Siemens Experiences in the field of Flexible Operation

EEC Seminar

Ahmedabad | February 6, 2020

Ian Rebello

Siemens Experiences in the field of Flexible Operation

Journey of Coal Fired Power Plants

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Operation in Full Load
Focus on High Efficiency and High Avabillity
Base Load Plants
Middle Load Plants
Peak Load Plants

START

Poland

India

Operation in Partial Load
Higher Load Ramp
Min Load Reduction
Start Up Optimization

Brazil

Chile

Unit Control
Frequency Control
Automatic Generation Control

Austral

Germany

Min Load Reduction (<30%)
Less Operating hours
Strategical Power Plants

DESTINATION

SPPA-P3000 Process Optimization for steam power plants
Higher profitability through intelligent solutions

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Runback Plus
Life Time Plus
Uptime Plus

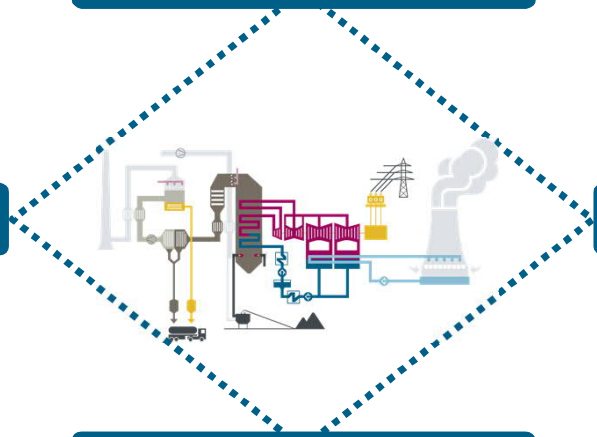
High Availability

Minimal mechanical changes

Low Loss Start
Combustion Optimizer
Sootblower Optimizer

High Efficiency

Temperature Optimizer
Low Throttling
Best Point



Fast Start
Fast Ramp
Frequency Control

High Flexibility

Dispatch Control
Minimum Load Reduction
Maximum Load Plus

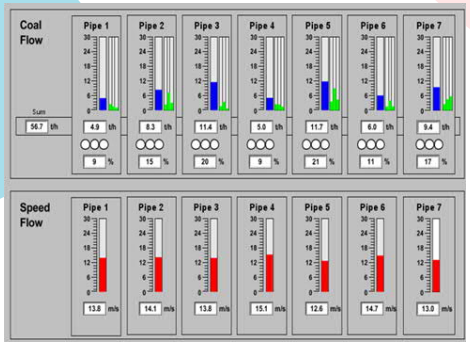
Low Emissions

NO_x Reduction
CO_2 Reduction
LoI Reduction

Omnivise Performance Combustion Optimization
P3000 Coal Flow – Recommended

Competence in measuring of bulk solids

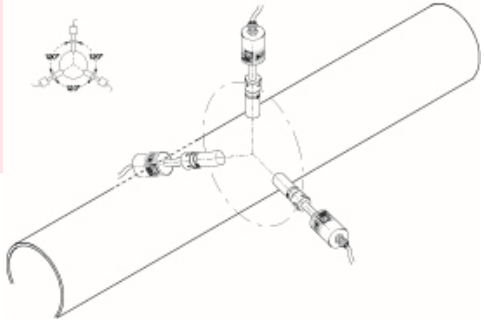
Competence in Power plants control and optimization



The Digital Solution

Advanced Coal Flow Measuring System

Measuring, Monitoring, Optimizing



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Omnivise Performance Coal Flow Measurement Solution

Fuel flow Monitoring for

- *Calculation of average coal*
- *Detection of unbalanced coal flow situations*
- *Full transparency in coal flow in all pipes over all load cases*

Plant specific solution

- *Adjustment of control strategy*
- *Compensation of unbalances in air-fuel*

Optimized plant economy

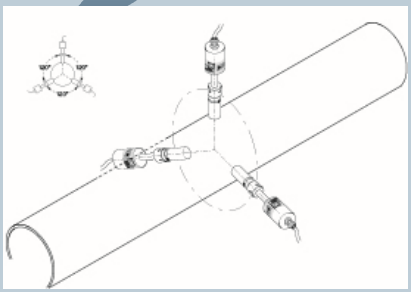
- ✓ **Better efficiency**
- ✓ **Reduction of min. load**
- ✓ **Higher Load Ramps**

New

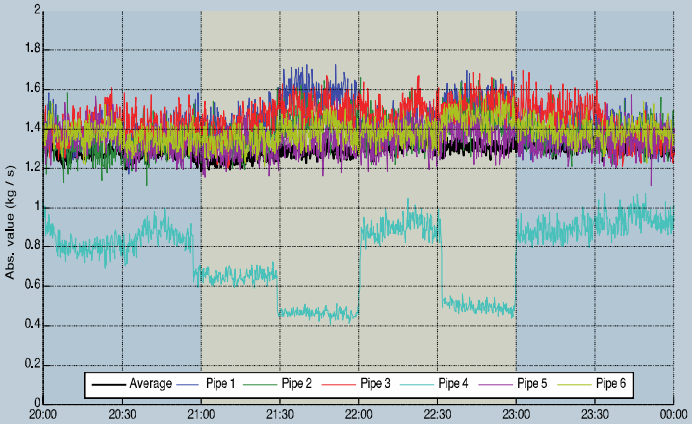
Flow Measurement per Mill

- *microwave sensor*
- *Roping detection by three sensor concept and compensation*

Measuring

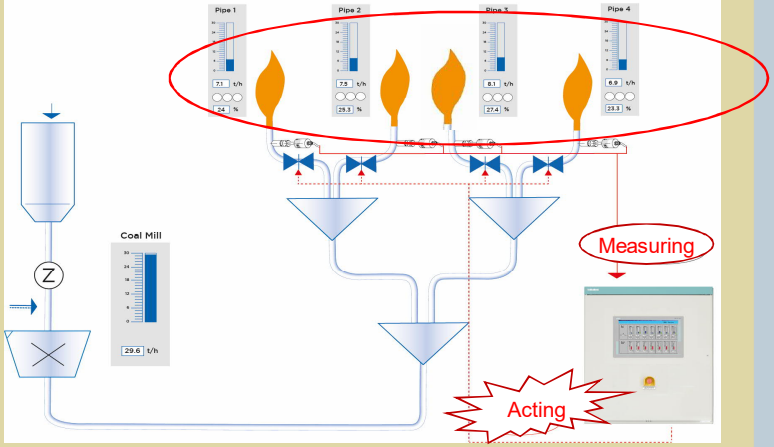


Monitoring

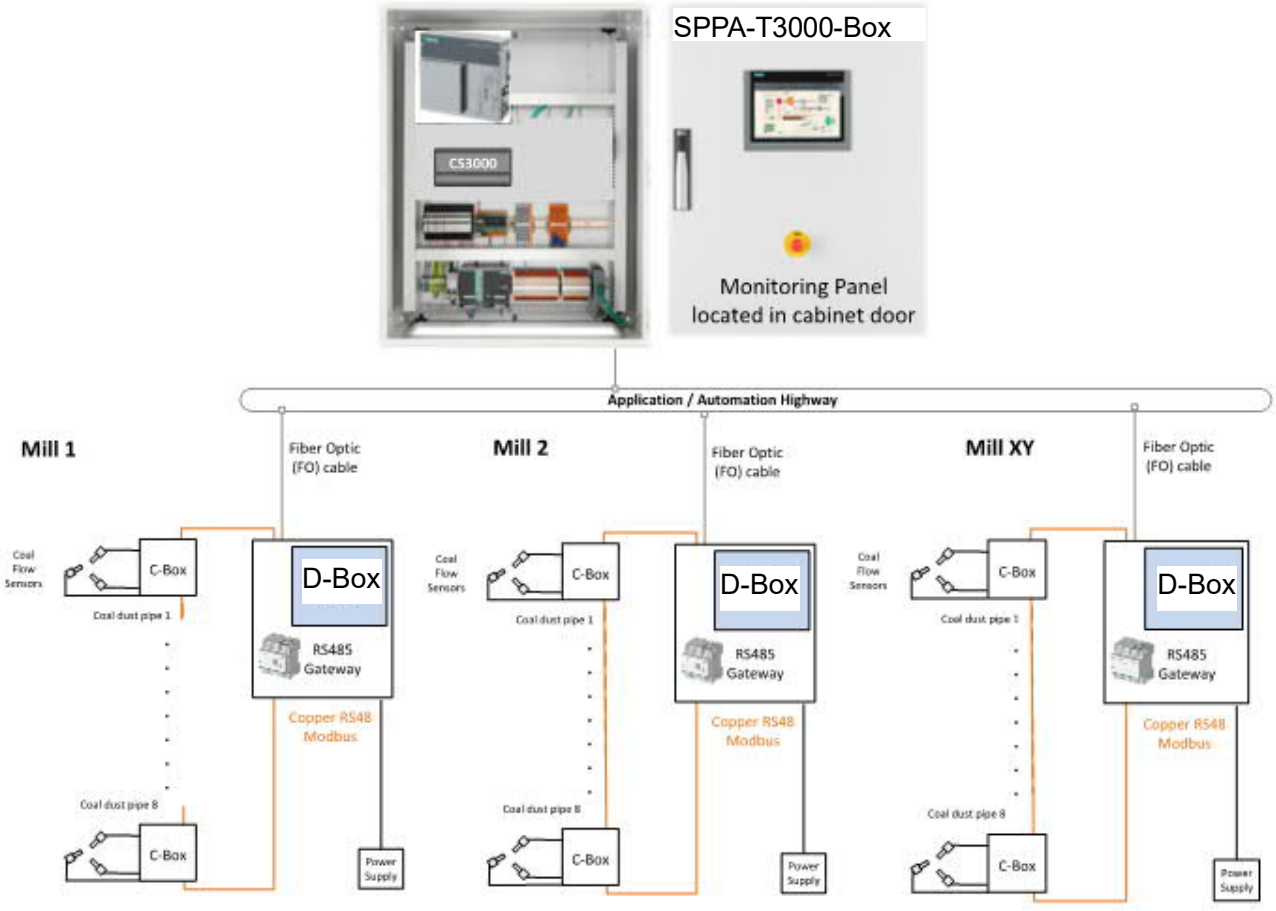


Optimizing

Optimized Combustion via closed loop balancing



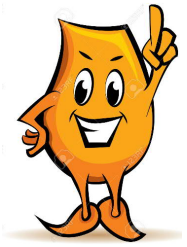
Omnivise Performance Combustion Optimization P3000 Coal Flow - High Standardized Solution



Basic Setup for one Mill

- 3 Sensors and 1 C-Box per coal dust pipe
- 1 D-Box per mill
- 1 T3000 Box
- Defined acceptance tests
- Commissioning 1 week/mill
- Connection to main DCS optional

Extendible up to 9 mills



Can be installed by Siemens India and local partners.

Omnivise Performance Combustion Optimization
First P3000 Coal Flow Reference

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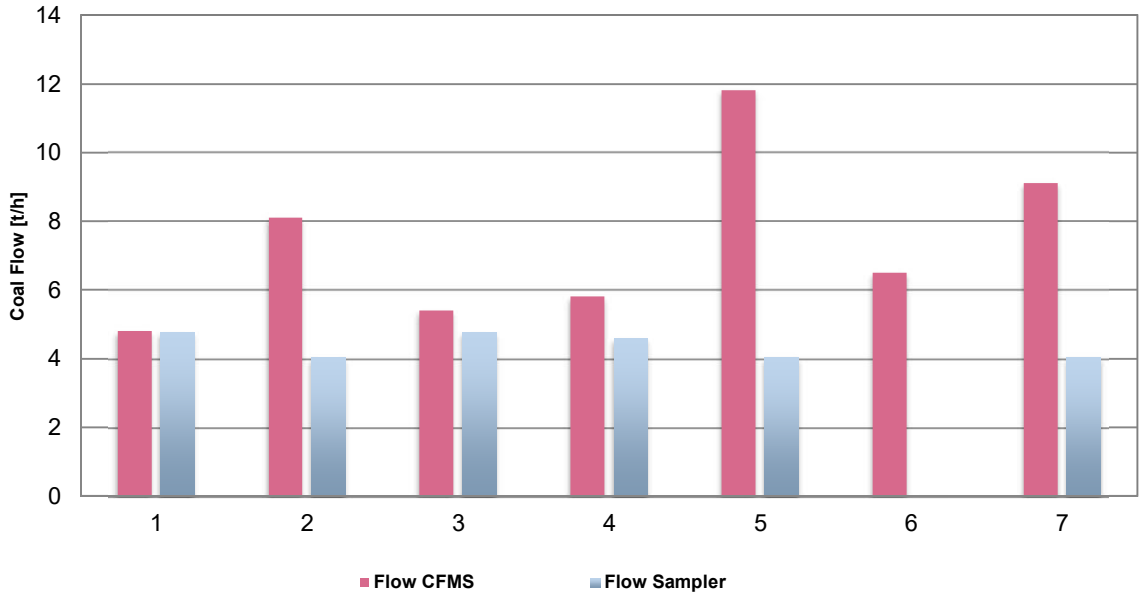
South Korea Coal Power Plant,
Hard Coal, Output 870 MW

- 6 Mills
- 7 Coal dust pipes per mill
- Communication to DCS via interface

High unbalanced coal flow



Inconsistence between P3000 Coal Flow and Coal Dust Sampler

Omnivise Performance Combustion Optimization
First P3000 Coal Flow Reference

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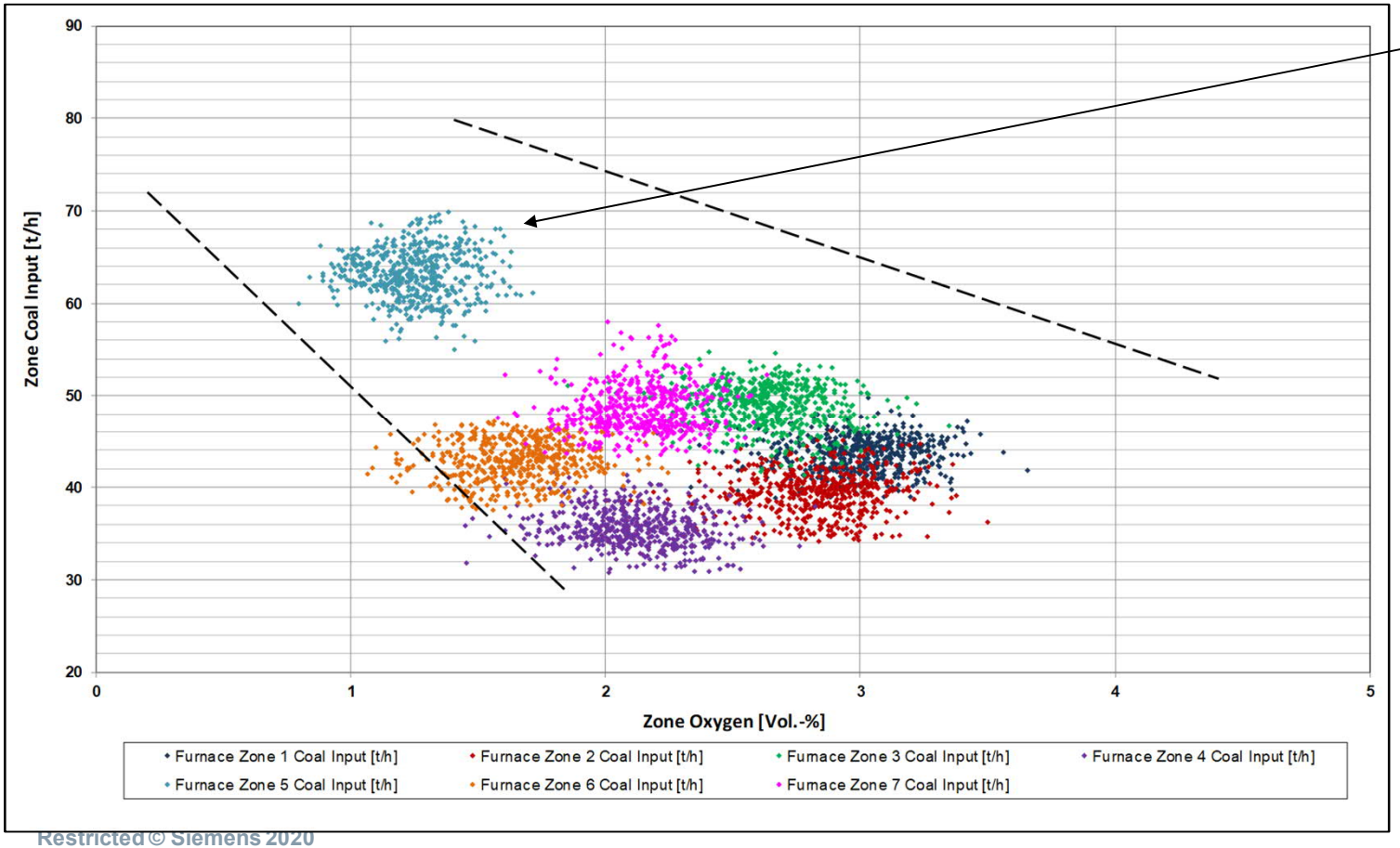
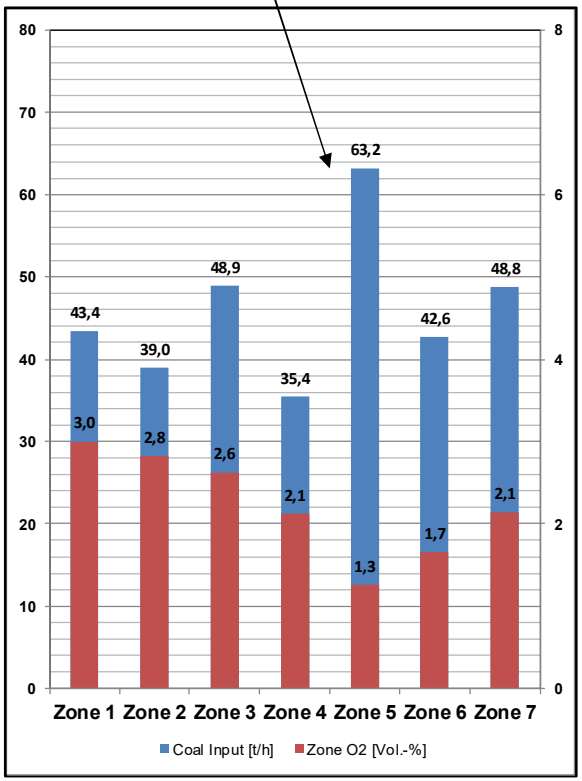


Zone 5 with the highest fuel input has the lowest zone oxygen value



Omnivise Performance Combustion Optimization
First P3000 Coal Flow Reference

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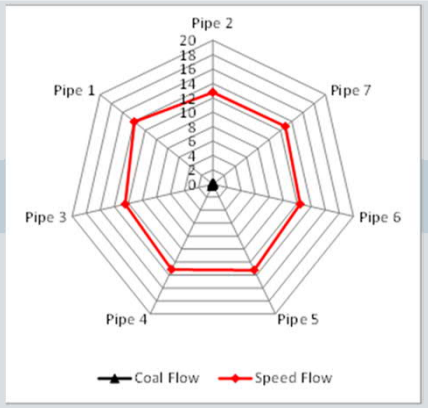
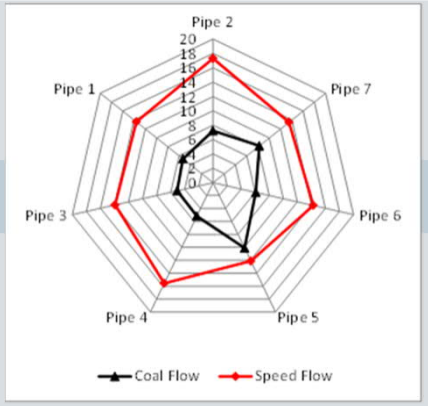
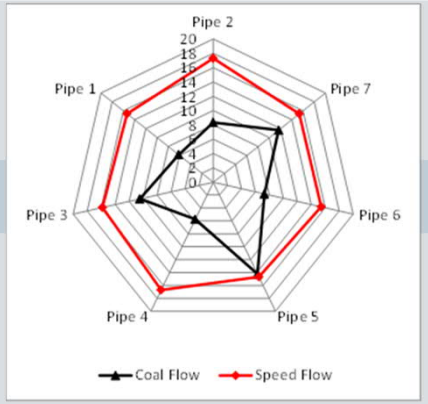
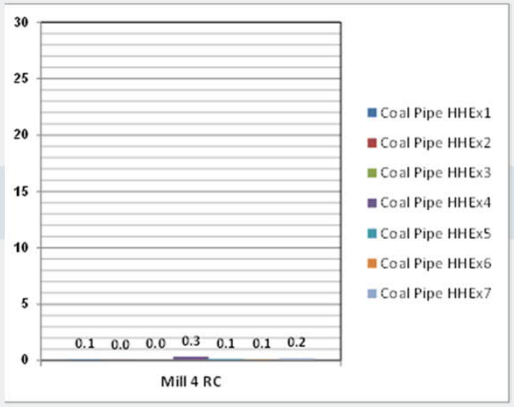
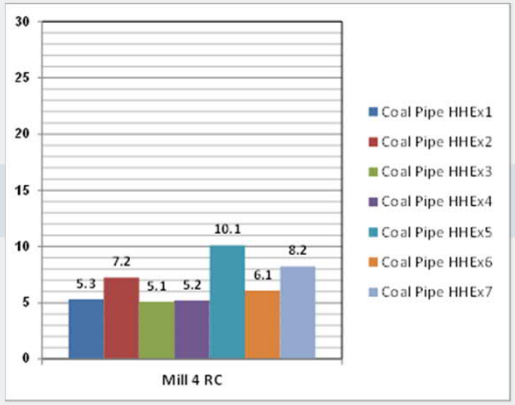
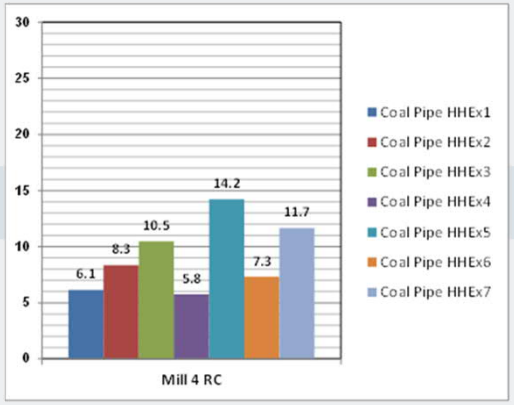
Mill Pre-warming 28.05.2018 15:35	Coal feeder initialization 28.05.2018 16:45	Mill started 28.05.2018 17:35
		
• well distribution of primary air when mill is purged	• after feeder initialization the air distribution changes significantly	
• adjustable orifice valve setting seems right if only based on air purging	• Coal mass flow does not follow the primary air mass flow	
		

Omnivise Performance Combustion Optimization
First P3000 Coal Flow Reference – next step

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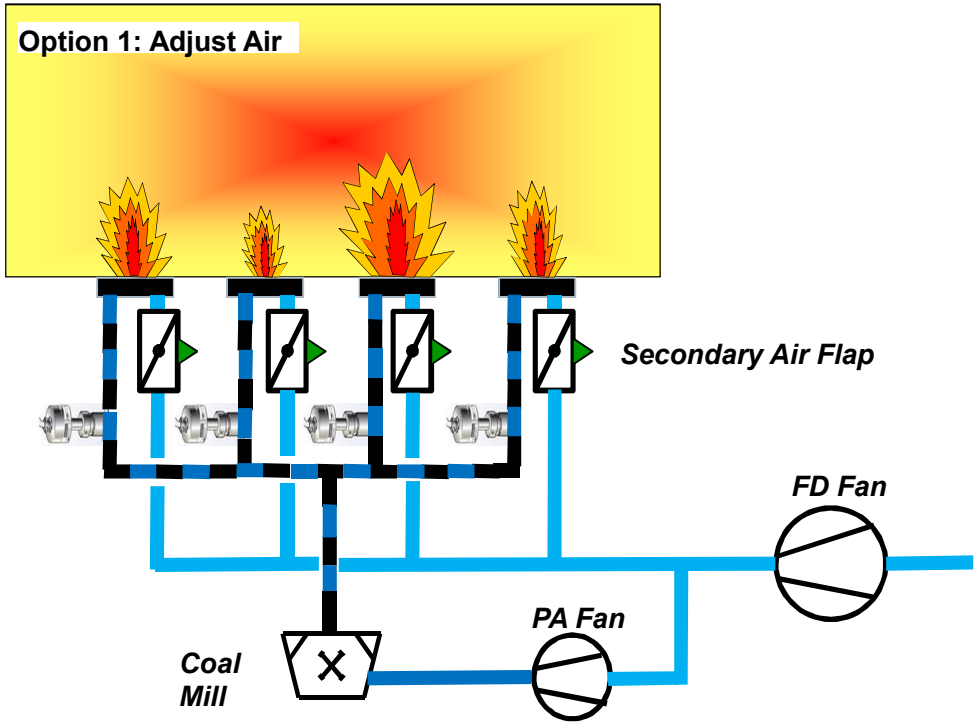
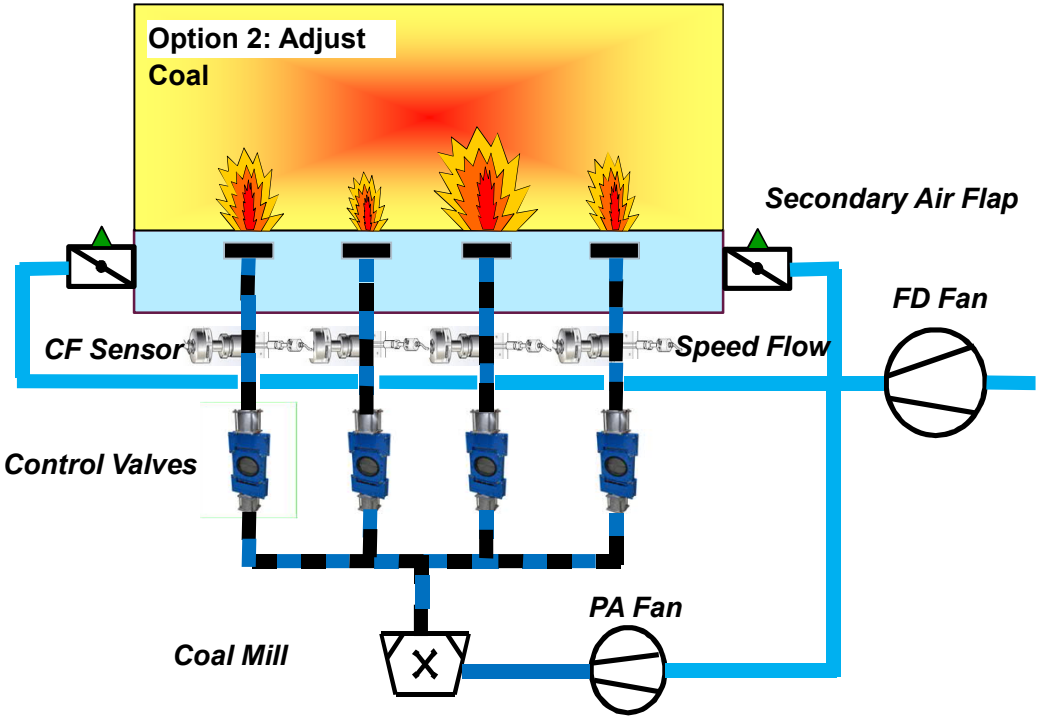
Higher Partial Load with optimization of air/fuel ratio



Higher Partial Load with optimization of air/fuel ratio



Siemens Experiences in the field of Flexible Operation
Poland 200+ Program - Flexibilization of Jaworzno CFPP

Capacity:	220 MW
Boiler:	Rafako
Type:	Drum Boiler
Number of mills:	4
Total coal dust pipes:	24

Poland 200+ Program

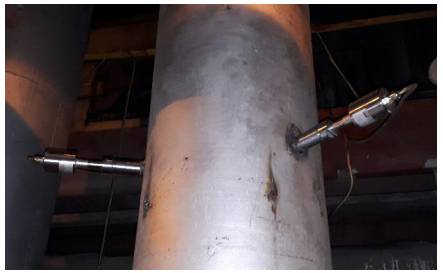
- Program from Polnish Government with financing from European Union
- Flexibilzation of 50 Units with 200MW
- Cold/Warm/Hot Start Optimization
- **40% min Load**
- **4% Load Ramps**
- Partial Load Efficiency Increasing

Recommended measures

- **Unit Control** to coordinate slow-acting boiler and fast-acting turbine
- **Temperature Control**
- **Coal Flow Measurement System** to increase partial load efficiency and load ramps

Current Situation

- Coal Flow System installed in one mill
- Performance tests done



Siemens Experiences in the field of Flexible Operation
Poland 200+ Program – Load ramp tests in Jaworzno CFPP

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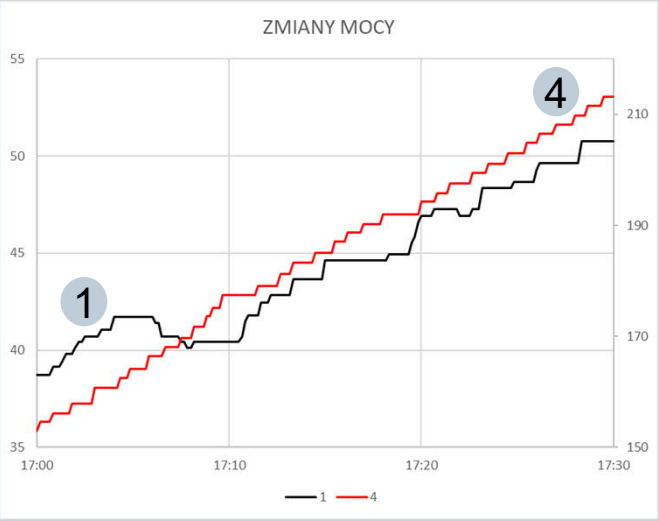
Current Load Ramp

- Load Ramps with 1%/min
- From min to max



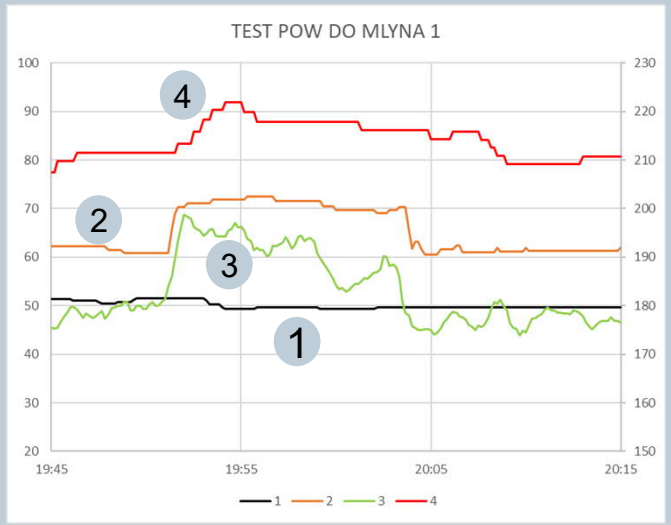
½ hours excerpt from load ramp

1 – average feeder speed [%]

4 – generated load [MW]

Primary Air Flow Test

- Coal Flow Measurement in Mill1
- Step Change with Primary Air
- Delay of Load ~90s behind Air Flow
- **Load ramp with 3,1%**



Conclusion

- Storage capacity of the mills can be used for load ramp
- CFMS necessary to identify the moment of coal increase-ment

Next Step

Extension of Coal Flow Measurement Solution to all Mills

1 – average feeder speed [%]

2 - primary air flow mill 1 [m^3/h)

3 – coal flow measurement

4 – generated load [MW]

Siemens Experiences in the field of Flexible Operation
Benefit of Coal Flow Measurement Solution

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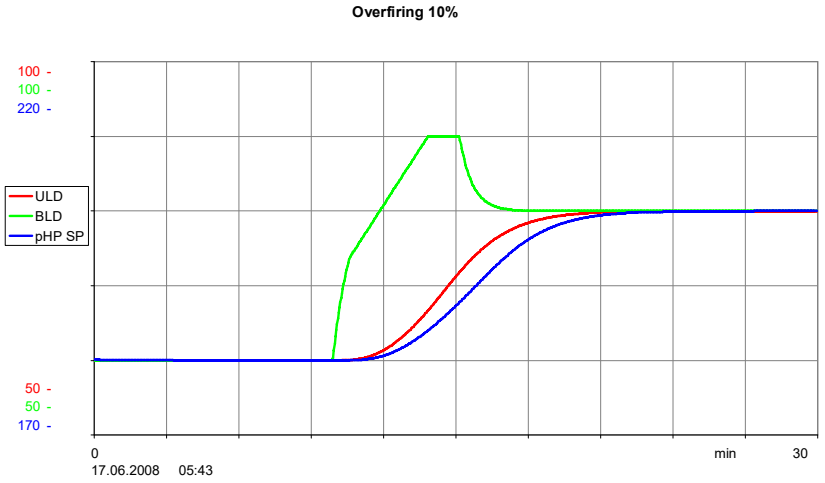
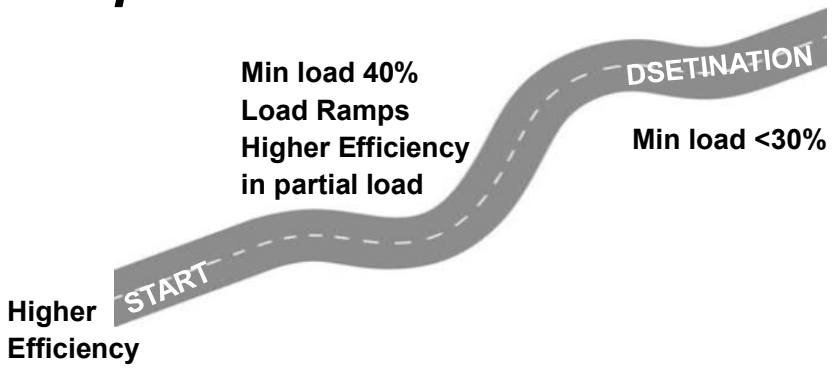
Higher Load Ramps with less fuel costs / Overfiring



CF Sensor

„Effective Investment for the flexibility journey of coal fired power plants!“



Siemens Experiences in the field of Flexible Operation
Successful Min Load Tests in Dadri CFPP Unit 06

Capacity:	500 MW
Boiler:	BHEL
Type:	Drum Boiler
Number of mills:	9
Total coal dust pipes:	36
Turbine:	BHEL-KWU design

Min Load Test on June 21, 2018

- Load reduction from 490MW to 250MW
- Changing from four to three mills operation
- Load reduction in steps of 5 MW
- 195MW achieved and kept for 2.5 hours

Recommended measures to automize 40% min load:

- **Unit Control** to coordinate slow-acting boiler and fast-acting turbine ✅
- **Reheat / Flue Gas / Main Steam Temperature Control** ✅

- **Mill Scheduler** to switch coal mills on/off automatically depending on the firing demand
- **Fatigue Monitoring System** to determine residual lifetime of highly stressed components
- **Replacing of the feed water recirculation valve** by a control valve

Next step:

- Installation of an Online Coal Flow Measurement System

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