Monitoring & Diagnostics potentials

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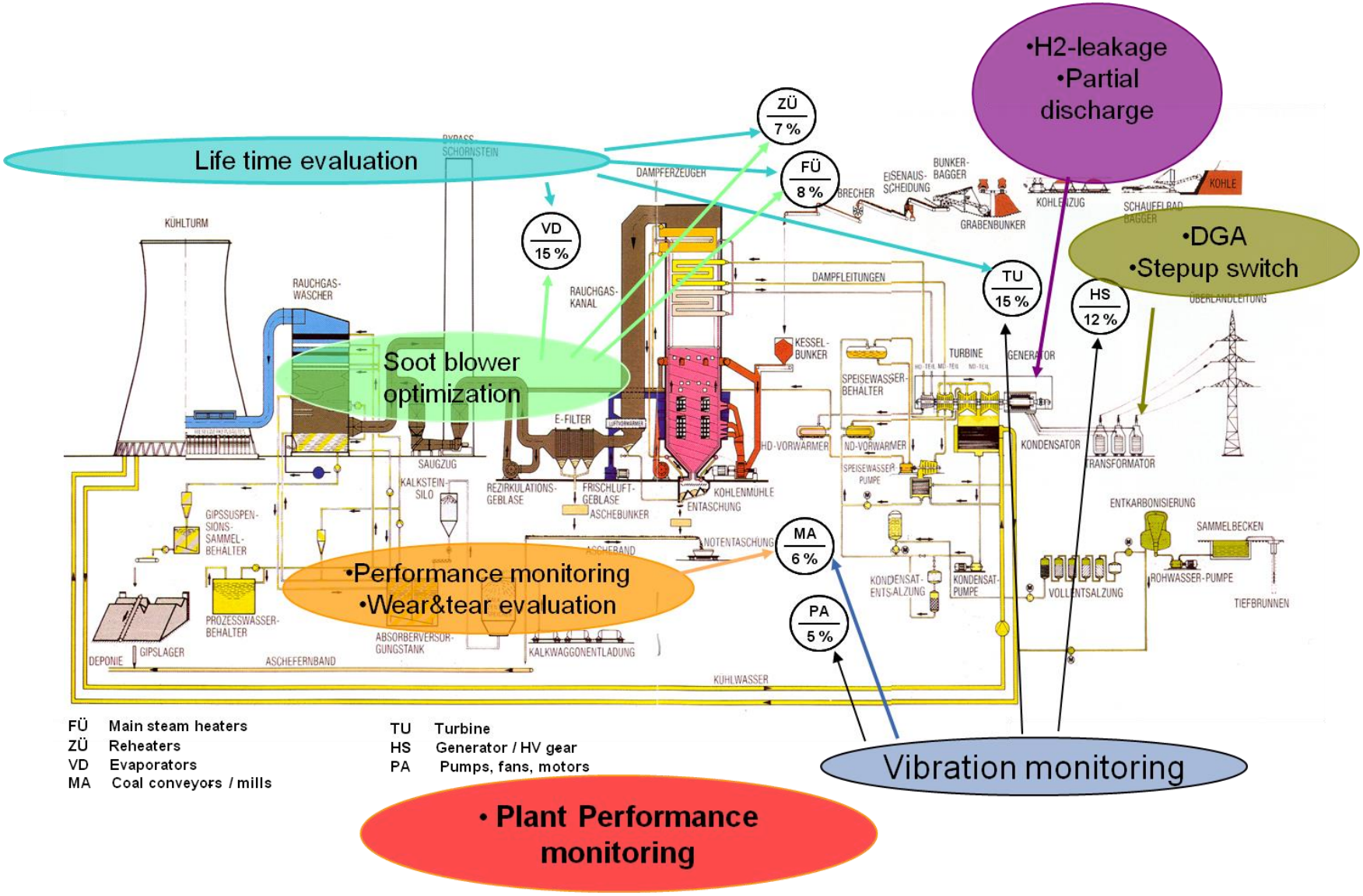
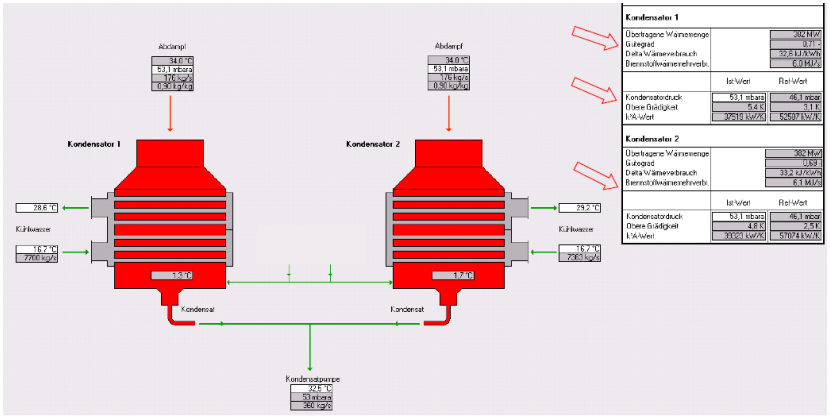
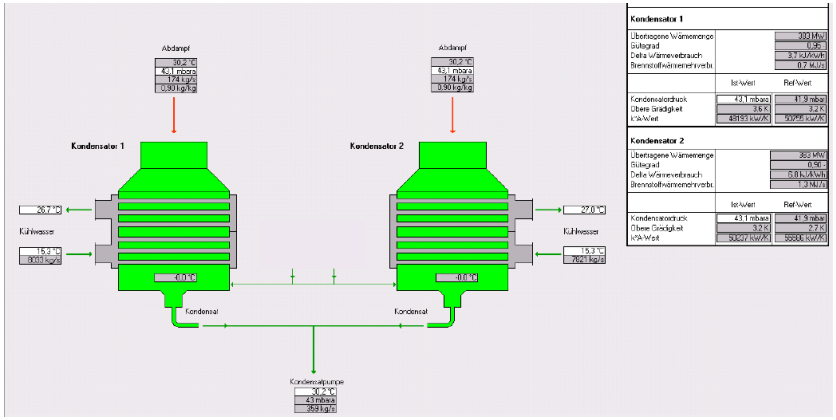


FÜ	Main steam heaters	TU	Turbine
ZÜ	Reheaters	HS	Generator / HV gear
VD	Evaporators	PA	Pumps, fans, motors
MA	Coal conveyors / mills		

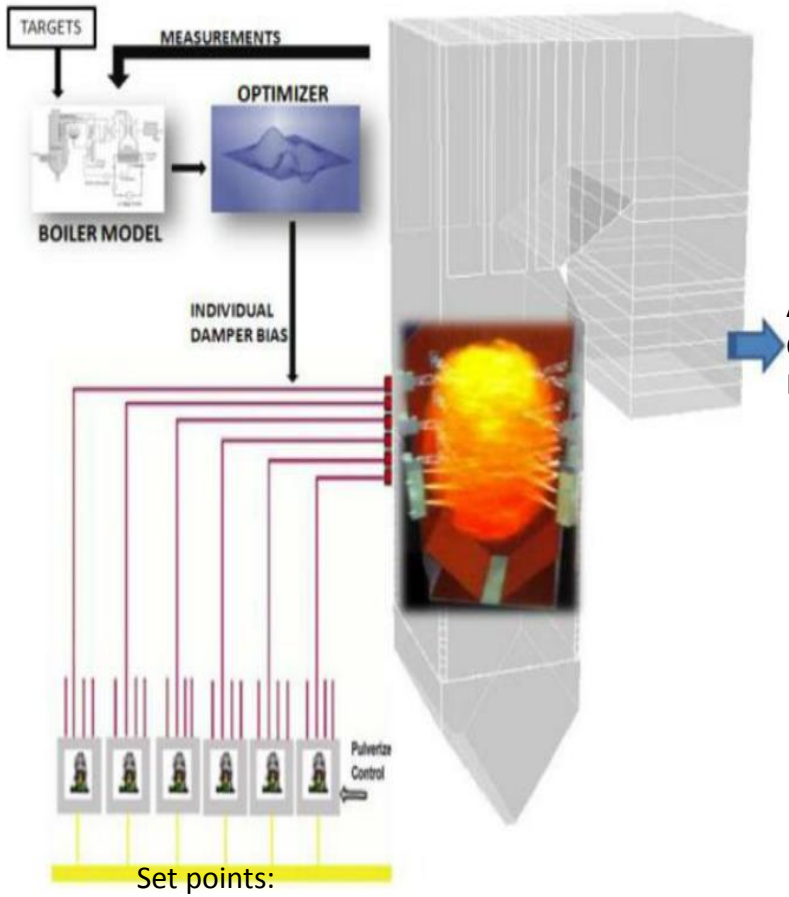
Example 1: Condenser pressure



Condenser pressure difference detected: 7 mbar
Additional fuel: 6 MJ/s reaching 140.000 €/month



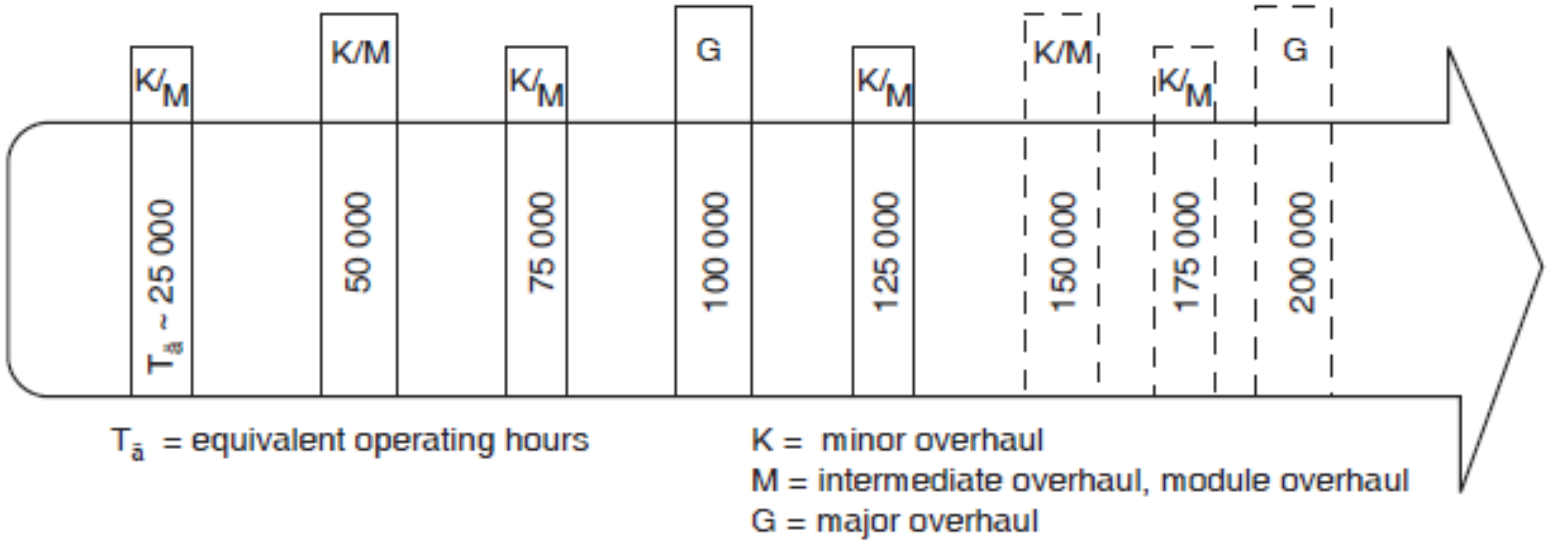
Example 2: Minimum load stabilization



Set points:
Secondary air
O2 surplus
Mill load
Burner angle

Source: SR:EPOS, STEAG

O&M: Maintenance overhaul periods



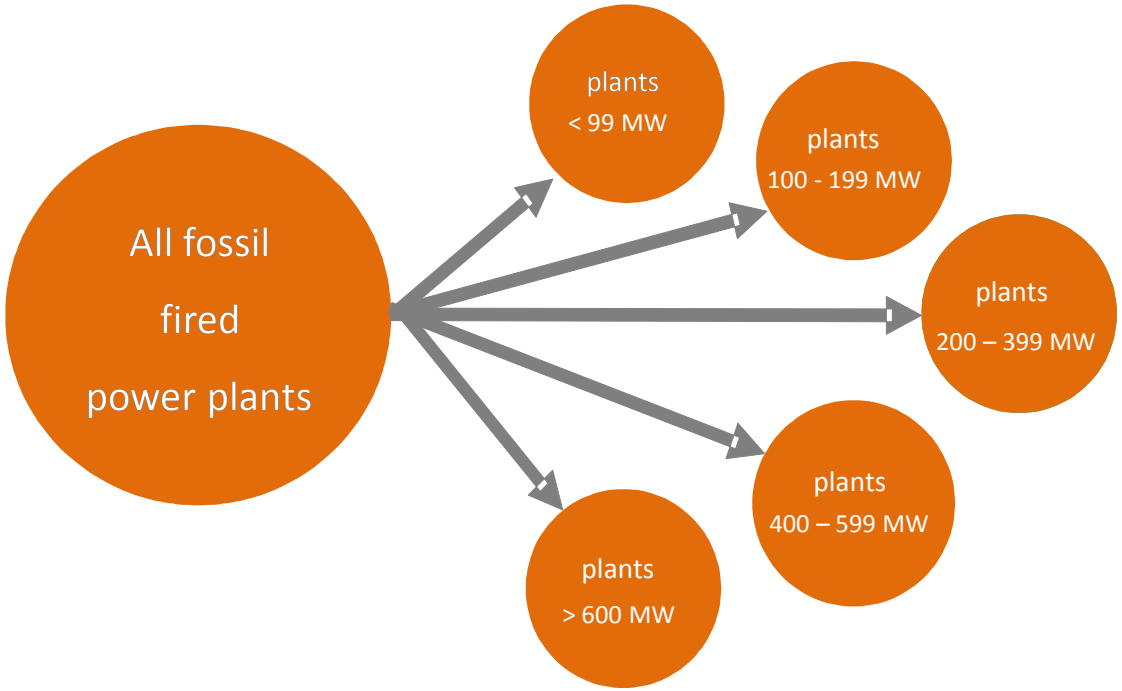
KISSY – power plant information system

KISSY provides the opportunity to benchmark power plants by:

- Compiling availability data and evaluating performance indicators
- Comparing the indicators of single plants with indicators of peer groups

Characterics:

- Size of power plant capacity
- Fuels by capacity
- Furnace type by capacity
- Units by single or dual boiler operation
- Units by sub-critical or supercritical pressure



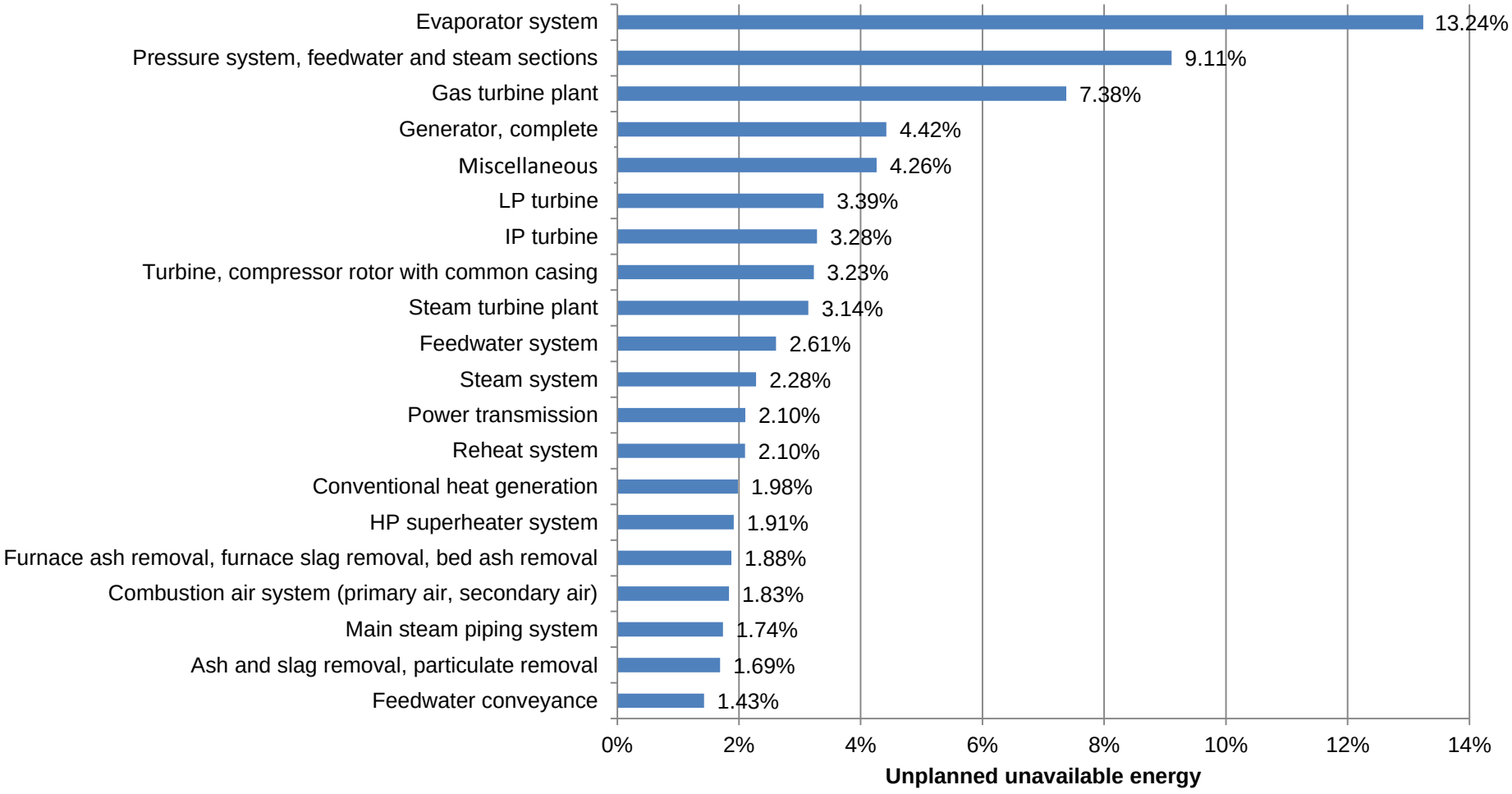
Benchmarking is a good way to assess the O&M performance of the own plant(s). It provides necessary transparency about focus areas for maintenance interventions.

TOP 20 components with highest unplanned unavailability

Evaluation of 3,633 incidents without external influence

Collective: fossil fired units; commis. date ≥ 2000; ≥ 200 MW gross capacity; all countries

Time Period 2000 to 2013

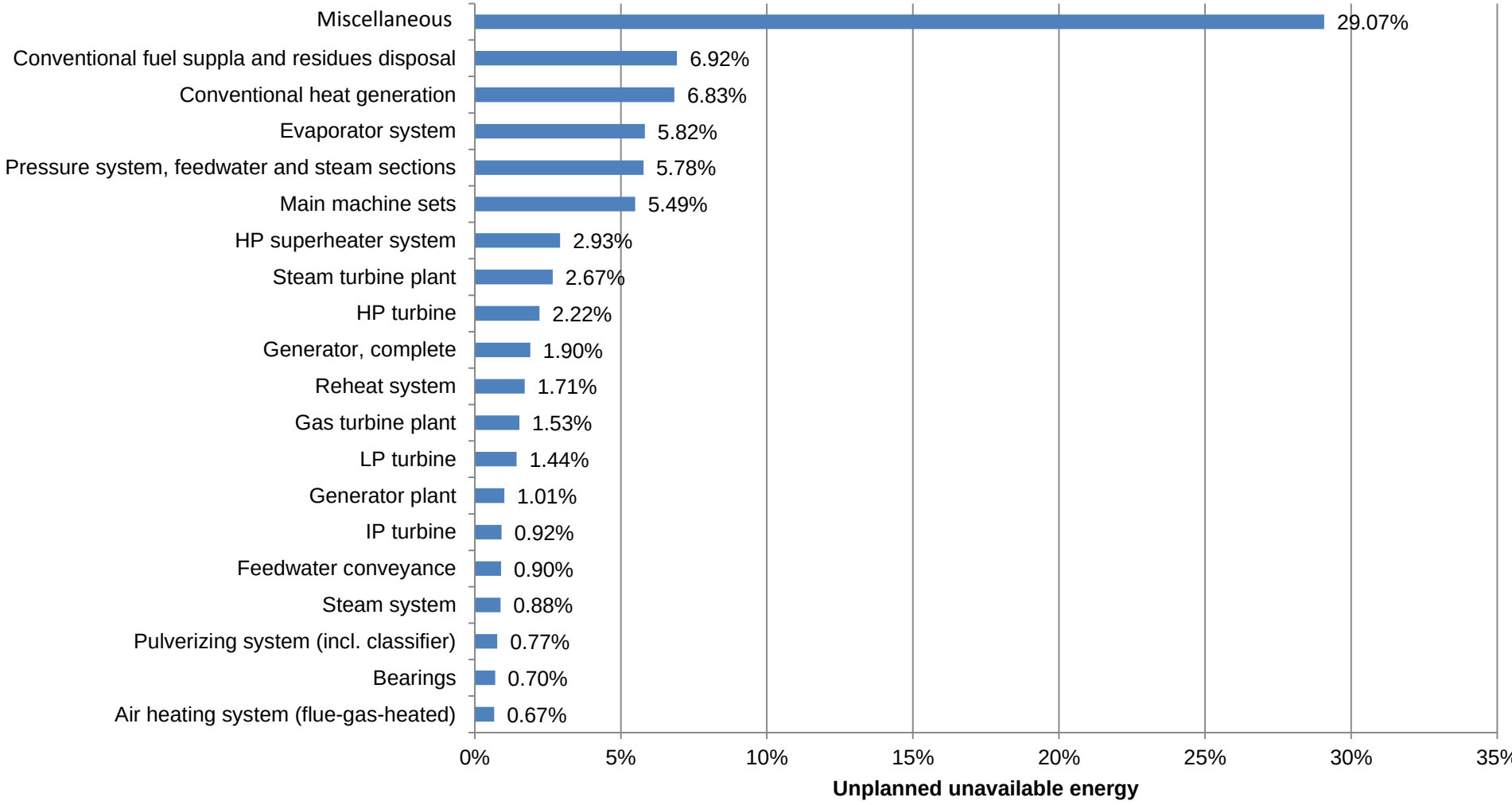


TOP 20 components with highest unplanned unavailability

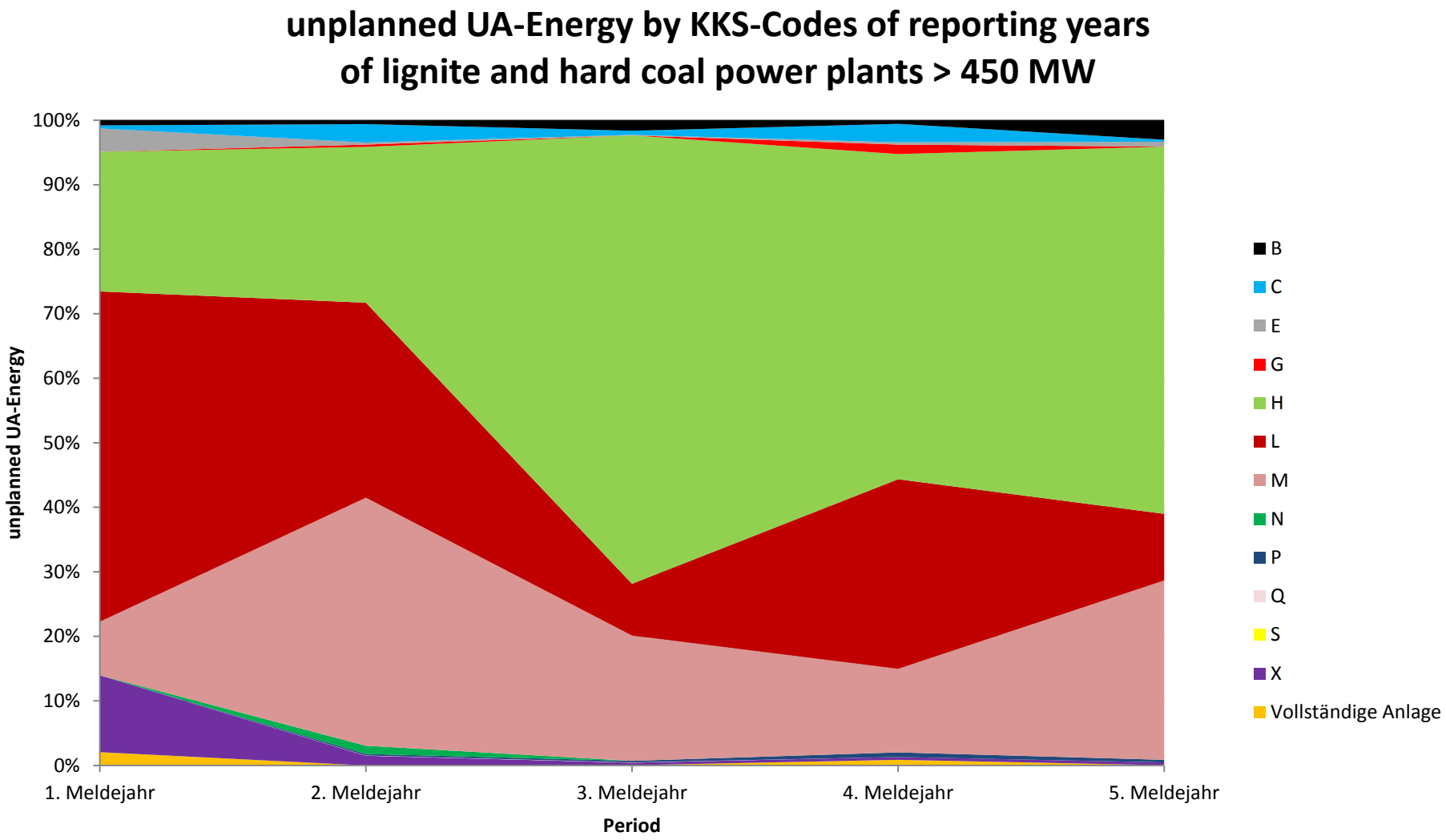
Evaluation of 66,330 incidents without external influence

Collective: fossil fired units, ≥ 200 MW gross capacity, all countries

Time Period 2000 to 2013



KISSY – unplanned unavailable energy



Meldejahr = reporting years

Organizational structure of a power plant team

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Level 0-1 CEO, MD
Top Management
Senior Level, >20 years experience

Level 0-1 CEO, MD
Top Management
>20 years experience

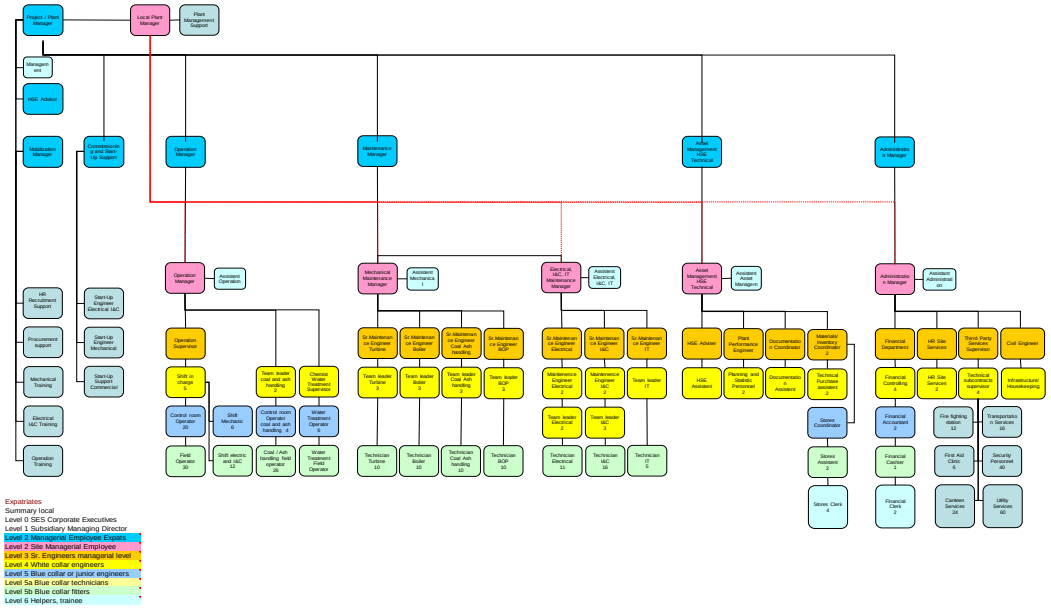
Level 1-2 Plant Manager
Senior Management
>15 years experience

Level 3 Senior Engineering
Middle Management
>10 years experience

Level 4 Junior Engineering
Assistant Managers / Specialists
>5 years experience

Level 5 Technicians / Fitters
Senior operational craft
>5 years experience

Level 6 Helpers / Trainees
Operators and manual laborer
No or few experience



The organization of a power plant usually comprise seven hierarchical level. Besides the size of the plant the number of employees depends on the subcontracting philosophy.

New requirements for power plant personnel

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Technical challenges

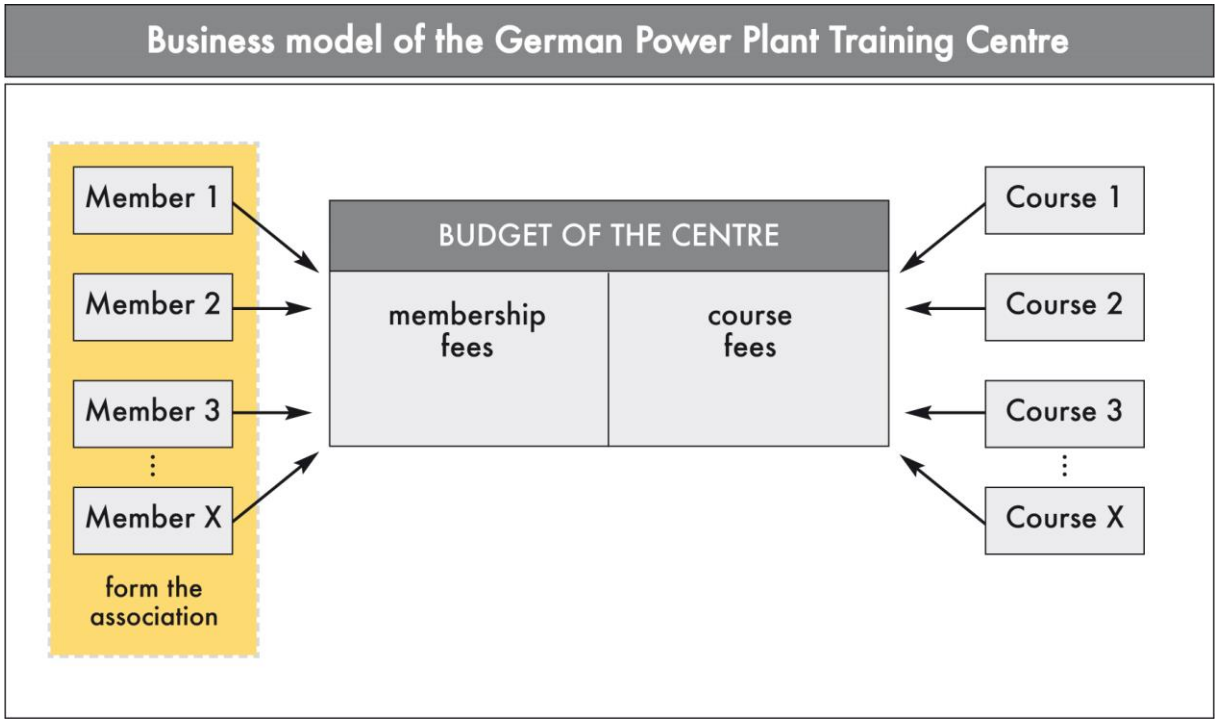
- reduction of full-load hours
- increased number of start-ups and load changes
- potential of reduced economic viability due to reduced life time
- technical development is focussed to ensure:
  - → more flexibility (load changes)
  - → reduction of minimal load
  - → high availibilty and reliability
  - → possibility of island operation and fast cold start

Skill challenges

- less predictability and seasonal variations and shut-down periods
- flexible working hours schemes
- variable areas of working with different technologies
- increased complexity

→ **continuous learning and skill enhancement**

German Training Center approach – Kraftwerksschule



The Kraftwerksschule is the benchmark for power plant training in Germany. The training of operators is in the focus of the skill program.

Documentation of best practices, expertise and lessons learnt

- not binding
- proven industry standard
- >300 standards, guidelines and instruction sheets, 100 available in English; 10-20 new/updated releases per year

Structure of a standard or guideline

- **Originators of the standard**
- **Introduction** (technical basics and scientific fundamentals)
- **Technical details** and recommendations (80 % of the guideline)
- **Literature and publications** (mainly articles in technical press)
- Related **standards and norms** (ASME, ISO, VdTÜV, DIN etc.


VGB-Standard

for Type, Operation and Maintenance of Flue Gas Desulphurisation Plants (FGD)

VGB-Standard-S-015-2011-EN

First edition 2011

Published by
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To be ordered at:
VGB PowerTech Service GmbH
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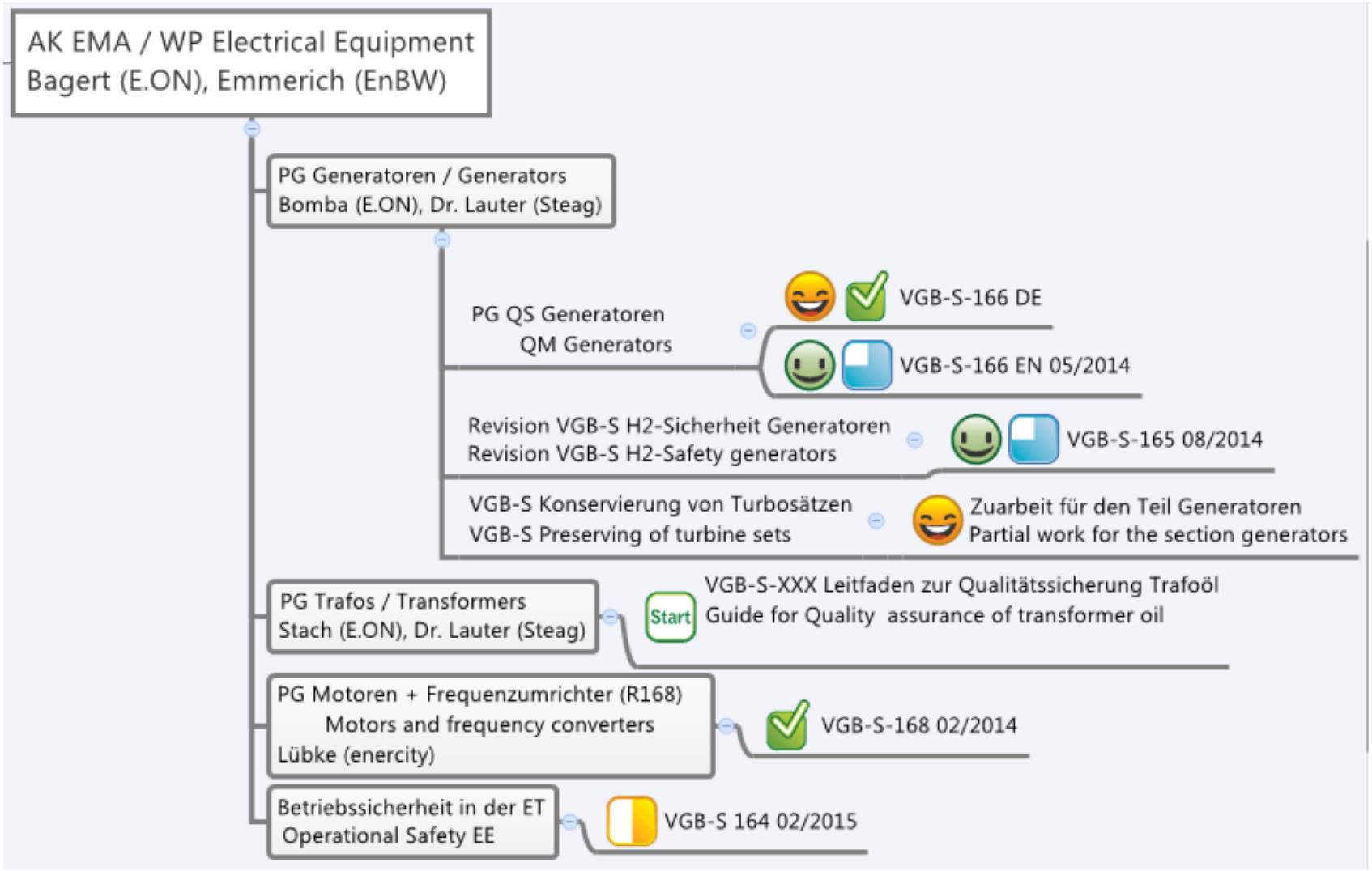
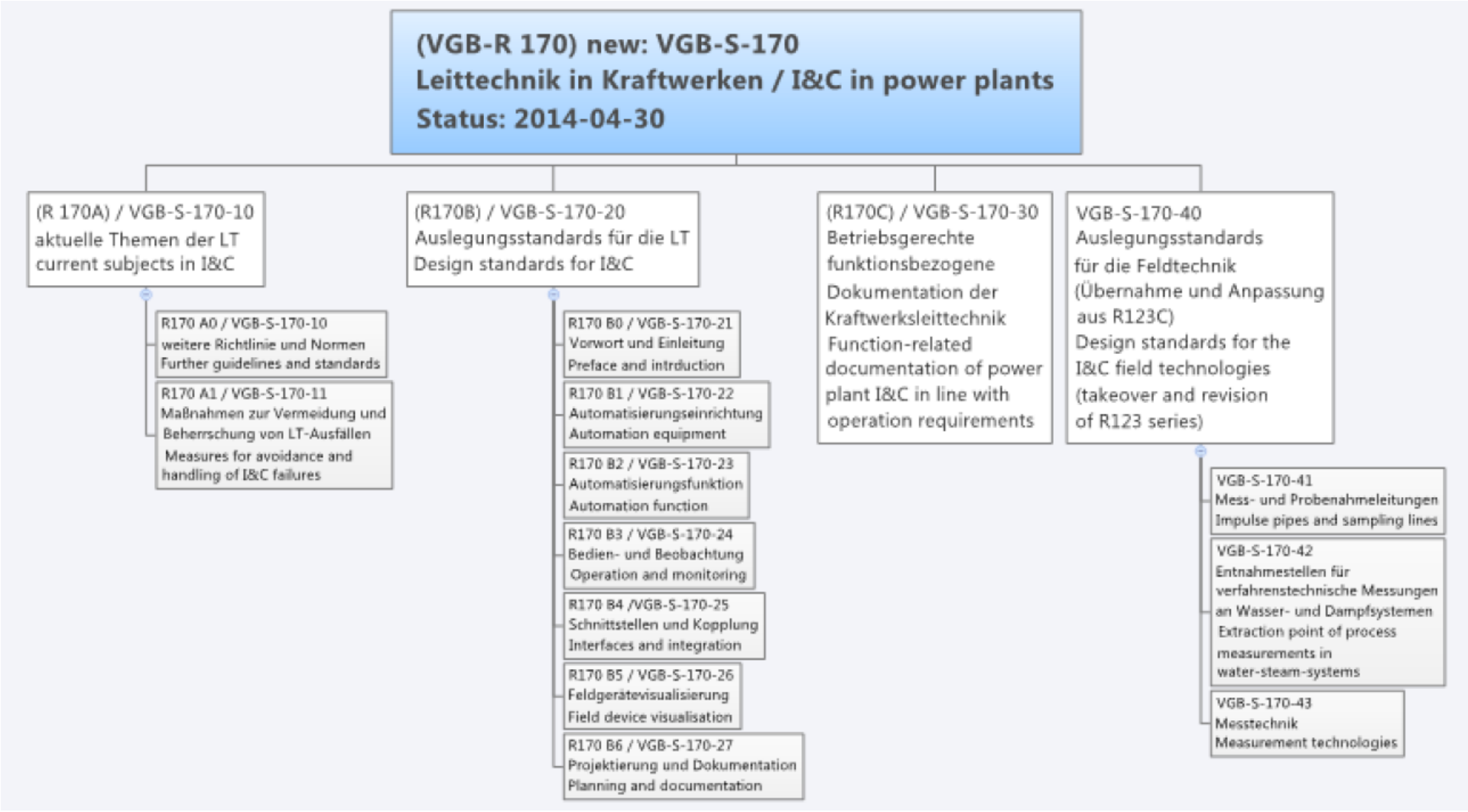
Fax +49 201 8128-329
E-Mail: mark@vgb.org
ISBN 978-3-86875-365-3

core group of **experts** (<15 persons) prepares the document

VGB Standards and Guidelines: Example Electrical



VGB Standards and Guidelines: Example I&C



VGB Standards – examples for thermal power plants

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Engineering

VGB-S-008
Recommendations for the SIL classification of safety-related systems and systems in the water circuit

VGB-S-010
Feed Water, Boiler Water and Steam Quality for Power Plants/Industrial Plants

VGB-R170e
Design standards for instrumentation and control equipment

VGB-R455e
Cooling Water Guideline

Procurement & Manufacturing

VGB-S-166
Quality Assurance in the Manufacture of Generators

VGB-R101e
Guideline for Ordering High-Capacity Steam Boilers

VGB-R145e
Guide for Procurement of Steam Turbine Plants, Part A, B and C

Construction & Commissioning

VGB-S-013
Construction and installation supervision in the manufacture and assembly of water-tube boilers and associated systems in thermal plants

VGB-S-513
Internal Cleaning of Water-Tube Steam Generating Plants and Associated Pipework

VGB-S-504
Inspection and Testing of Large Forgings and Castings for Steam and Gas Turbine Generators

O & M

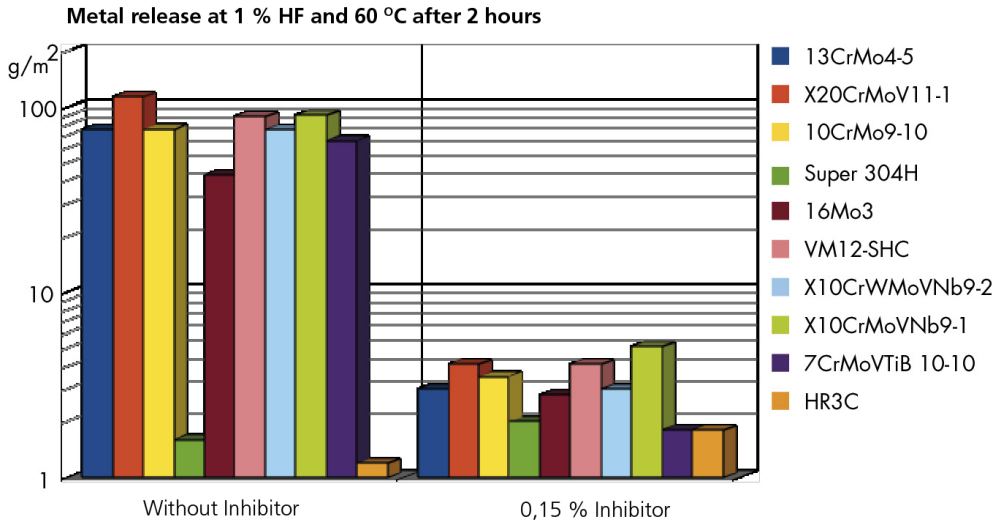
VGB-S-506
Condition Monitoring and Inspection of Components of Steam Boiler Plants, Pressure Vessel Installations and High-Pressure Water and Steam Pipes

VGB-S-517
Guidelines for rating the microstructural composition and creep rupture damage of creep-resistant steel for high pressure pipelines and boiler components and their weld connections

VGB-R167e
Overhaul recommenda-tions for turbo-generators

Example: Internal Cleaning of water-tube steam generating plants and associated pipe-work issued in 2015 (revised version)

- aims at cleanliness of the inner surfaces
- includes all kind of cleaning procedures: flushing, acid cleaning, blow through, alkaline boiling
- reflects recent experiences made in comissioning of new built plants
  - new materials are included like Ni-based alloys and austenitic steels
  - completely revised chapter about blow-through
  - comprehensive quality and preparing recommendations



Best Practices in applying inhibitors during acid cleaning

VGB Standards – overview of cleaning applications in new builts

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Country	Name of Plant	Name of Company	No. Units	Unit Cap. MW (gr.)	Main Fuel	Life/RH Steam Temp. (°C)	COD (Y)	Steam Blowing	Acid cleaning	High speed flushing
Germany	Neurath F&G	RWE Power	2	1100	LIG	595/605	Jul 12		X	X
Germany	Datteln 4	E.ON	1	1100	HC	600/620	?		X	X
Germany	Moorburg A-B	Vattenfall Europe	2	820	HC	600/610	2015		X	X
Germany	Boxberg R	Vattenfall Europe	1	675	LIG	600/605	Okt 12		X	X
Germany	GKM 9	Grosskraftwerk Mannheim AG	1	911	HC	600/610	2015		X	X
Germany	RDK8	EnBW	1	912	HC	600/620	2014		X	X
Germany	Walsum 10	STEAG/EVN	1	725	HC	610/620	Nov 13		X	X
Germany	Lünen	Trianel	1	750	HC	600/610	Jan 14		X	X
Germany	Wilhelmshaven	GDF Suez	1	800	HC	600/610	Apr 14		X	X
Germany	Westfalen D&E	RWE Generation	2	800	HC	600/610	Sept 14		X	X
Netherlands	Eemshaven	RWE Power	1	1600	HC	600/610	Jan 15		X	X
Netherlands	Maasvlakte	Electrabel	1	750	HC	600/610	2013		X	X
Netherlands	Maasvlakte 3	E.ON Benelux	1	1100	HC	600/620	2015		X	X
South Africa	Medupi	Eskom	6	4800	HC	600/620	2015	X	X	X

Summary

- → Excellence in operation is a lot about transparency of the plant status.
- → Modern I&C equipment and analyzing instruments are useful tools to identify improvement potential.
- → To sustain the improvement process benchmarking provides useful information to assess own performance.

- → Fleet management is a good way to optimize maintenance costs.
- → Guidelines and standards that are based on industrial best practices document valuable experiences.

Transparency of the plant status, skilled personnel and the application of best practices are key to excellence in O&M.

german cooperation
DEUTSCHE ZUSAMMENARBEIT

धन्यवाद

Thank you

for your interest!

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