



# Siemens Experiences in the field of Flexible Operation

*EEC Seminar*

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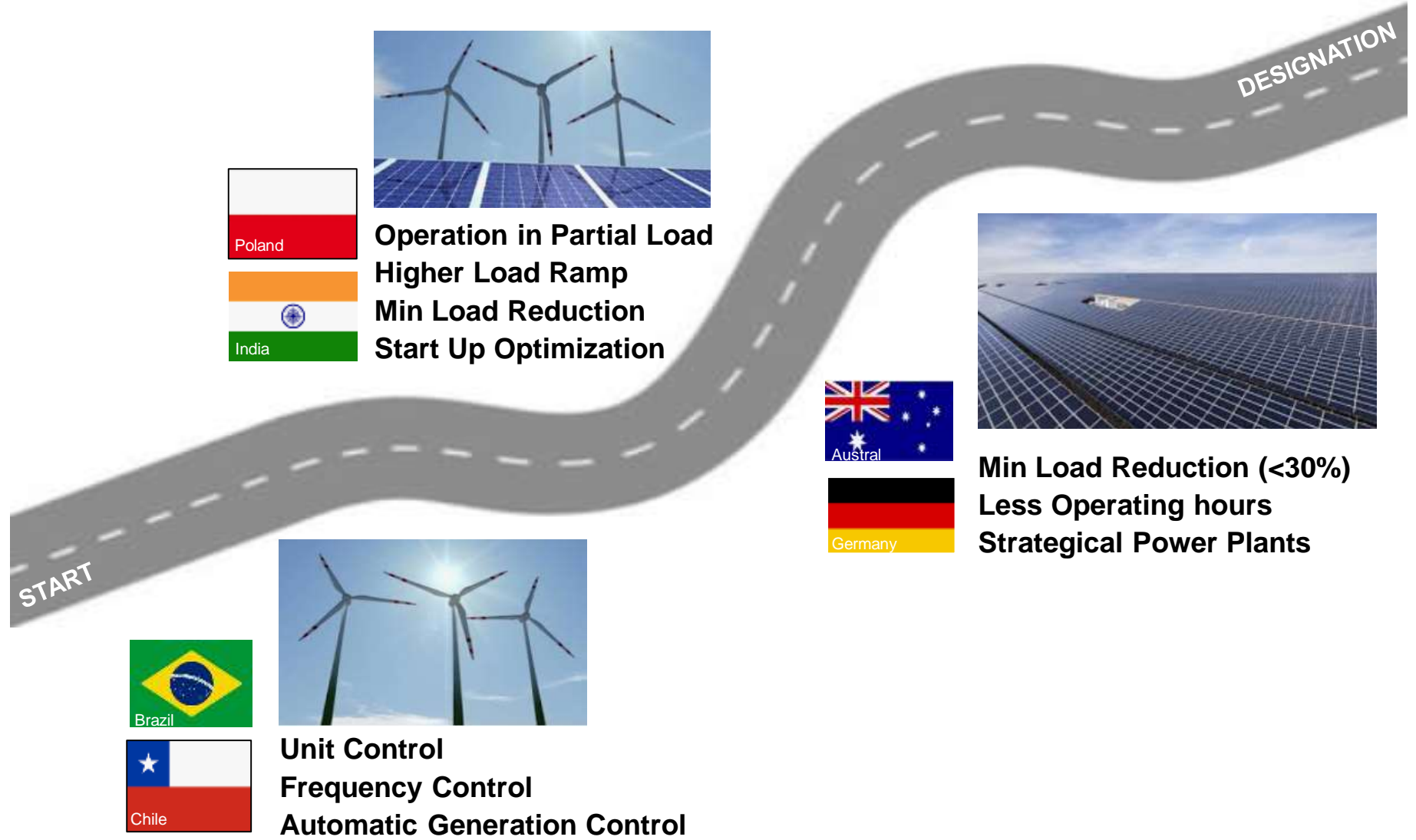
**Rainer Aulfinger**

# Siemens Experiences in the field of Flexible Operation

## Journey of Coal Fired Power Plants



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



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



**Unit Control**  
**Frequency Control**  
**Automatic Generation Control**



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

# Siemens Experiences in the field of Flexible Operation

## Successful Min Load Tests in Dadri CFPP Unit 06



**SIEMENS**  
Ingenuity for life

**VGB**  
POWERTECH



### 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 automate 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

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

# Siemens Experiences in the field of Flexible Operation 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**

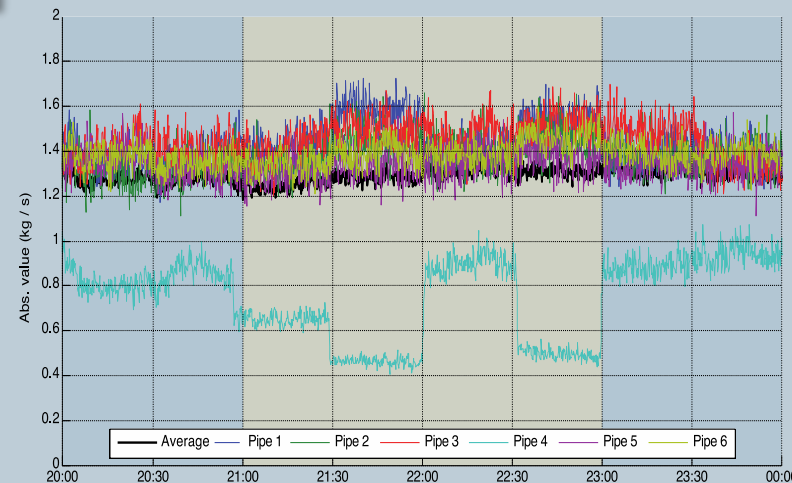
**New**

## Optimizing

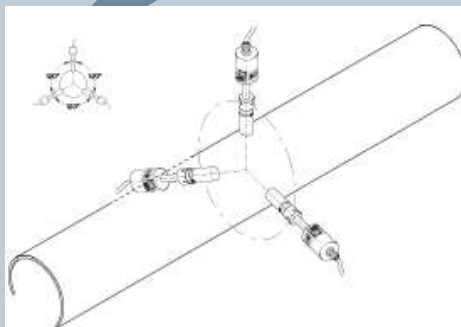
## Flow Measurement per Mill

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

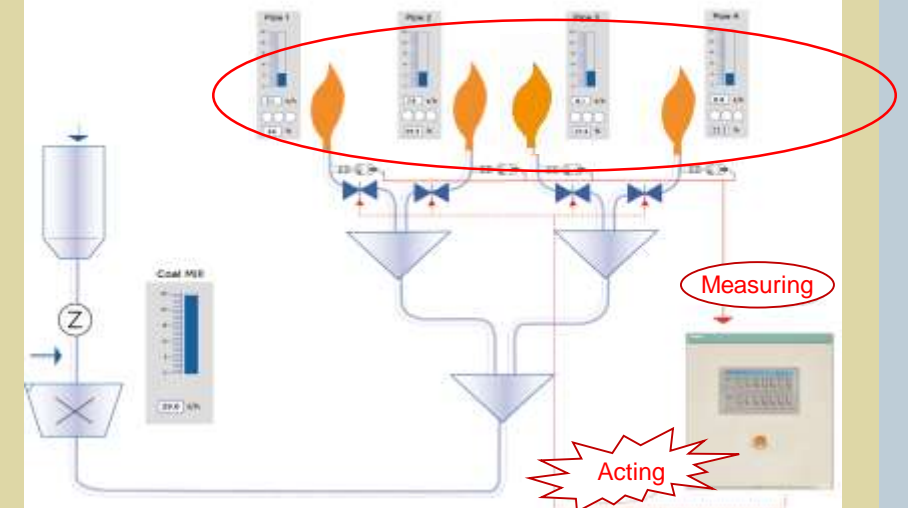
## Monitoring



## Measuring



## Optimized Combustion via closed loop balancing



# Siemens Experiences in the field of Flexible Operation

## Poland 200+ Program - Flexibilization of Jaworzno CFPP



### Poland 200+ Program

- Program from Polish Government with financing from European Union
- Flexibilization 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

### Actually Situation

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



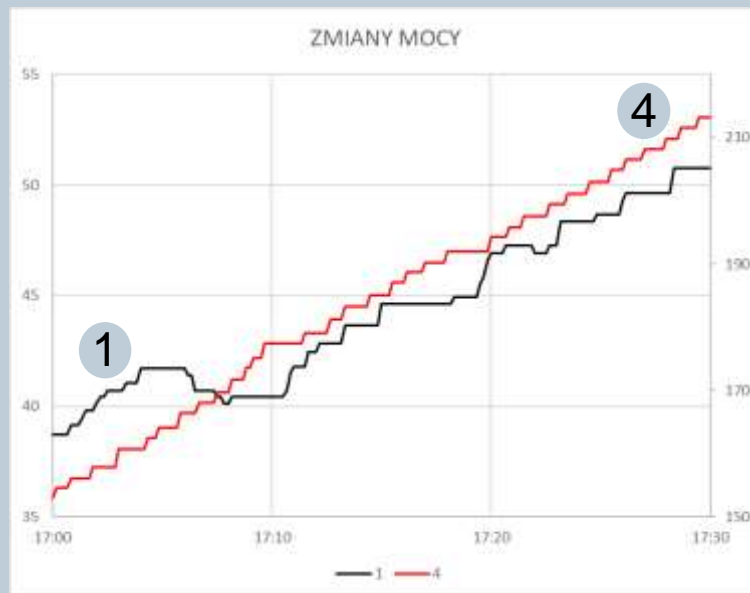
<b>Capacity:</b>	220 MW
<b>Boiler:</b>	Rafako
<b>Type:</b>	Drum Boiler
<b>Number of mills:</b>	4
<b>Total coal dust pipes:</b>	24

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## Poland 200+ Program – Load ramp tests in Jaworzno CFPP

### Actually Load Ramp

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

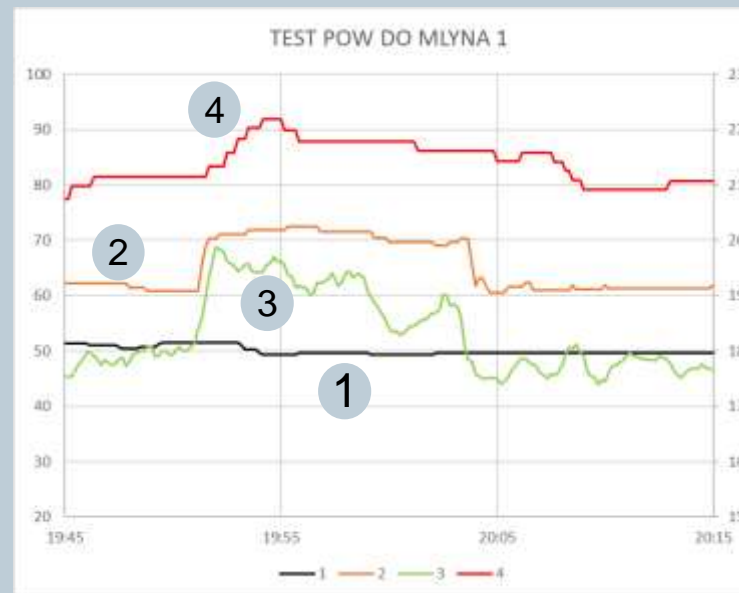


**½ hours excerpt from load ramp**

- 1 – average feeder speed [%]
- 4 – generated load [MW]

### Primary Air Flow Test

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



- 1 – average feeder speed [%]
- 2 - primary air flow mill 1 [m³/h]
- 3 – coal flow measurement
- 4 – generated load [MW]

### Conclusion

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

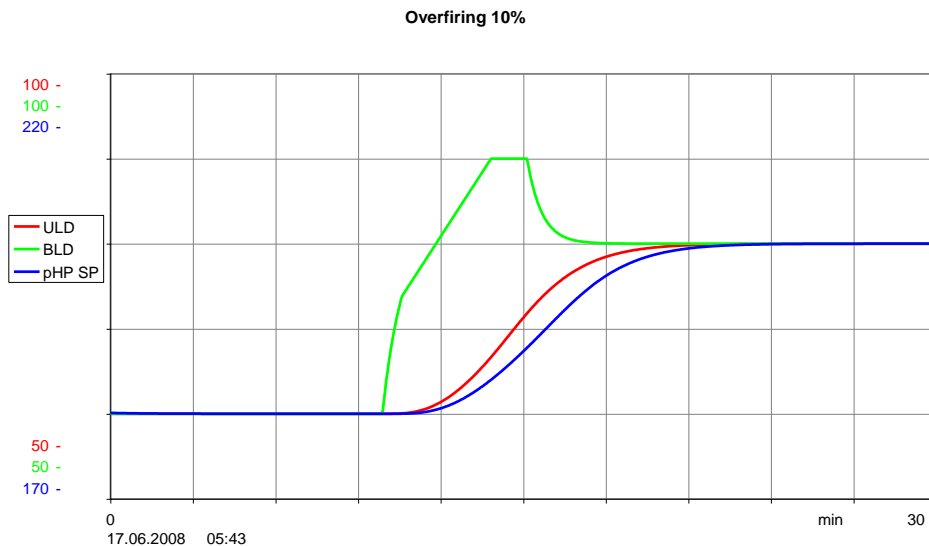
### Next Step

Extension of Coal Flow Measurement Solution to all Mills

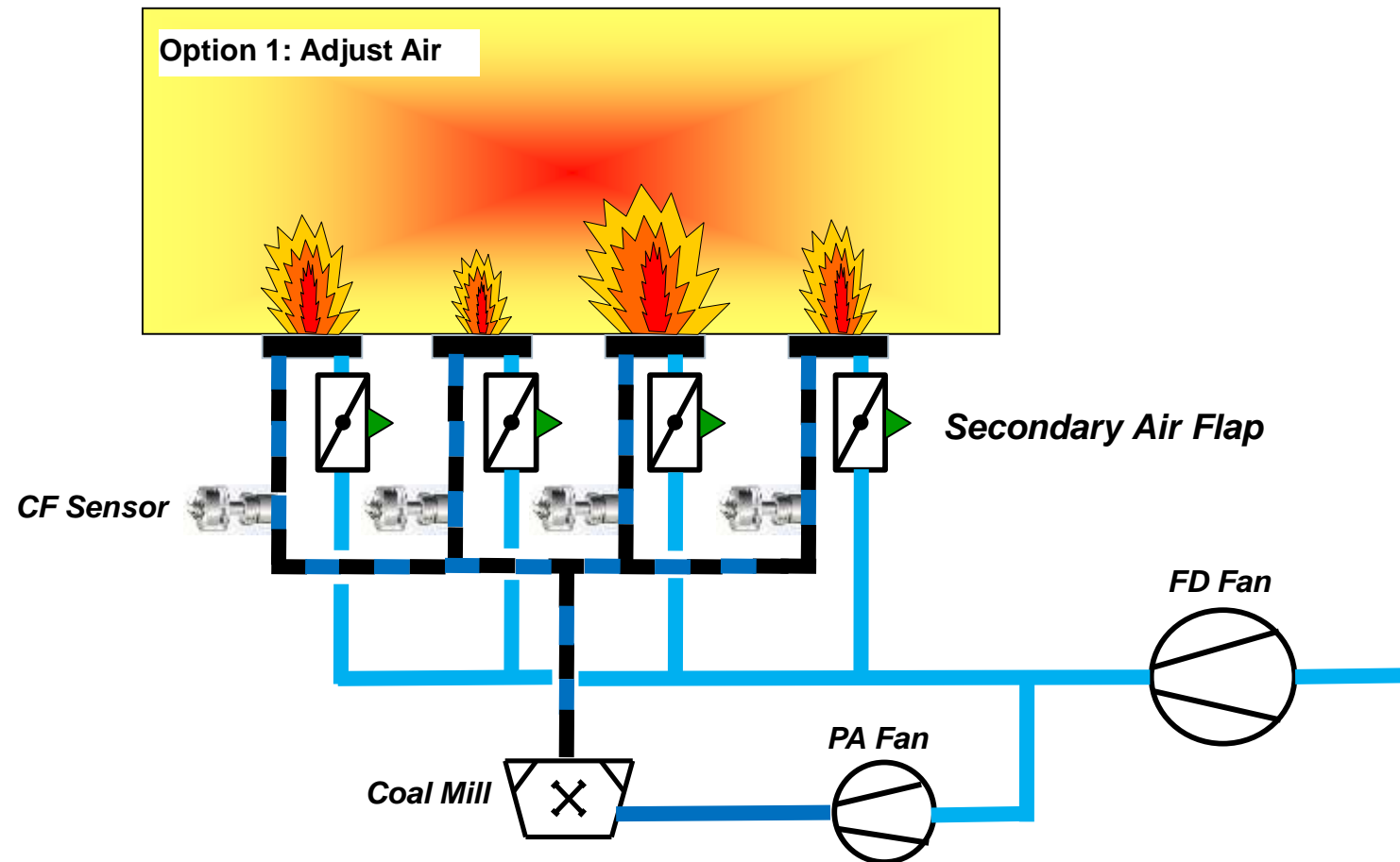
# Siemens Experiences in the field of Flexible Operation

## Benefit of Coal Flow Measurement Solution

### Higher Load Ramps with less fuel costs / Overfiring

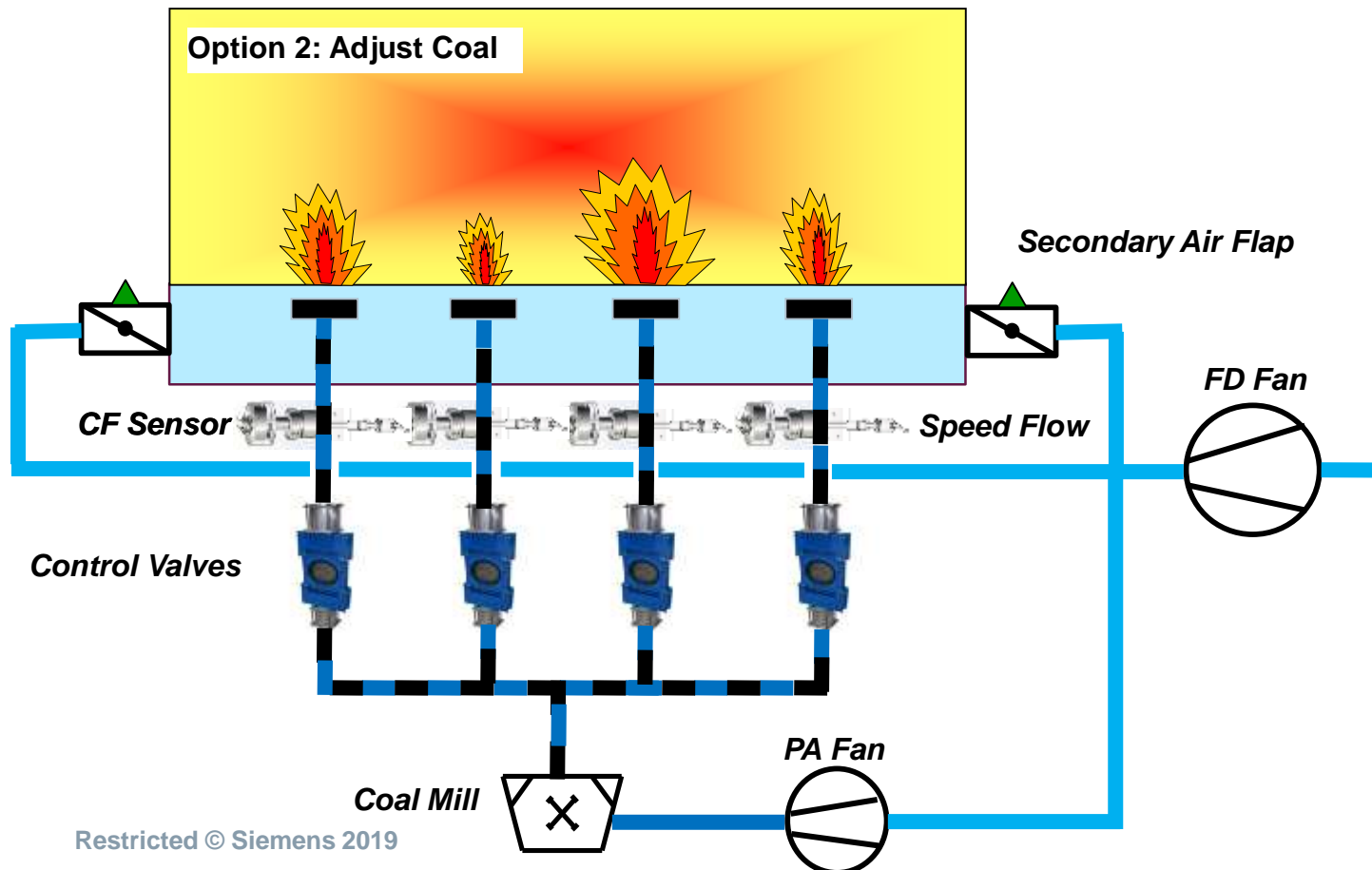


### Higher Partial Load with optimization of air/fuel ratio

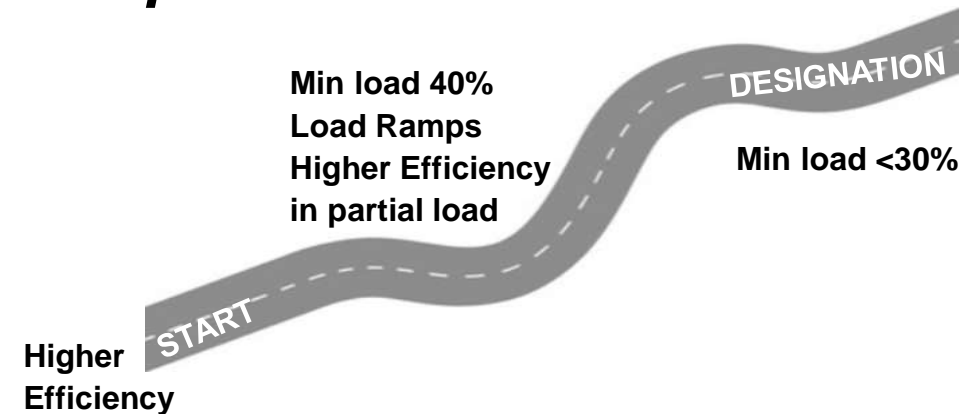


# Siemens Experiences in the field of Flexible Operation Benefit of Coal Flow Measurement Solution

Higher Partial Load with optimization of air/fuel ratio



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





# Contact



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