Flexibility Solutions for Thermal Power Plants and Their Implementation: The View of a German Utility

Dr. Nicolas Mertens

Flexibilisation of Indian Thermal Power Plants, New Delhi, 30/11/2018

Presentation Agenda

- Who we are
- Our coal fired plant experience
- Observed trends in the power market
- Implications for coal plant operation
- Impact on income, costs, and risk
- Uniper's Economic Flexible Operation (EFO)
- Components & benefits to owners & operators
- Uniper's offer to you

- Contact details
- Case studies

Uniper at a glance

Our operations

Power Generation
Commodity Trading
Energy Storage
Energy Sales
Energy Services

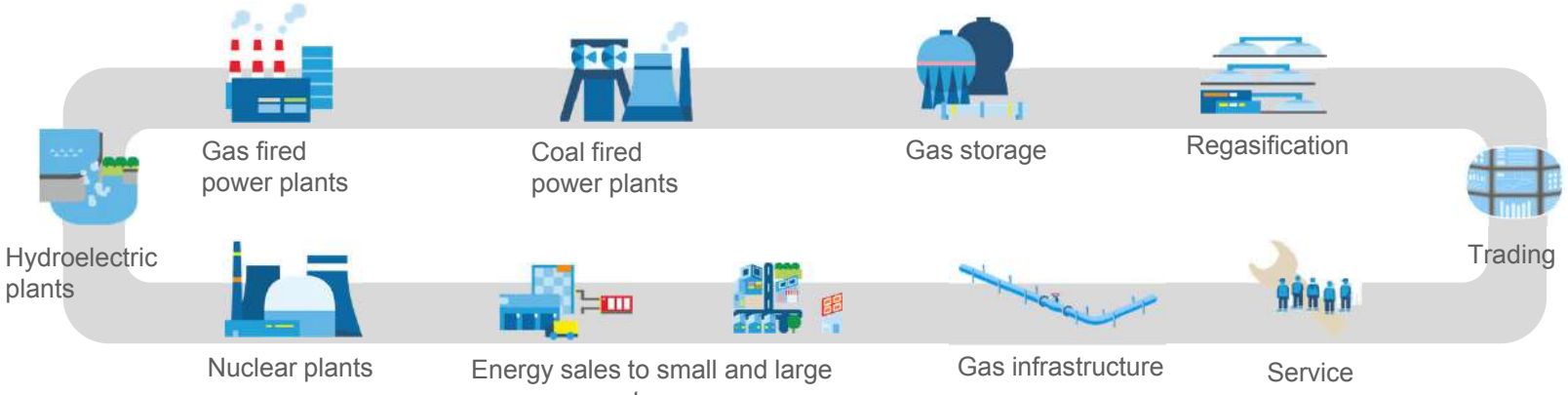
We operate in 40+ countries. Around the world.

€1.7bn
EBITDA in 2017

100 years
Experience

~36 GW
Generation capacity

Main activities



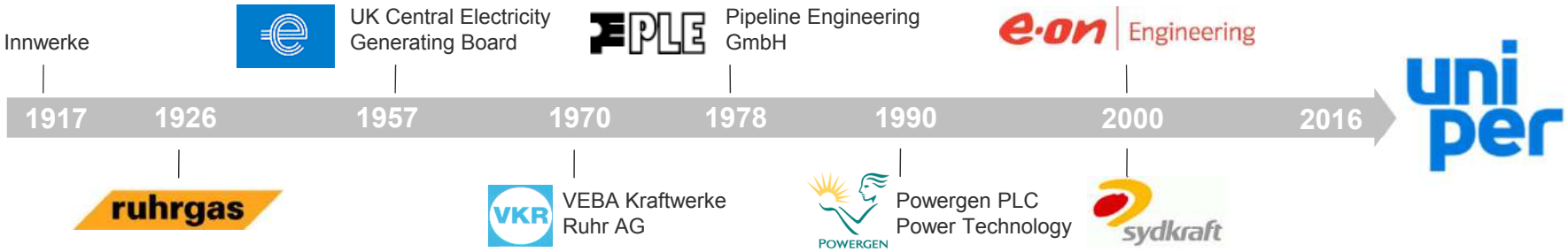
Expertise built on engineering excellence and owner-operator asset experience

We are a **one-stop shop** offering a broad range of services that work closely together, reducing complexity and risk for clients

Our **background as an asset owner/operator** gives us deep understanding of the energy industry and our clients' needs

We are **independent** of equipment and component suppliers, giving us freedom to choose the best solution for clients

Expertise based on experience



A partnership of strength, commitment between Uniper and India Power

A global energy company

- ~40GW of own assets under operations globally
- One of the largest energy commodity traders in the world including coal & freight
- Track record of sustaining operational excellence to respond to market changes
- With ~1000 engineers delivering tailor solutions

+

A leading end to end solution provider

- An integrated power utility, distribution company since 1919
- 1500MW Thermal Power portfolio and 130+MW of renewable assets
- ~200k customers through distribution network
- Inhouse coal sourcing and power trading capabilities

INDIA UNIPER POWER SERVICES

The exclusive local delivery partner for Uniper's global expertise

- Engineering
- Operations and Maintenance
- Asset Management
- Specialised Tools and Services

Select credentials in India

Services offered

- Flexible generation related technical studies
- Full scope O&M (incl. BTG, CHP, AHP, Control room operations etc.)
- Operational Maturity Assessment
- Technical Due Diligence
- Fuel Evaluation tool *(ongoing)*
- Engineering and commissioning support
- HV safety review
- Current project: "Using cycling flexibility of coal fired power plants to respond to the Grid fluctuations" , Andhra Pradesh, client KPMG

uniper

→ Back to agenda

Over 50 years international coal plant operation

- Uniper is the home of coal fired plant operational excellence
- Operator of one of the best optimised and managed fleets in the world
- From 1950’s technology to the most modern ultra-supercritical units
- Hard & brown coal, mine mouth and world-traded coals
- Provider of international O&M, engineering and consultancy services

→ Back to agenda

Uniper's Economic Flexible Operation (EFO)

Potential Value of EFO

The potential real world value of EFO approach typically includes*:

- Shorten start-up times by 20-50%
- Improve ramp rate and load following by 50%
- Reduce major component replacement costs by 20-30%
- Increase max load by 5-10% of P_{max}
- Reduce minimum load by 5-10% of P_{max}
- Increase major outage intervals by 20-40%
- Reduce daily maintenance costs by 10-20%
- Reduce fuel oil and water consumption by 10-20%
- Extend economic plant life by 5-15 years

A significant increase in useful asset utilisation, life and profitability

What would these benefits be worth for your plant?

**Achievable benefits are site specific*

Case study: Shorten start-up times

Customer:
Coal Fired Power Station.

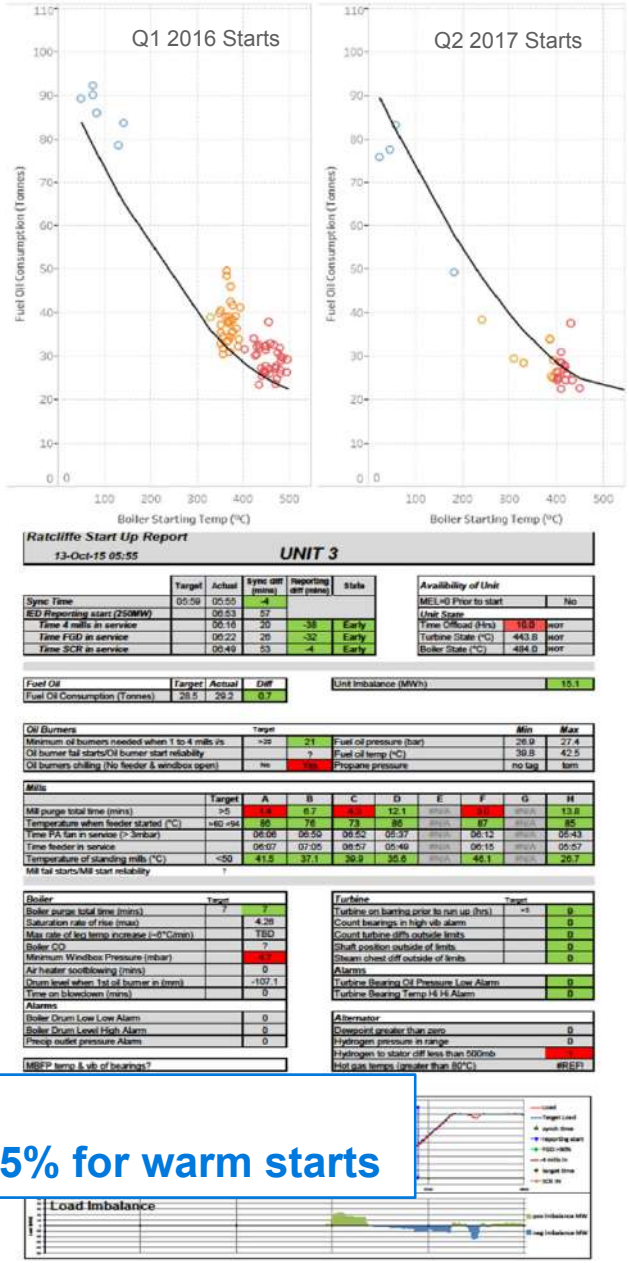
Challenge:
To reduce Start-up Time & Costs of a 500MW coal unit to improve market attractiveness.

- Reduce duration of hot starts
- Reduce start up fuel oil volume
- Ensure process safety
- Identify variances in current practise & optimise

Solution:
Use of Lean and Operational Excellence concepts to challenge and improve the process.

- Consistent & standardised operational practise (OSTRA)
- Operator training & engagement
- Operator friendly on & off line monitoring tools
- Sequence Control enhancements

Outcome:
Start up time 120mins to 60 minutes (Hot start)



- **Up to 50% reduction in start-up times**
- **~30% reduction of oil use for hot start, 20-25% for warm starts**

Case study: Improve ramp rate and load following

Customer:

International Utility – Coal Fired Power Stations

Challenge:

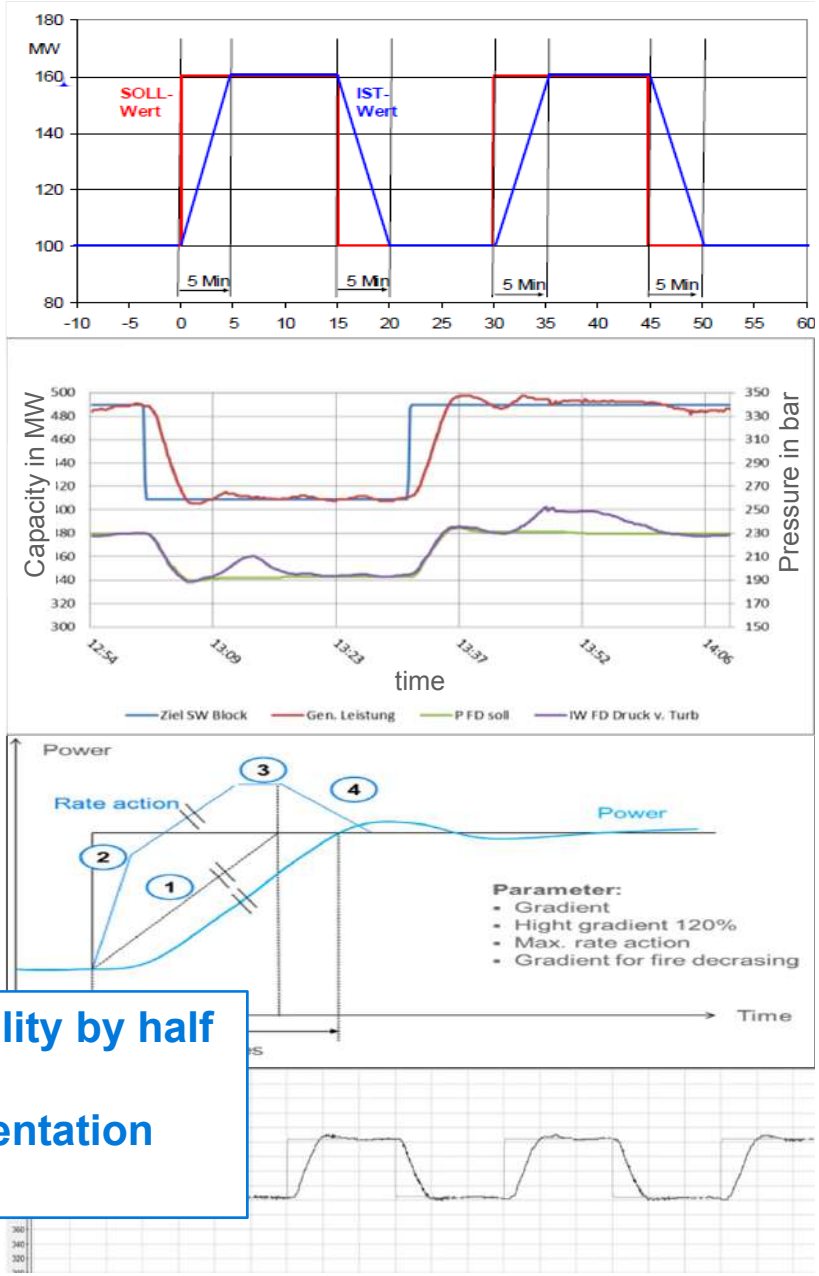
- Increase of secondary response capability up to 15% of MCR
- Different fuel types

Solution:

Dynamic model of the power plant and the control system to identify control issues and potentials at low costs and without any risk to the real plant. This leads to a reduction of real plant tests.

Outcome

Increase secondary frequency response capability from 10.2% to 15.5% of MCR



- **Increase secondary response capability by half (from 10% to 15% MCR)**
- **Detailed knowledge enabled implementation across the whole of the plant**

Extending the load limits

Increasing maximum generation

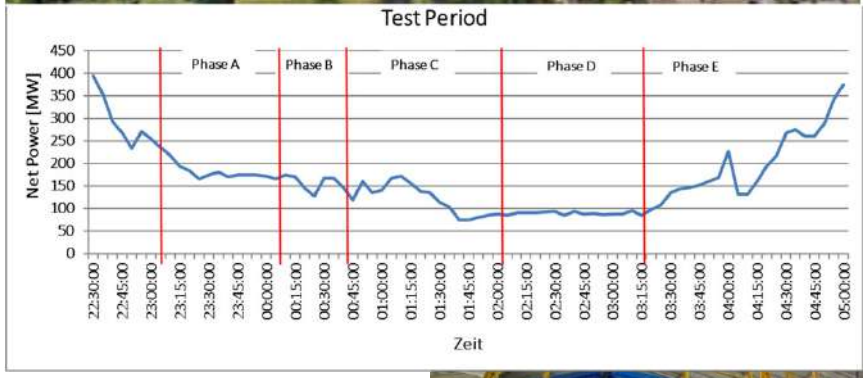
- Maximise revenue from the existing asset
- Verification of pressure parts integrity
- Prove firing systems & generator capability
- Turbine & feed systems
- Additional 10-30MW is typically feasible depending on size

Decreasing minimum stable generation

- Avoid shutdown operations and plant damage
- Increase revenue while on load
- Reduce oil burn whilst maintaining stability
- Manage boiler and turbine exhaust temperatures
- Reduction to 10% maximum load is typically possible

Case Study: Reducing Minimum Load

875MW, hard coal plant, Germany



Mission:

- Avoid life reduction due to unit starts
- Avoid start-up oil consumption
- Summer and night-time opportunities
- Maintain commercial operation
- Determine a new minimum load point
- Test & demonstration program
- Boiler & turbine capabilities established
- Stable operation confirmed

Outcome:

- **Reduce P_{min} from 180 MW design to 90 MW (10%) stable coal operation**

Case Study 1: Fuel flexibility

Customer:
2000MW, non-Uniper coal fired power plant.

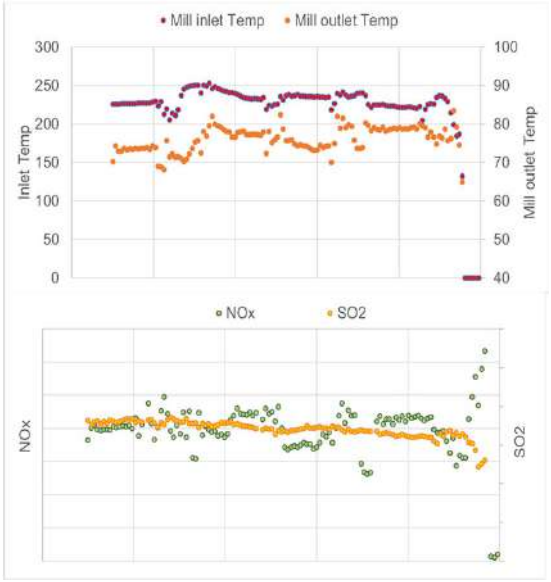
Challenge:
Investigate capability to fire sub-bituminous Indonesian coals to reduce fuel costs and enable compliance with lower SO_2 limits.

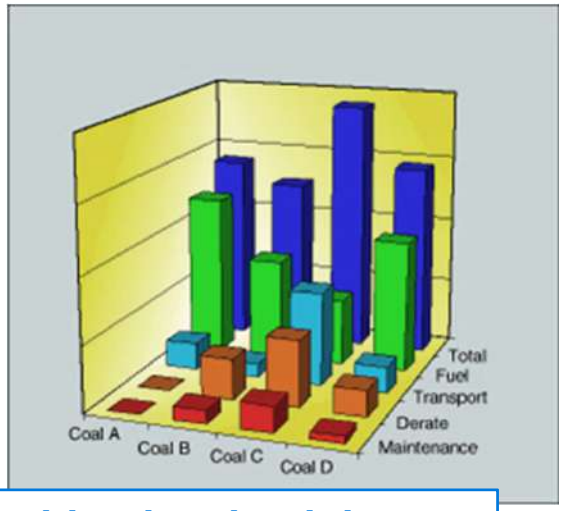
- Technical constraints (throughput and coal drying capability)
- Managing increased risk of stockpile and mill fires
- Understanding coal blending options

Solution:
A combination of theoretical calculations and plant tests:

- Full-scale boiler trials of two Indonesian coals
- Indonesian coals were fired in blends with Russian and South African coals
- Detailed analysis of plant performance data
- Computer modelling enabled other soals and blends to be assessed
- Optimum fuel mix was identified.
- Technical advice regarding mill operation was provided to maximise performance while maintaining safe operation.

Outcome:
Safe firing of cheaper import coal with large emission reductions.





- **Selected coals identified can be fired up to 50% in blend maintaining full boiler capacity**

Case Study 2: Fuel flexibility

Customer:

Coal Fired Power Station.

Challenge:

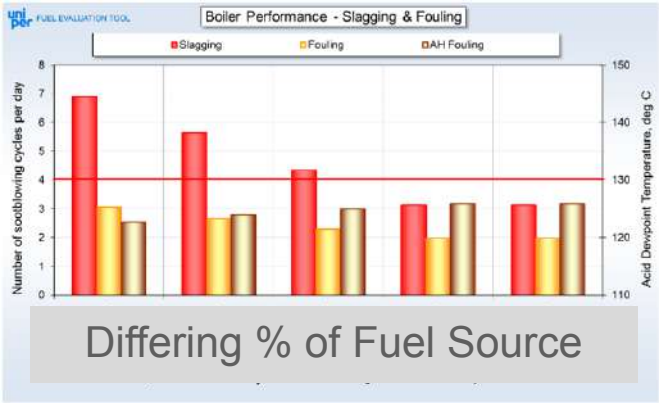
To reduce the slagging

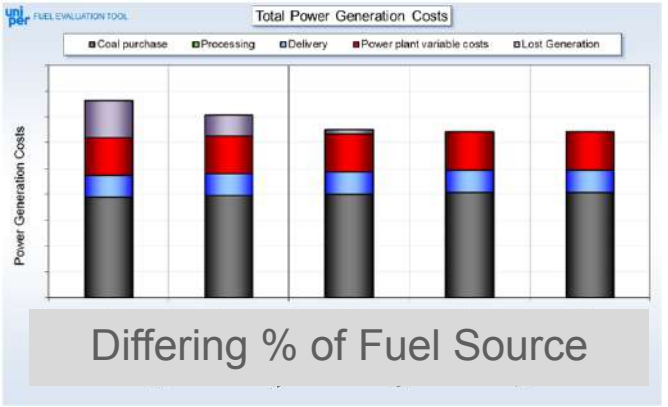
Solution:

- Major slagging problems are experienced with some international coals
- Historic problems: 3-day forced outage, boiler cleaning costs, ongoing boiler de-rates

Outcome:

- Fuel Evaluation Tool used to asses blending options and scenarios
- Result: Optimised coal blending strategy to avoid slagging problems at lowest possible cost

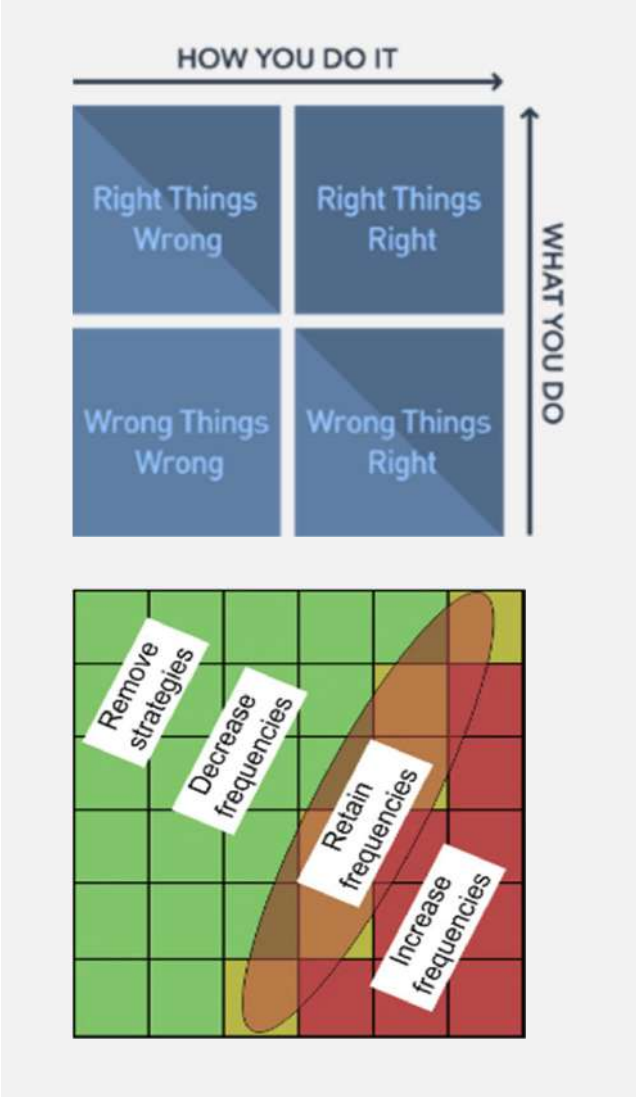




- **Optimal coal blending to avoid operational issues**
- **Slagging problems reduced significantly**
- **Lowest cost solution**

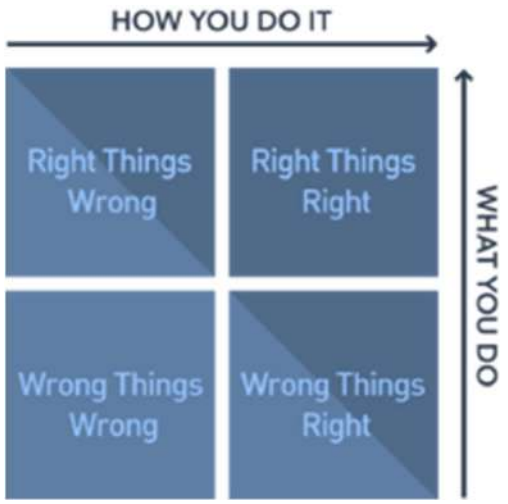
Maintenance cost optimisation

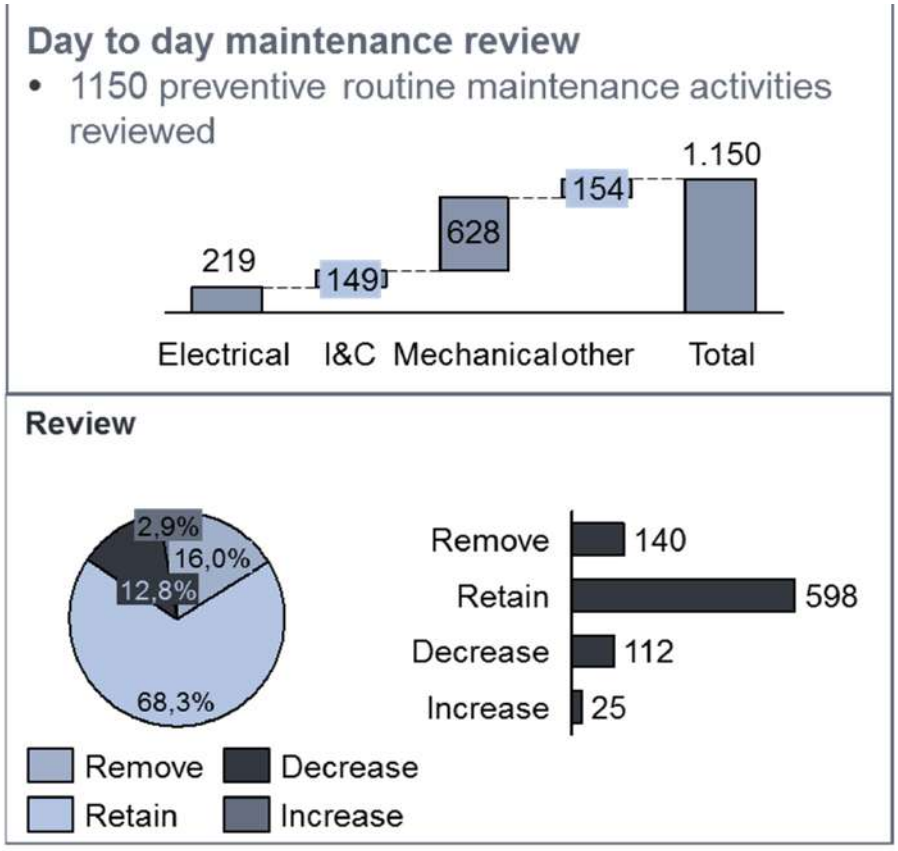
- Improve reliability & efficiency through better maintenance practices
- Refocus maintenance based on condition and risk
- Optimise outage works & extend outage intervals
- Inspection support, defect analysis and avoidance
- Optimise running and strategic spares stockholding
- Maintenance strategy improvement & optimisation
- Structured risk management
- Extract the maximum value from the asset



Case Study: Daily Maintenance Effectiveness

- Coal site: Reviewed preventive maintenance plans on
  - **Reason**
  - **Interval**
  - **Risk management**





Results

- ~275 maintenance activities adapted to reflect the market situation of the Maasvlakte
- Associated savings **575k€/yr** on a 3.5 mln.€/yr. reviewed budget
- **49k€/yr reallocated,** maintenance budget from mitigation a lower risk to higher risk measures

Advanced online monitoring solutions

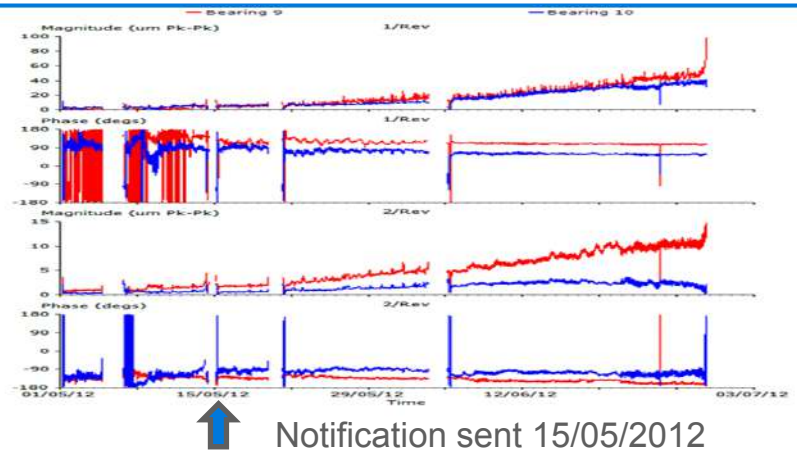
- Apply the most modern techniques to reduce cost and risk
- Automated and semi automated monitoring and information
- Continuously optimise maintenance actions to meet the plant needs
- Understand the characteristics of your equipment & operation
- Reveal hidden problems before they become a major issue

- Patented algorithms for advanced fault detection
- Online portal interface for engineering staff

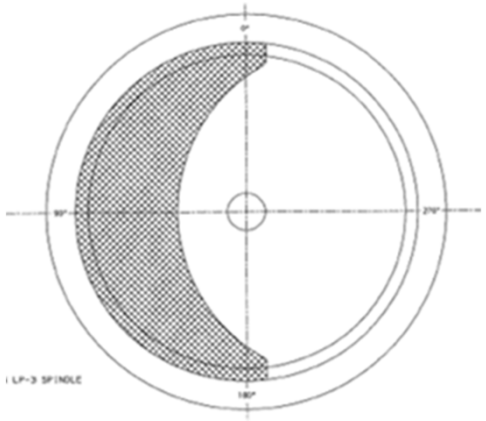
Case study: Online monitoring to reduce failures

Technology : Coal	Type : OLVMS	Site: External	

- Routine OLVMS monitoring identified problems with the LP rotor on one unit
- Problem first identified during monitoring of routine run down
- Issue monitored through the OLVMS service. Indications continued to change
- Intervention was planned for July – exponential increase late June, off early



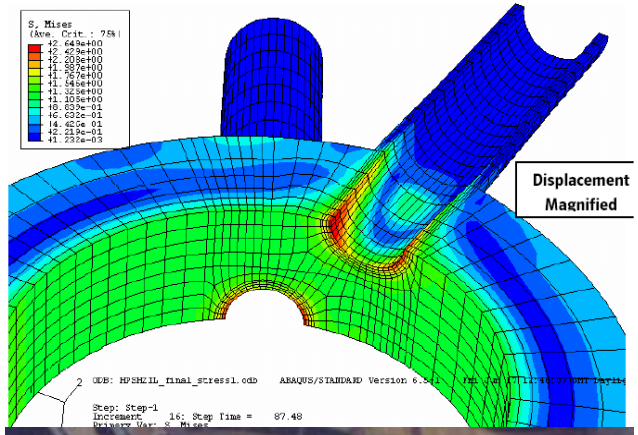
Notification sent 15/05/2012

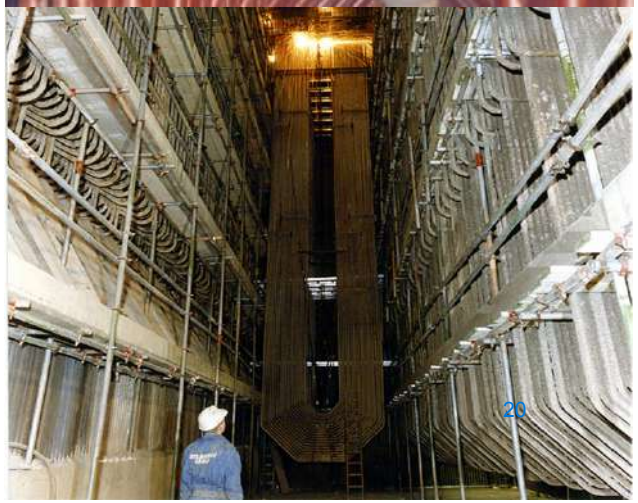


- Mid span crack found within the LP rotor
- On line vibration monitoring picked up the problem early enabling a more planned approach
- Close working between site team and UTG Monitoring team
- Identification prevented potential major failure of the rotor.

Our comprehensive services

- Adapt your plant for best economic operation
- Feasibility, options analysis, change control
- Specification writing & owners engineer support
- Engineering, design, supplier quality & verification
- Tendering & procurement support
- Project management, commissioning & acceptance
- Environmental and compliance support
- Modifications ‘beyond design’ for flexibility, life, performance or emissions
- World class training academy for power plant staff





Uniper's offer to you: Economic Flexible Operation

- Shorten start-up times by 20-50%
- Improve ramp rate and load following by 50%
- Reduce major component replacement costs by 20-30%
- Increase max load by 5-10% of P_{max}
- Reduce minimum load by 5-10% of P_{max}
- Increase major outage intervals by 20-40%
- Reduce daily maintenance costs by 10-20%
- Reduce fuel oil and water consumption by 10-20%
- Extend economic plant life by 5-15 years

A significant increase in useful asset utilisation, life and profitability

What would these benefits be worth for your plant?

**Achievable benefits are site specific*

Your partner for most economic operation

- Do you face any of these issues?
- Are you looking to improve the economics & flexibility of your operations?
- Add advantage to your operations by having Uniper as a partner

- Turnkey package of measures or individual components
- Target the operational issues of most concern to you
- Flexible contracting and risk/reward options

Thank you for your attention!

Animesh Kumar
Chief Commercial Officer
India Uniper Power Services Pvt. Ltd.
Animesh.kumar@uniper.energy

Dr. Nicolas Mertens
Specialist Plant Flexibility
Uniper Technologies GmbH
nicolas.mertens@uniper.energy

Doug Waters
Sales
Uniper Energy Services
doug.waters@uniper.energy