Best practice of modern coal-fired power plants

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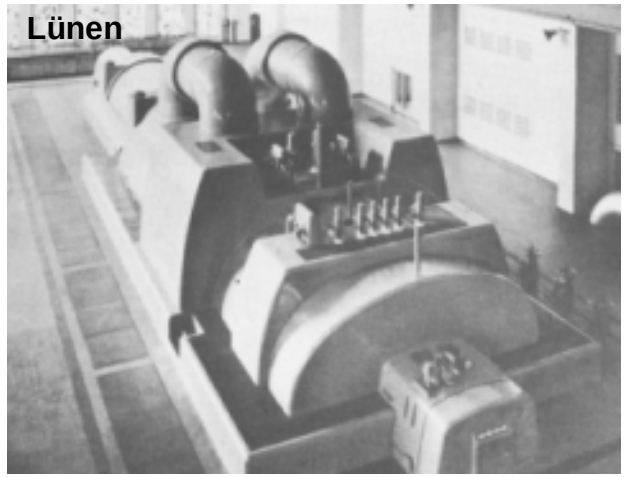
EVONIK INDUSTRIES

1. **Introduction**
2. Efficient Plant Technology
3. Efficient Plant Operation
4. Summary

Where STEAG comes from

- Former subsidiary of the German Mining Company (“RAG”).
- Experience in design, erection and operation of mine-mouth power plants burning low-grade coals for more than 70 years.
- Currently STEAG operates 9 units with a capacity of 3,000 MW designed for the combustion of low-grade coal.
- STEAG owns and operates about 9,000 MW mainly based on coal in Germany and abroad.
- Energy Services is the Engineering subsidiary of STEAG and acts as international Owner´s Engineer for STEAG as well as for third parties.
- Energy Services itself has additional 4,000 MW under O&M contracts.

1950 – 1960



Duisburg-Walsum 10

commissioning	2011
gross capacity	790 MW
project volume	820 Mio €
fuel	imported hard coal
efficiency	>45%

CCT and CCS

- Efficient power plants will be in the centre of modern electricity supply on short, medium and long range.
- It complies with current discussion on efficient usage of fuel and CO_2, but each t of CO_2 that has been reduced by efficiency measures or use:
  - has not to be compressed, pumped away and stored,
  - cannot disappear by leakages,
  - has not to be monitored over decades.
- STEAG´s contribution to these discussions is to realize new power plants
  - for a sustainable energy supply
  - with high net efficiencies compatible to local necessities and conditions,
  - which are competitive in the regional electricity market.

Focus Foreign Power Plants

Long-term efficient operation of the power plants built and operated by STEAG in Turkey and Colombia and on the Philippines.

- With its concept "investment in countries outside of Europe and long-term operation", STEAG as a German energy supplier has trodden new paths.
- The power plant in Paipa (Colombia) was completed in 1999 and has been operated since then.
- The hard-coal fired power plant Iskenderun (Turkey) was officially opened in 2004. This project was the biggest investment in STEAG's history to date (US$ 1.5 billion).
- On the Philippine island of Mindanao STEAG has built its third foreign power plant, involving capital expenditure of about US$ 305 million. The power plant was successfully put into service at the end of 2006.
- These power plant projects boost the local economy and the regional labour markets. The vast majority of workers at the sites are recruited in the region.

To STEAG, economical, ecological as well as

social responsibility and sustainability are important corporate objectives.

Overview STEAG Power Plants Abroad

	Termopaipa (Colombia)	Sugözü (Turkey)	Mindanao (Phillipines)
Capacity (gross)	165 MW	2 x 660 MW	2 x 105 MW
Commissioning	1999	2003	2006
Net efficiency	< 40%	> 40%	< 40%

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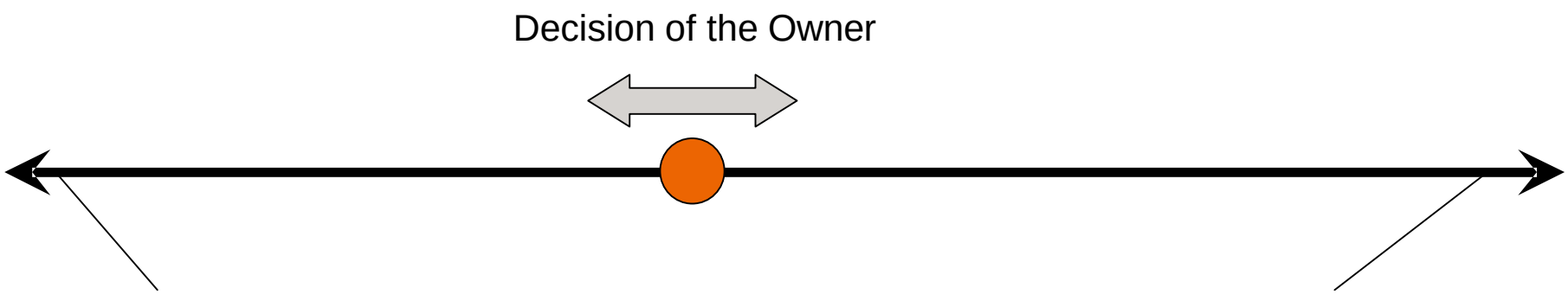
Characteristics of Modern Coal Fired Power Stations

- site related coal logistics
- coal pulverization
- low NOx combustion
- supercritical boiler and steam parameters
- one train at air and flue gas systems
- steam turbine with optimized cold end
- air pollution control with secondary NOx abatement measures (depending on local requirements), dedusting and flue gas desulfurization
- flue gas discharge by cooling tower or wet stack
- optimal automation and “lean” operation
- competitive civil solutions dependent on site specific climatic conditions

Technology Decision



Simplest Technology

- low investment
- higher fuel consumption
- low efficiency

Adaptive Technology

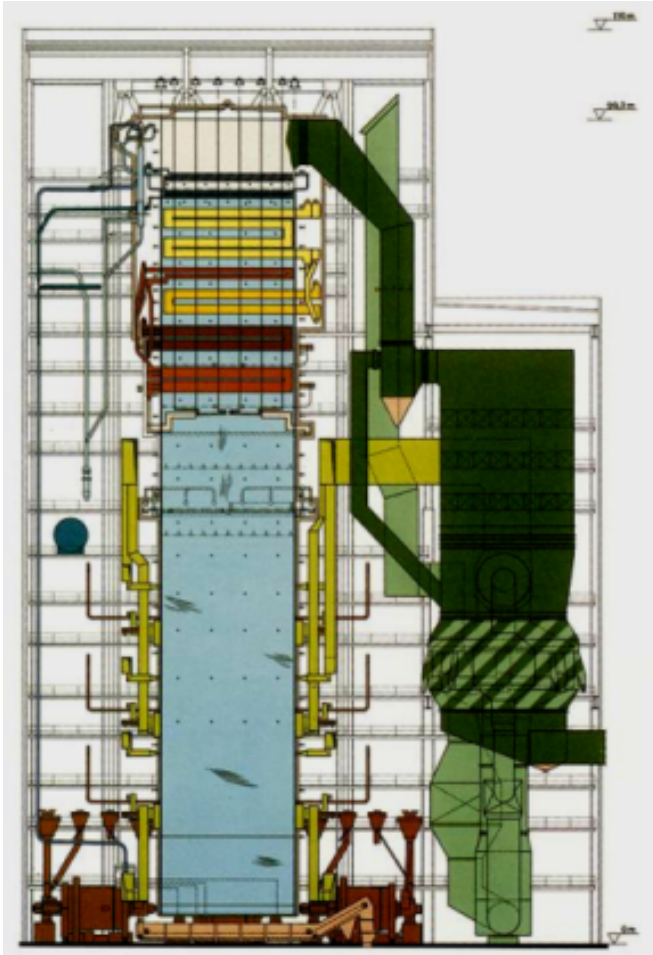
- market oriented investment
- minimal fuel consumption
- optimized efficiency
- high flexibility compatible to market needs

Future Technology

- highest efficiency
- extremely high investment
- lower fuel consumption
- no flexible operation possible
- maybe not economical

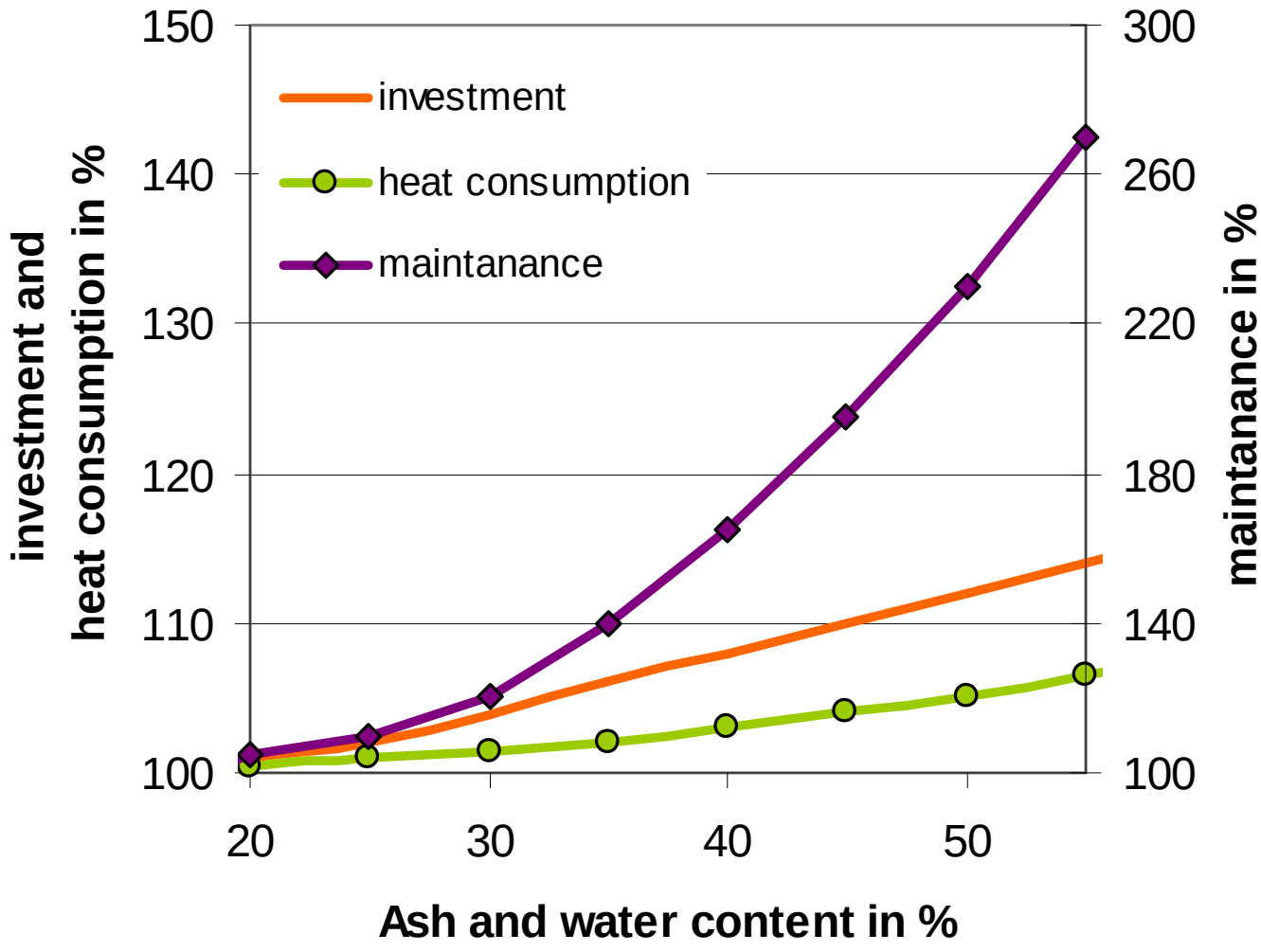
Example: Herne Cogeneration Plant
Supercritical boiler using low grade coal

– Commissioning		1989
– Steam Generator		
– Type		Benson / Tower
– Thermal capacity	MW	1,277
– Steam capacity	t/h	1,584
– Life steam	°C / bar	535 / 255
– Reheat steam	°C / bar	541 / 63
– Feedwater temperature	°C	284
– Mills		
– Type / Number		tube / 3
– Capacity	t/h	85
– Coal quality		
– net cv	MJ/kg	17.6 – 29.8
	Kcal/kg	4,200 – 7,100
– ash	% a.r.	28 – 35
– water	% a.r.	8 – 12
– volatile matter	% (waf)	20 – 38
– N	% a.r.	1.2



Influence of ash and water content on costs of a hard coal fired power plant

Example in % from base design



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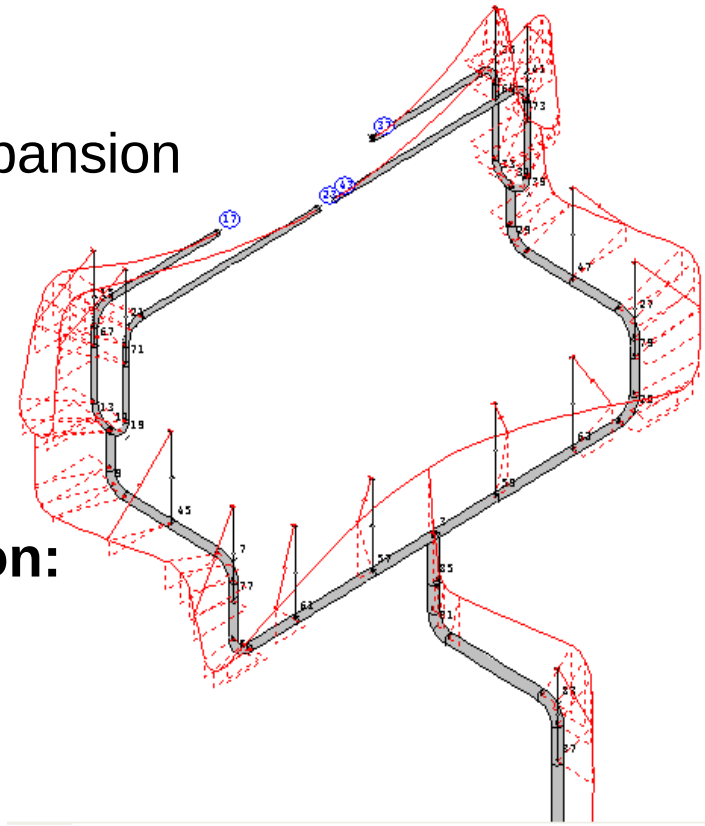
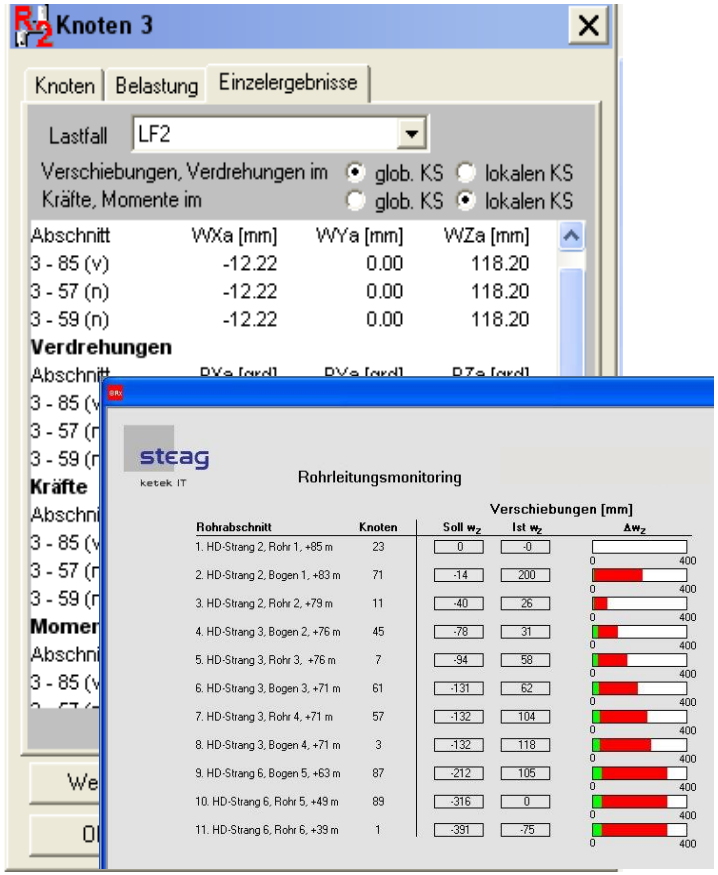
SR 1 – Online Lifetime Monitoring

Thick-walled Components of the Boiler and the Turbine and Pipings

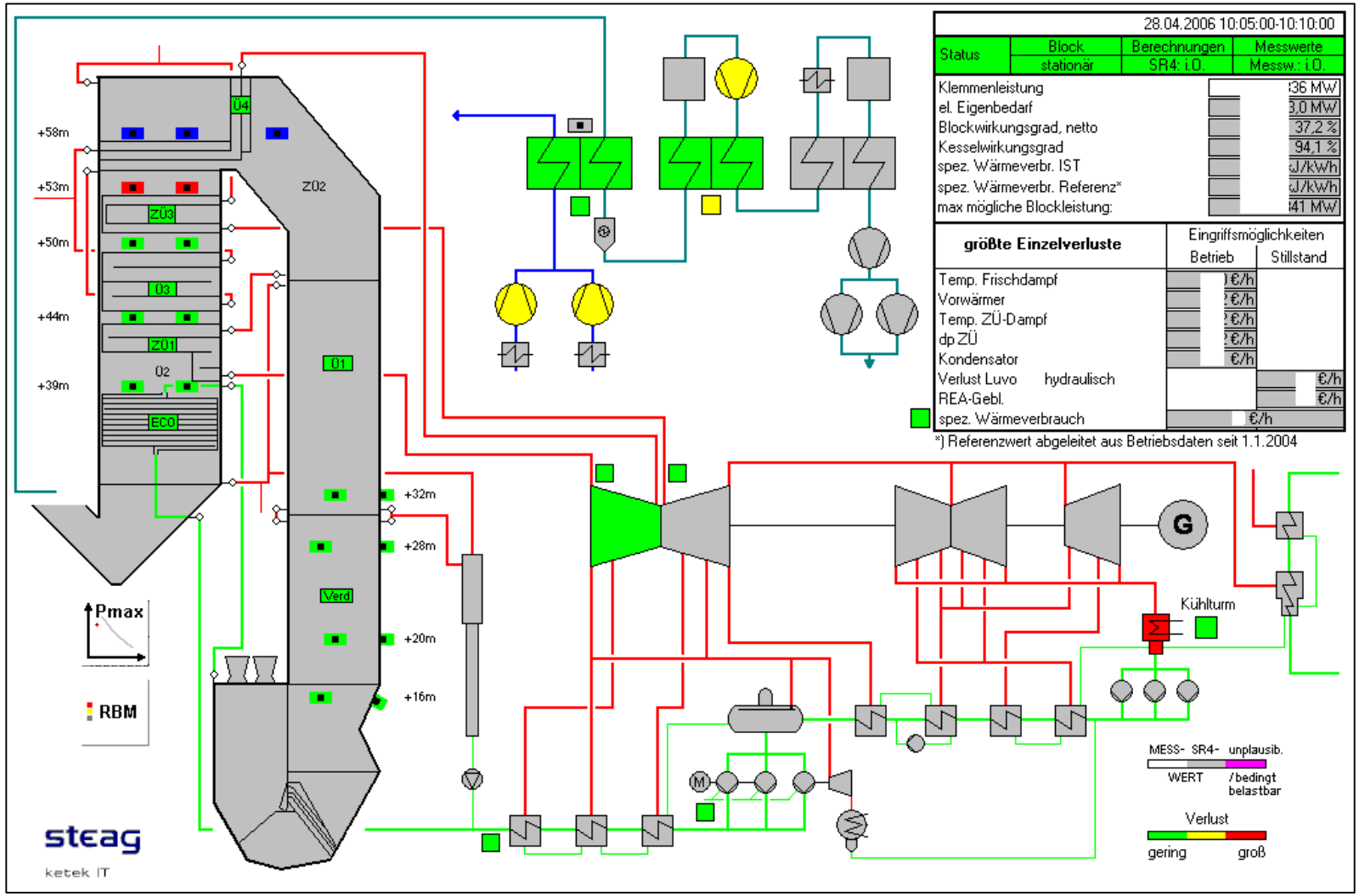
Operation:
Weight
Thermal Expansion

Visualization:
unplanned
Dislocations





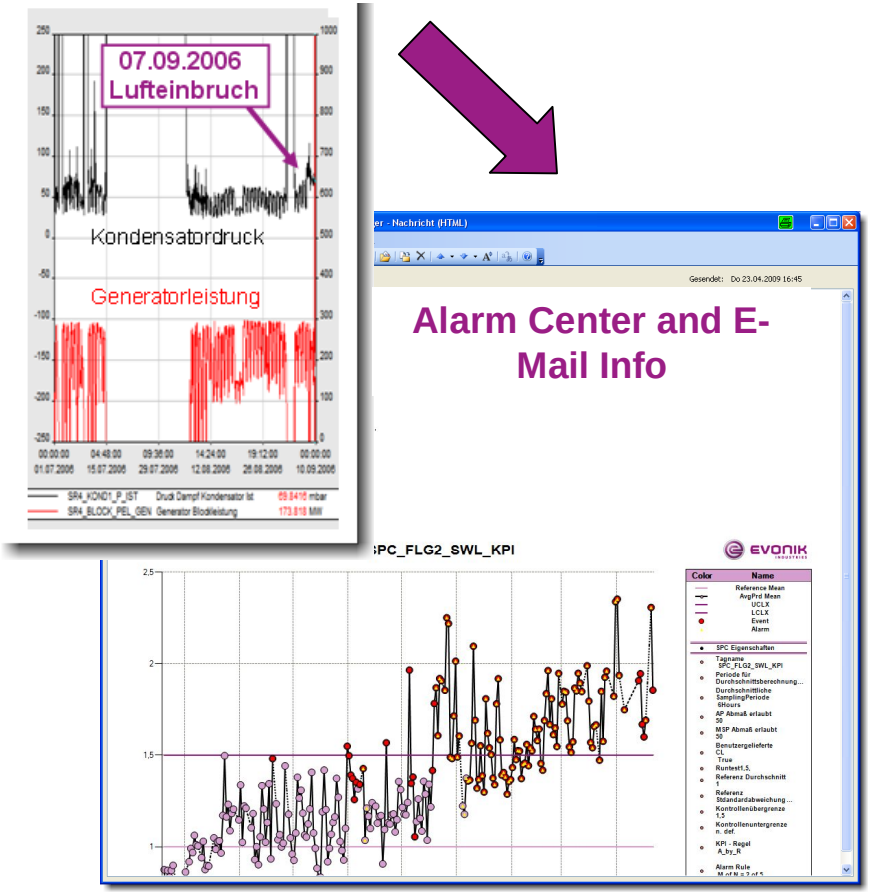
SR::EPOS – Power Plant Performance Monitoring and Optimization



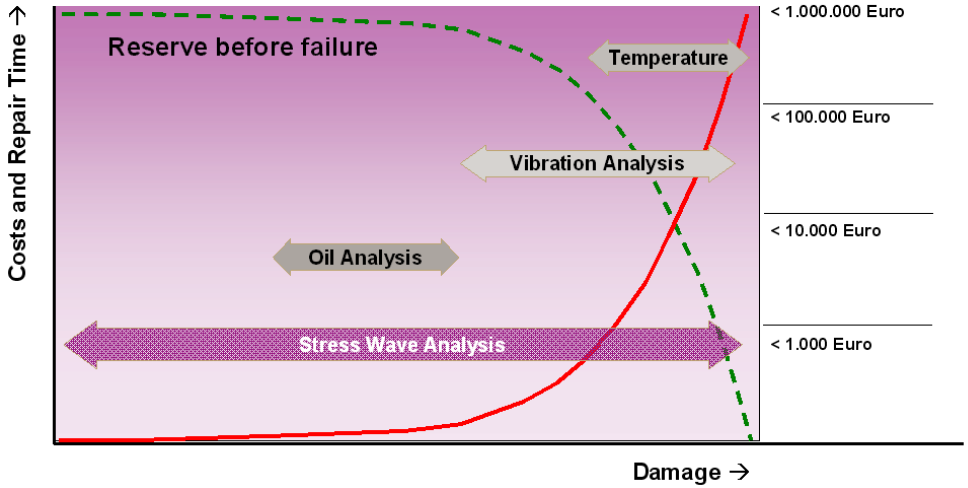
Process and Component Monitoring

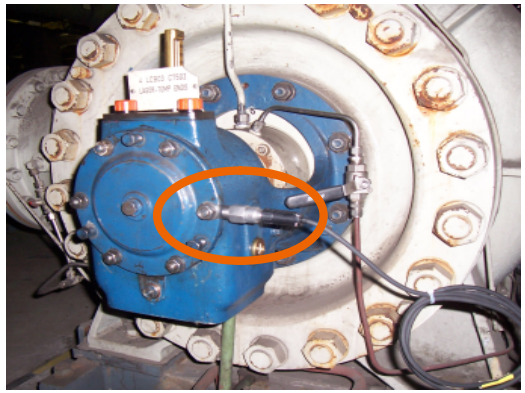
SR::SPC – Continuous Process Quality Monitoring

IC-Data



Stress Wave Analysis: SWAN





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Efficient Power Plant Technologies – Contribution of STEAG

- Efficiency is not only related to optimization of technology, process, project development and execution and operation.
- Net efficiency is a relative figure and related to the possibilities in the individual countries, e.g. electricity market.
- STEAG has long-term experience with large variety of coals regarding to ash, moisture, sulfur content, heating value etc.
- International experiences in project development, sourcing and O&M
- STEAG develops, owns and operates competitive, tailor-made power plants with high efficiency compatible to local energy markets and conditions.