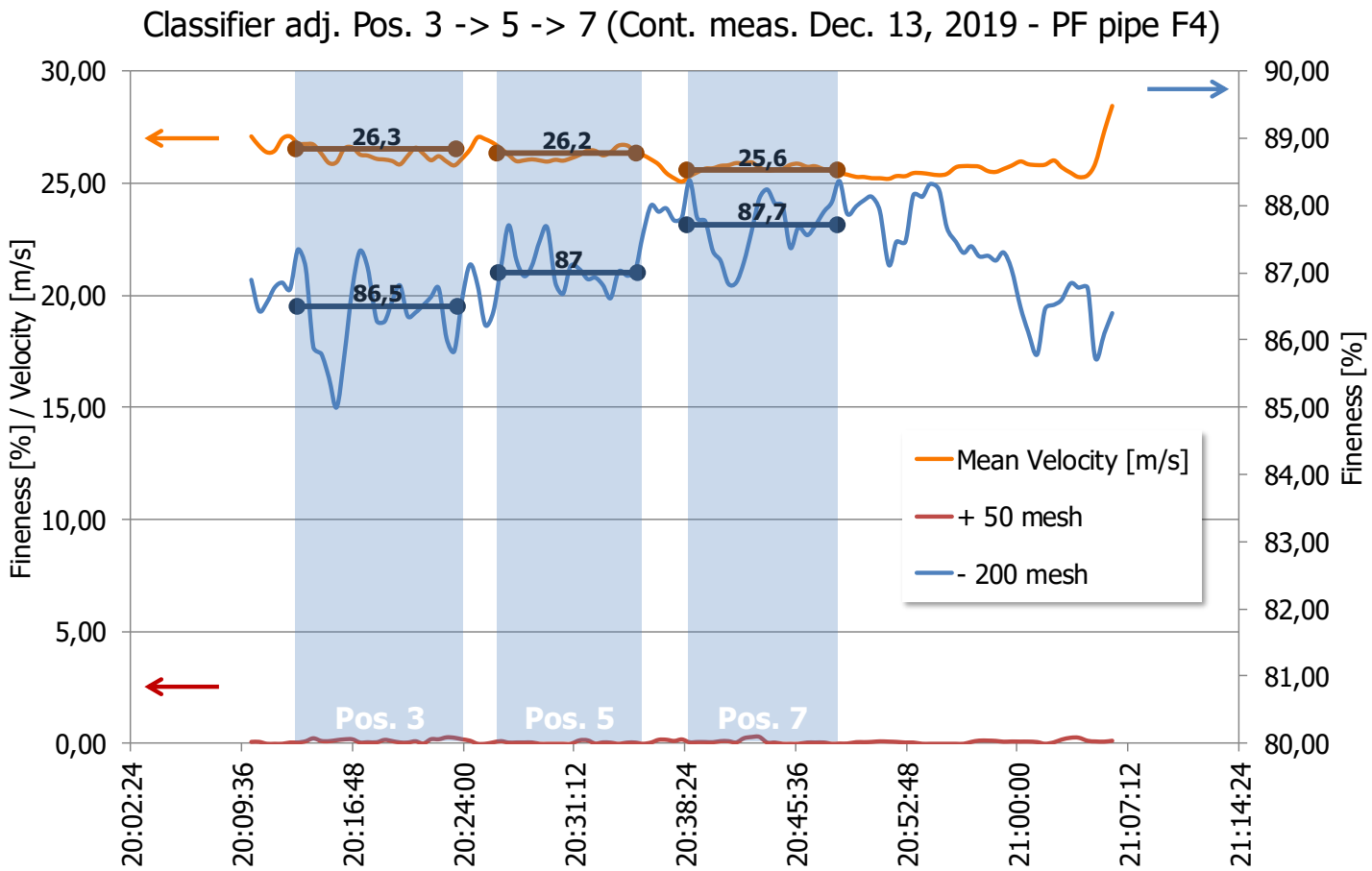
Achievements

- Stable and reproducible signal correlates with mill load
- Direct monitoring of dynamic effects allows active pipe-to-pipe mass flow & FEGT temperature balancing
- Safety increase due to direct information of PF pipe choking (e.g. with wet coal)
- Improve efficiency and emissions (CO, η)

EUcoalsizer mobile (660 MW TPP)

Online fineness optimization



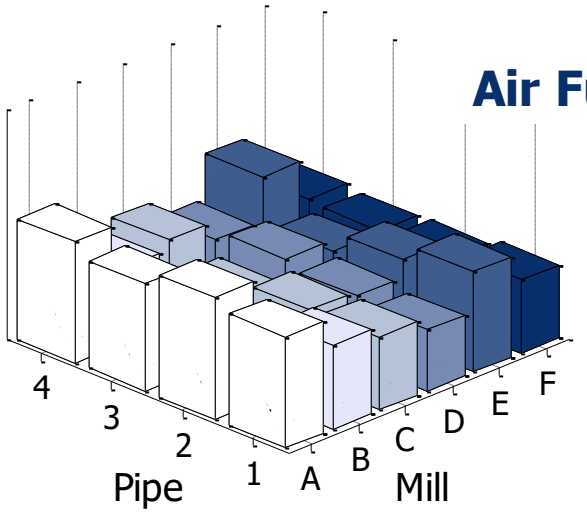


Achievements

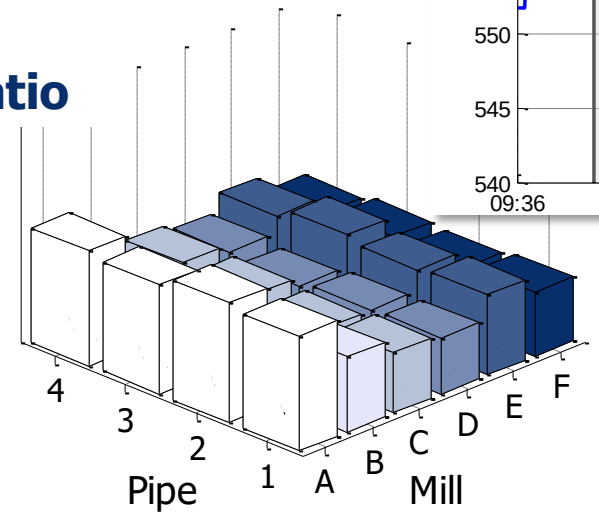
- Active fineness management over whole mill lifetime
- Ignition & combustion improvement (CO, η)
- Reduction of unburned carbon (LoI)
- Condition based mill maintenance
- Availability improvement (slagging and fouling minimization)

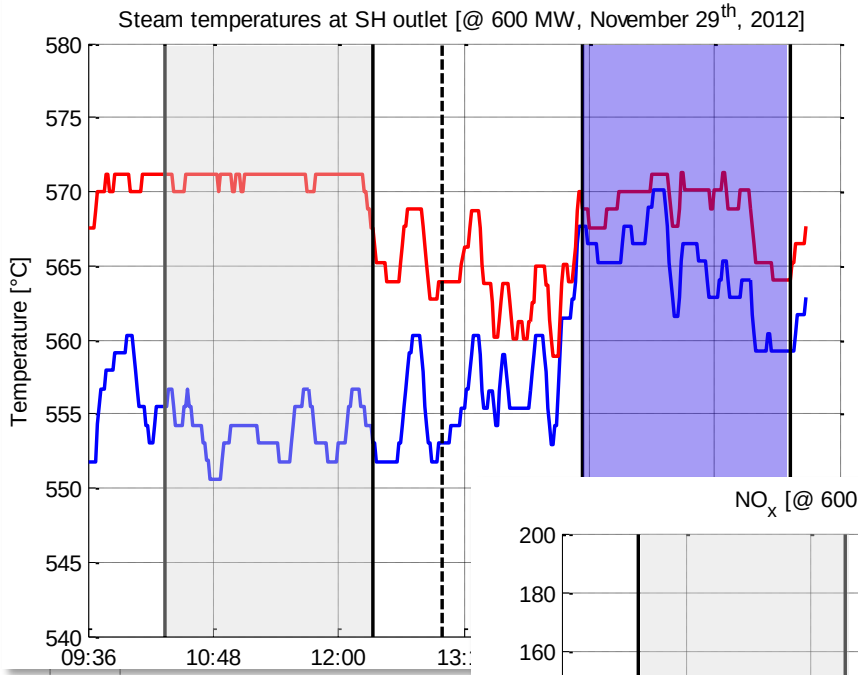
EUsoft air (600 MW TPP)

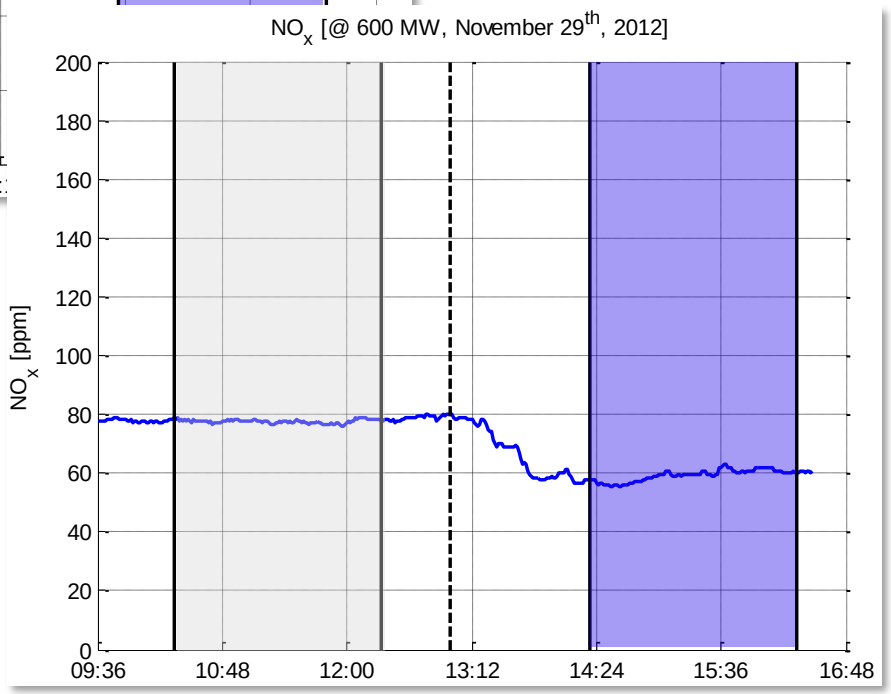
AFR management with virtual sensors



Air Fuel Ratio





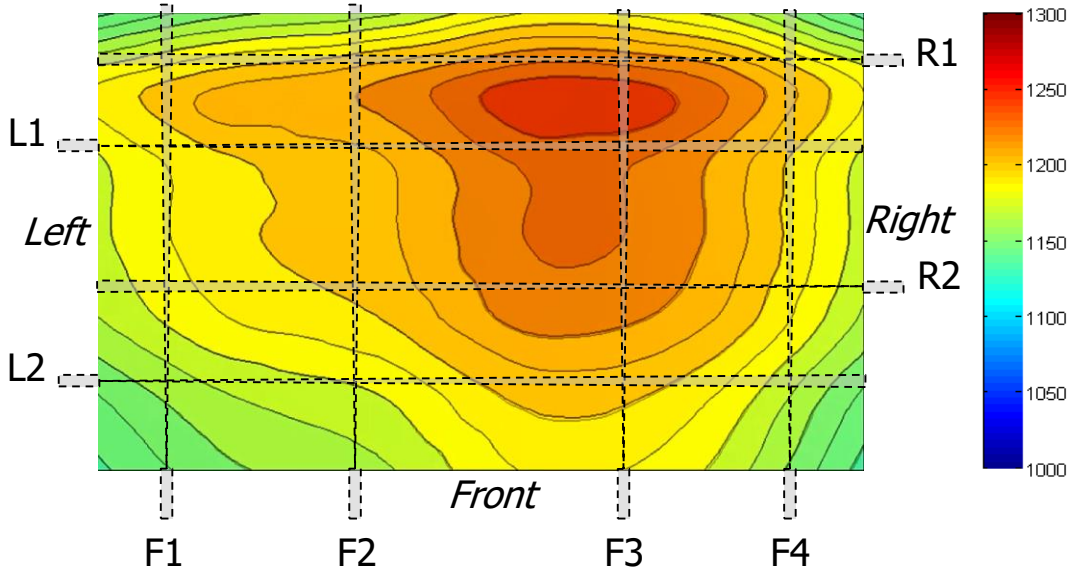


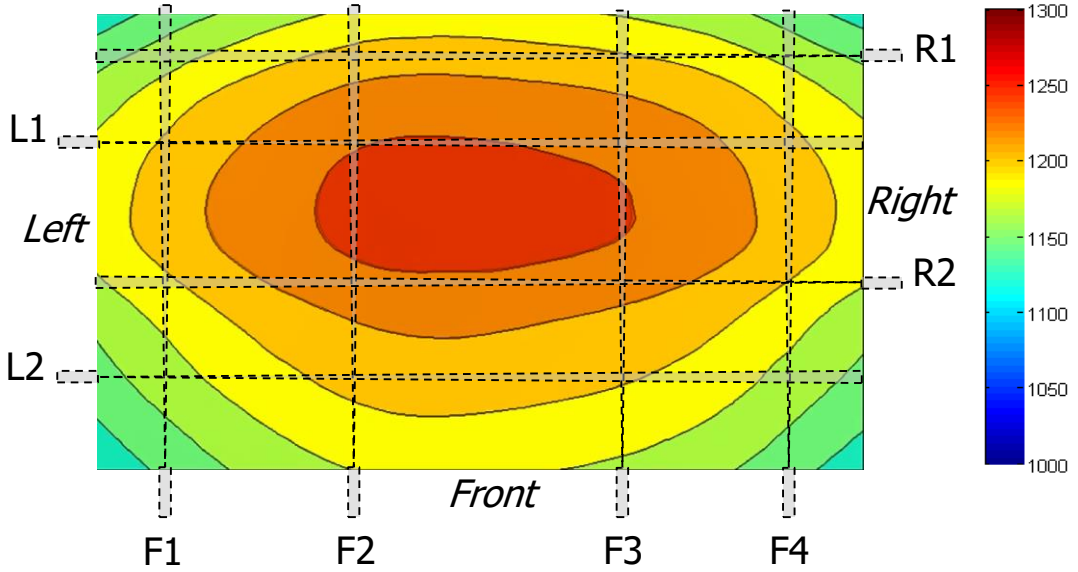
Achievements

- Air-fuel ratio balancing and staging (key-driver of combustion)
- Direct combustion and emissions improvement (CO, LoI, NOx, particulates)
- Reduce spray-water injection requirements
- Further reduction of excess O2, increases efficiency η

EUflame 2D (710 MW TPP)

Combustion homogenization





Achievements

- Higher combustion efficiency and higher flexibility
- Active FEGT control / homogenization and emissions improvement (CO, LoI, NOx, particulates)
- Identify and optimize optimal location for injecting NO reducing agents in SNCR
- Reduce spray-water injection requirements
- Less thermal stress

Summary and outlook

Summary and outlook

Cost-effective flexibilisation

- Online and robust measurement of the coal flow and PA flow in each pipe
- Adjust coal flow to acceptable reference limits (e.g. manual static adjustments)
- Robust AFR management at burner levels
- Use of optimisation tools rather than just measurement devices
- Quality enhancement through frequent real-time measurement in less time
- Real-time data enabling efficient and powerful control
- Optimal efficient / cost ratio

Opportunities for power generation in India

- Robust and fully reliable solutions
- Increase operational flexibility (fuel flex., load swing flex.)
- Seamless integration into existing plant infrastructure
- Improve overall plant efficiency (O_2 level & minimize flue gas losses)
- Comply with emissions legislation (NO_x, CO, GHG, particulates)
- Avoid major, capital intensive retrofit
- Reduce fatigue, wear and thermal stress
- Leverage the best possible cost value option for plant upgradation

Thank you!

www.eutech-scientific.de