

Flexibilization of Coal Fired Power Plants

Rainer Aulfinger | 21.09.2021



Siemens Energy Experience in the Field of Flexibilization Journey of Coal Fired Power Plants

SIEMENS
ENERGY

Operation in Full load

- Min / Base / Peak Load Power Plants
- High Efficiency
- High Availability
- Frequency Control

Flexible Operation

- Min Load Reduction
- Automatic start & stop of mills & fans
- Higher Load Ramps
- Condition Monitoring

Conversion of CFPP

- Synchronous Condenser (reactive Power)

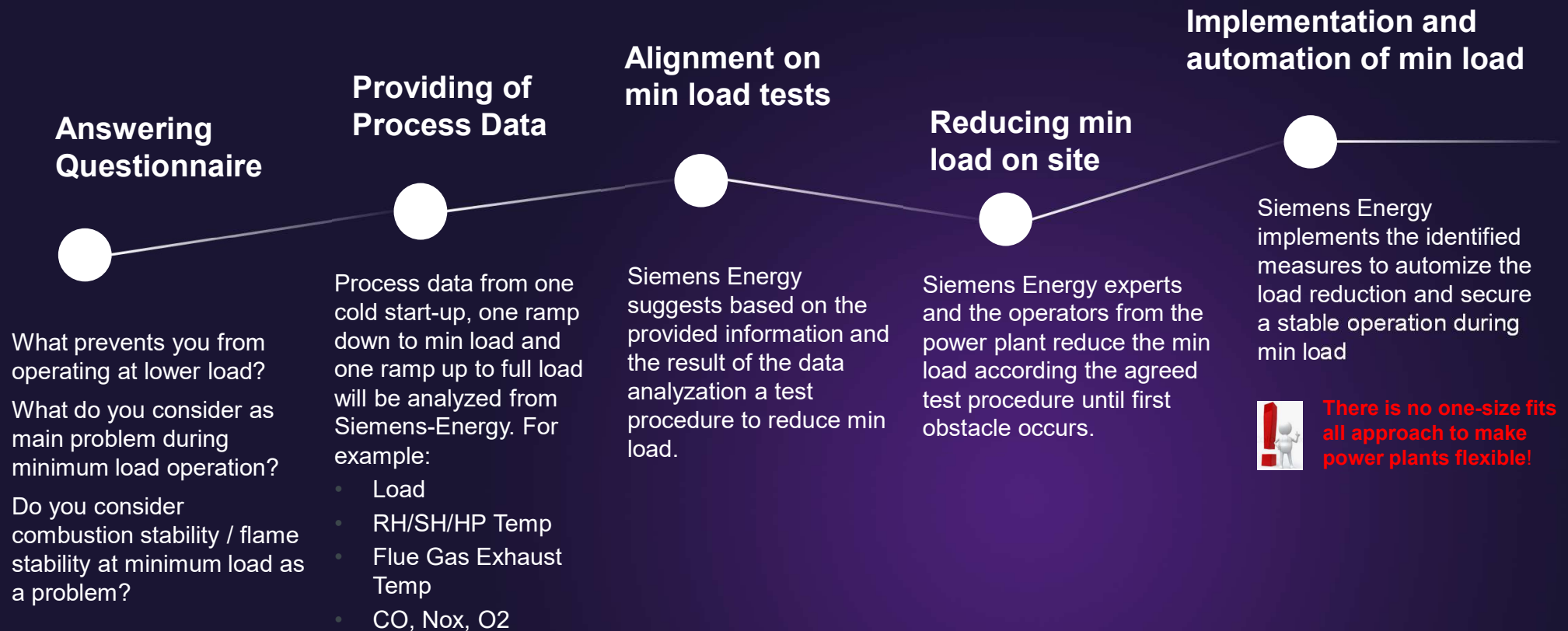
Strategical CFPP

- Standby Power Plant to secure energy supply

Flexibility thru Storage

- Batteries
- Thermal storage
- Hydrogen large scale

Siemens Energy concept to operate power plants more flexible



Example 01: First min load test in Dadri CFPP



Capacity:	500 MW
Boiler / Steam Turbine :	BHEL / BHEL- Siemens design
Boiler Type:	Drum Boiler
Number of mills:	9
Actually min load :	55%
Result of data analysis:	no limitations Identified

2021-09-21

VGB
POWERTECH

iggf Indo-German
Energy Forum

SIEMENS
ENERGY

June 2019: First min Load test to achieve 40% min load

- Load reduction in steps of 5MW from 490MW to 195MW
- 195MW achieved and kept for 2.5 hours

Recommended measures to automatize 40% min load:

- **Unit Control**
- **Temperature Control** (Reheat / Flue Gas / Main Steam)
- **Mill Scheduler** to switch automatically coal mills on/off
- **Fatigue Monitoring System** to determine residual lifetime



https://www.vgb.org/minimallast_test_ntpc_kraftwerk_dadri.html



**Implementation of
recommended measures
are ongoing!**

R. Aulfinger | SE GP SV CD GTM 4
Restricted © Siemens Energy, 2021

Example 02: Second min load test in Maithon CFPP



Capacity:	525 MW
Boiler / Steam Turbine :	BHEL / BHEL- Siemens design
Type:	Drum Boiler
Number of mills:	8
Result of data analysis:	no limitations identified
Siemens Questionnaire:	Flame instability during min load

2021-09-21

VGB
POWERTECH

iggf Indo-German
Energy Forum

SIEMENS
ENERGY

July 2021: Test to identify min load

- Installation of Coal Flow Measurement System (CFMS) to monitor coal flow distribution in all coal dust pipes in one mill
- Load reduction to 40% min load (210 MW)
- Load reduction to 36% min load (190 MW)



R. Aulfinger | SE GP SV CD GTM 5
Restricted © Siemens Energy, 2021

Coal Flow Measurement System

Effective investment for the journey of coal fired power plants

SIEMENS
ENERGY

New digital 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

- Compensation of unbalances in air-fuel
- Higher plant stability during load changes
- Higher load ramps by using mill storage

Flow Measurement per Mill

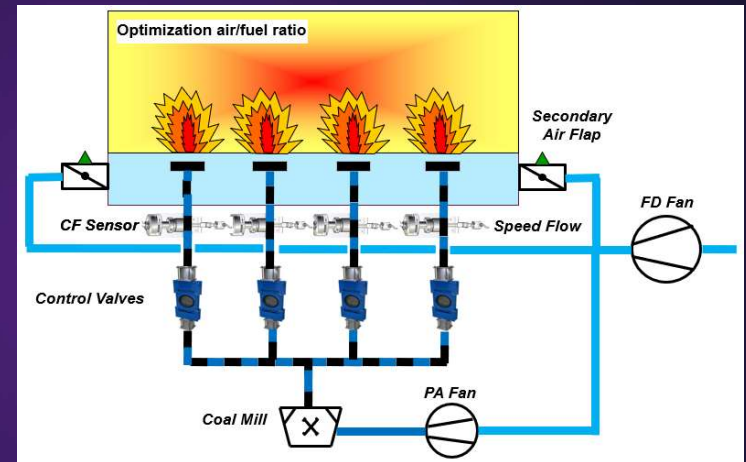
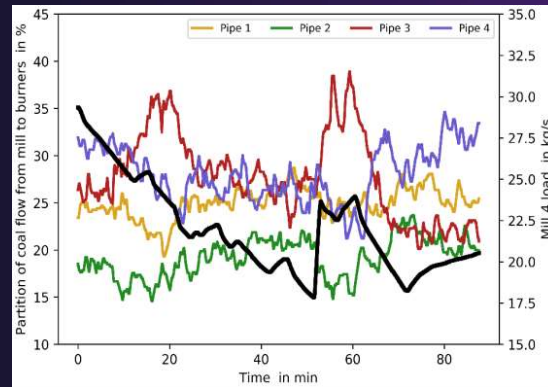
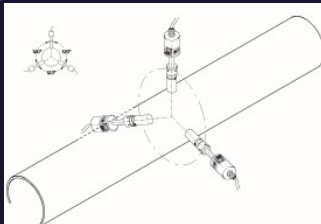
- microwave sensor
- Roping detection by three sensor concept and compensation

Optimizing

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

Monitoring

Measuring

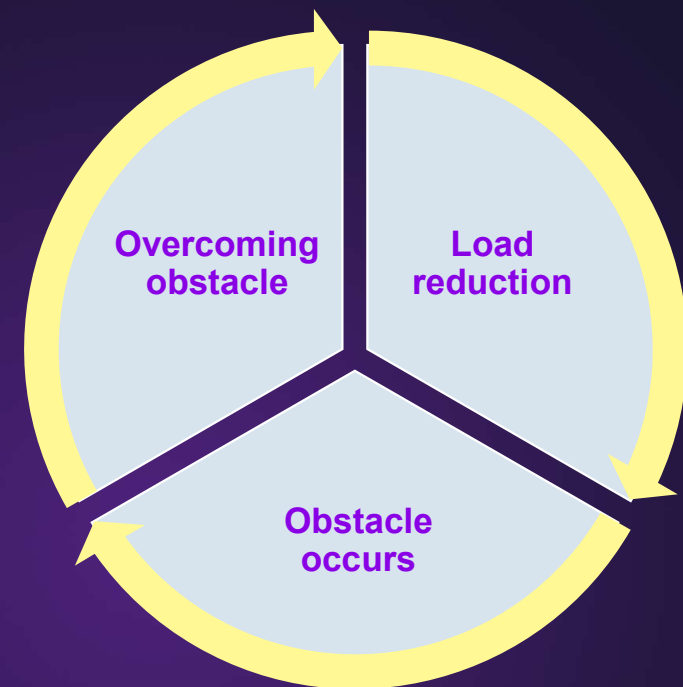


Siemens Energy Experience in the Field of Flexibilization Lessons Learned & Recommendation for ESKOM

Indification of Automation level & Optimization of relevant control loops

- Sequence **Control of ID/FD/PA FAN** with balancing close loop circuit
- Sequence **Control of Mills** with balancing close loop circuit
- Air Flow Control
- Fuel Flow Control
- Drum Level Control
- Furnace Draft Control
- LP/HP Heater Level Control
- Super Heater Steam Temperature
- Expected transfer time over communication Link
- etc.

Min load tests to identify process limitations and restrictions (thermal, mechanical etc.)



Siemens Energy Experience in the Field of Flexibilization Lessons Learned & Recommendation for ESKOM

SIEMENS
ENERGY

Learn from the min load tests and identified limitations

- NOx Emissions
- Unstable Combustion
- Flame instability
- Vibration Issues
- Low back-end temperature
- Unstable Temperature
- etc.

Invest in Measurements and Condition Monitoring Systems

- CO, NOx and O2 Measurements
- Coal Flow Measurement System
- Individual Secondary Air Flow Measurement
- Individual Flame Scanner
- Vibration Monitoring System
- Fatigue Monitoring System
- etc.

https://www.vgb.org/en/flexibility_toolbox.html

Siemens References for flexible operation

Dismantling
ongoing

January
2022

Voerde CFPP



- Germany
- 700 MW 700
- Benson Boiler
- Hard Coal
- Opposed wall firing

20% min load achieved

Atlas CFPP



- Turkey
- 2 x 600 MW
- Supercritical
- Hard Coal
- T-fired boiler

min load reduced by 30%

Neurath CFPP



- Germany
- 2 x 630 MW
- Benson Boiler
- Lignite
- T-fired boiler

40% min load achieved

Dadri CFPP

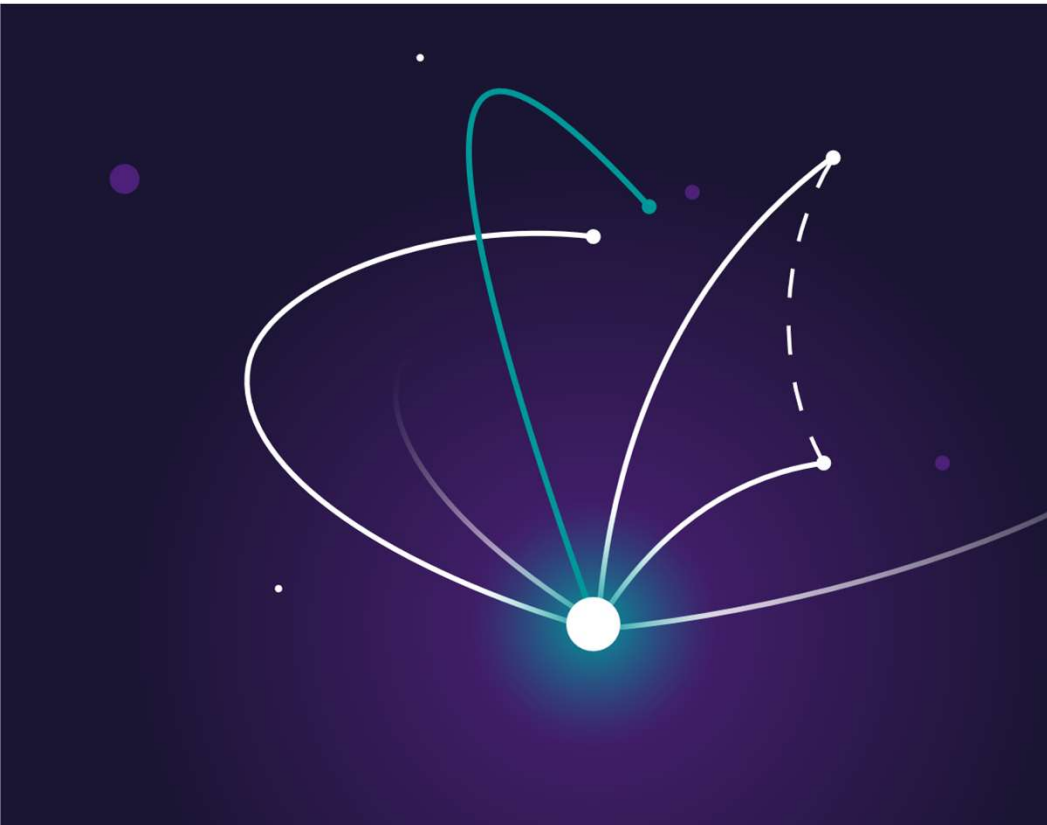


- India
- 500 MW
- Drum Boiler
- Hard Coal
- T-fired boiler

40% min load achieved

Thanks for your attention!

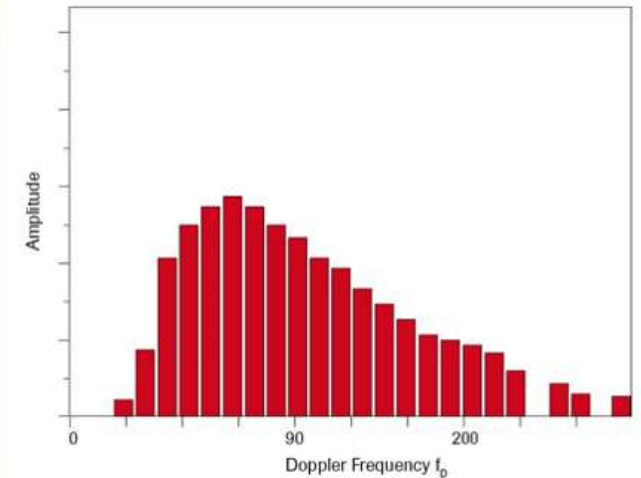
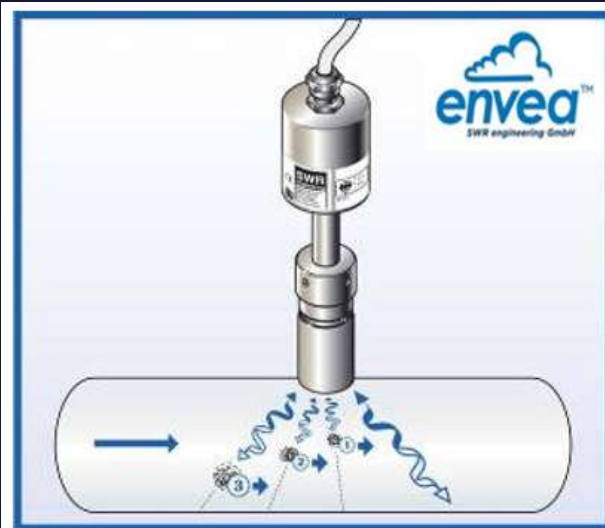
SIEMENS
energy



Siemens Energy
SE GP SV CD GTM
Siemensallee 84
76187 Karlsruhe, Deutschland
Mobil: +49 162 1025325
rainer.aulfinger@siemens-energy.com



Backup Slide – Coal Flow Measurement System

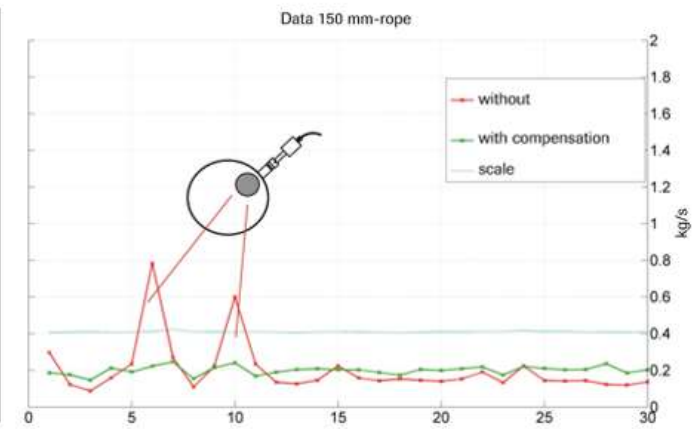
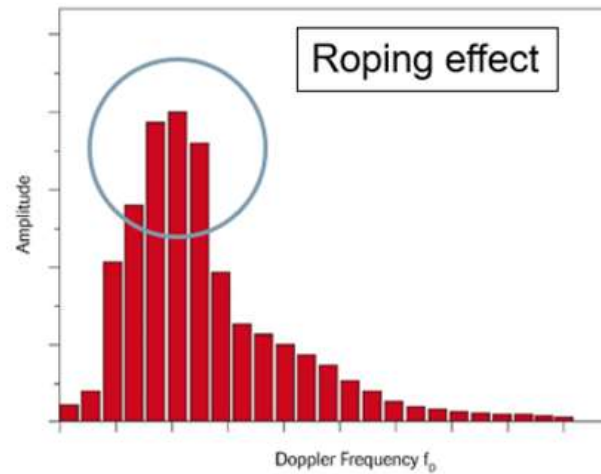
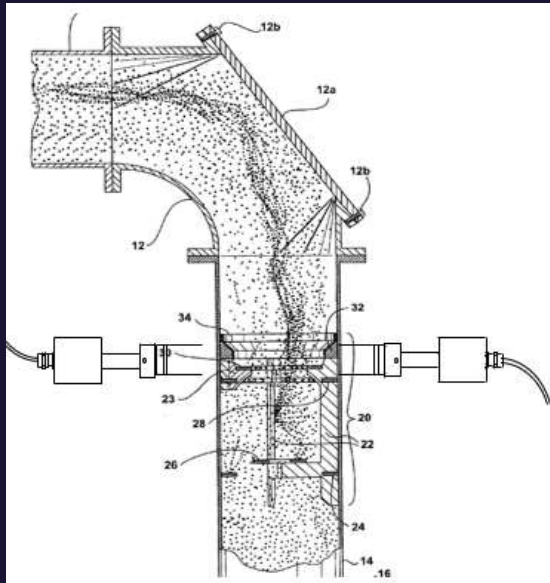


- Microwave Sensor
- Transmitter and Receiver
- Only moving particle will be measured

- x-axis: Particle speed
- y-axis: Particle size

- x-axis: Doppler Frequency shift ~ speed
- y-axis: Amount of particles with similar speed

Backup Slide – Coal Flow Measurement System



Roping effect in coal dust pipe

Detection of Roping on Sensor Level

Compensation of Roping in SPPA-T3000