



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



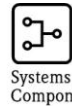
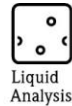
Services



Solutions

Competence in Power & Energy

Measurement instrumentation for Power Plants



Presented by

Uwe Wagner

Dipl.-Ing. (FH)



Industry Manager
Power & Energy

Marketing Manager
Pressure Measurement

@

Endress+Hauser
Instruments International

What does Power mean for Endress+Hauser?

- One of the most important industries worldwide
- High quality instruments for a reliable power plant
- Understanding of each individual power plant
- Our customers trust us
- Qualified service and support
- Capable instruments for use in nuclear power plants



Power & Energy is a standard industry

- A country will always produce its own electricity
- For economic reasons, politics will always support this industry
- Other industries require Power & Energy

Advantages and Benefits to customers

Family owned, stable company Sales approaching \$1B

True “One-stop-shop” supplier

Right instrument for the right application

Detailed process and application know how (many examples)

Cost-optimized instrumentation (T-M-S segmentation)

Concepts for customers (operators and contractors)

Global manufacture/supply activities plus local service organizations

Co-operations in servicing and maintenance: Asset management

Endress+Hauser Product Centers Worldwide



Maulburg, Germany
Level, Pressure, TG



Flowtec, Switzerland
Flow Headquarters



Conducta, Germany
Liquid Analysis



Wetzlar, Germany
Data Acq. & Temp.



Greenwood, USA
Level, Pressure, Flow



Yamanashi, Japan
Tank Gauging, Servo



Sicestherm, Italy
Special Temperature



Suzhou, China
Level, Pressure, Flow



Cernay, France
Flow



Manchester, UK
Flow



Aurangabad, India
Flow



Conducta, Germany
pH Sensor

Power & Energy industry - Tooling



Providing Measurement and Automation Solutions to the Power & Energy Industry

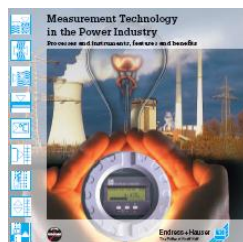


“Top down tool” Power Image Brochure / V I P Tool

The Power Behind the Plant

SD010/H/27/en/07.02 (English only)

Providing Measurement and Automation Solutions to the Power & Energy Industry

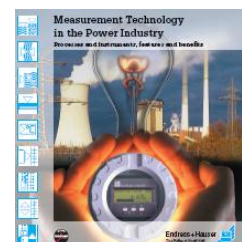


Power CD ROM

Presentations

Products+Industry

SD 028/27/1.0/en (English only)



Power CD ROM

Presentations

Products+Industry

SD 028/27/1.0/en (English only)



End user,
Operator

Our customers

Plant engineer,
Contractor

“Bottom-up tool”

Power Praxis-Know-how Brochure

Powered by Innovation

PK016/27/en/03.02 (English)

PK016/27/zh/07.02 (Chinese)

PK016/11/de/04.01 (German)

PK016/23/es/03.02 (Spanish)

PK016/27/ru/01.03 (Russian)

Powered by Innovation

Offering the full range of measuring instruments for power plants



Powered by Innovation

Offering the full range of measuring instruments for power plants



We tailor your demands

- The instruments we are developing are specially designed for our customers' power plants

We are with you also in the "Hot Phase"



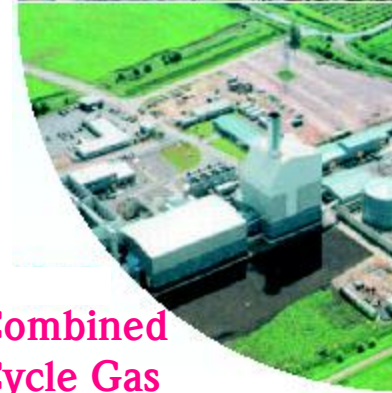
Thermal Power Plant



Incinerator Power Plant



Combined Cycle Gas Turbine Power Plant



Nuclear Power Plant



- Services throughout the entire life cycle of product and plant
- Top quality products
- References worldwide

Scope of Power & Energy

→ Power systems – what do they do ?

- Production of **ELECTRICITY**
- Production of **HEAT**
- Combustion of **WASTE** and **BIOMASS**









→ Fossil fuel power plants (coal, oil, natural gas)

- Coal power plant
- Gas turbing plant/combined gas and steam plant
- Heating power plant with district heating system

→ Nuclear power plants

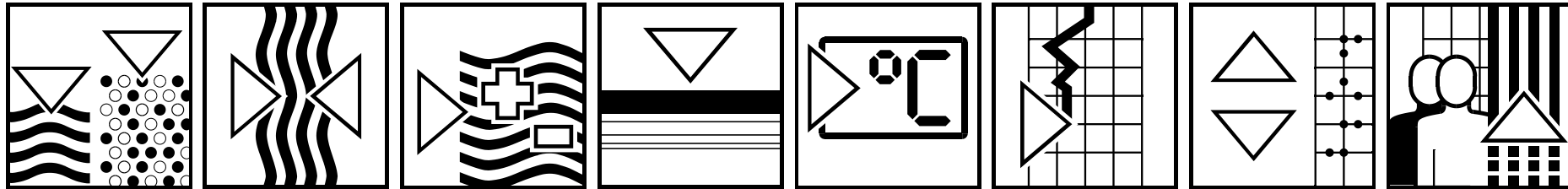
→ Incinerating plants

→ Hydro power plants

Plants	Amount of instrumentation	available E+H products
Coal,gas,oil		
Nuclear		
Hydropower		
Incinerator		

One-stop-shop supplier

Providing a complete product basket of solutions



Level	Flow	Analysis	Pressure	Temperature	Data Acquisition Components	Systems	Services
Capacitance	Electromagnetic	pH - Value	Pressure rel.	Pt 100	Standard Rec.	Profibus PA	Commissioning
Conductive	Vortex principle	Conductivity	Pressure abs.	Thermocouple	Hybrid Rec.	Fieldbus FF	Maintenance
Hydrostatic	Mass Flow	Oxygen	Diff. - Pressure	Transmitter	Displays	HART	Repair
Vibration	Ultrasonic	Turbidity	Pressure switch		Datalogger	Fieldcare	Calibration
Ultrasonic	Orifice / Pitot	Chlorine	p/dp nuclear		Datamanager	Control Care	Training
Microwave	T-Mass	Ammonium			Paperless Rec.	Systems	Spare parts
Microimpulse	T-Switch/Trend	Phosphate			Power supply		Equipment Hire
Electromech.		Nitrate			Process Trans.		Inst. Base Mgm
Radiometric		Silicate					Engineering
		Water sampler					

Role of instrumentation

Level	Flow	Analysis	Pressure	Temperature
Capacitance	Electromagnetic	pH - Value	Pressure rel.	Pt 100
Conductive	Vortex principle	Conductivity	Pressure abs.	Thermocouple
Hydrostatic	Mass Flow	Oxygen	Diff. - Pressure	Transmitter
Vibration	Ultrasonic	Turbidity	Pressure switch	Multipoint
Ultrasonic	Orifice / Pitot	Chlorine		
Microwave	T-Mass	Ammonium		
Microimpulse	T-Switch/Trend	Phosphate		
Electromech.		Nitrate		
Radiometric		Silicate		
		Sodium		

5 parameters

35 different principles

100 different devices

(each device with 1,000 combinations)



Maintaining know-how in the complex area of instrumentation is very difficult for operators and contractors

Role of instrumentation

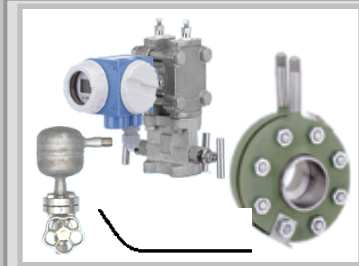


Example measurement of **TEMPERATURE** and **LEVEL** in a feedwater tank:

- Indicate
- Regulate
- Control



Right instrument for the right application (FLOW)



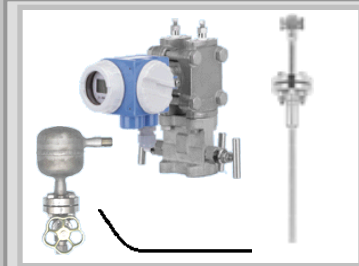
DELTA BAR

Orifice plate with impulse pipe



DELTA BAR

Orifice plate without impulse pipe



DELTA BAR

Pitot tube with impulse pipe



DELTA BAR

Pitot tube without impulse pipe



PROMAG

Electromagnetic flowmeter



PROWIRL

Vortex flowmeter



T-Mass

Thermal mass flowmeter



PROSONIC FLOW

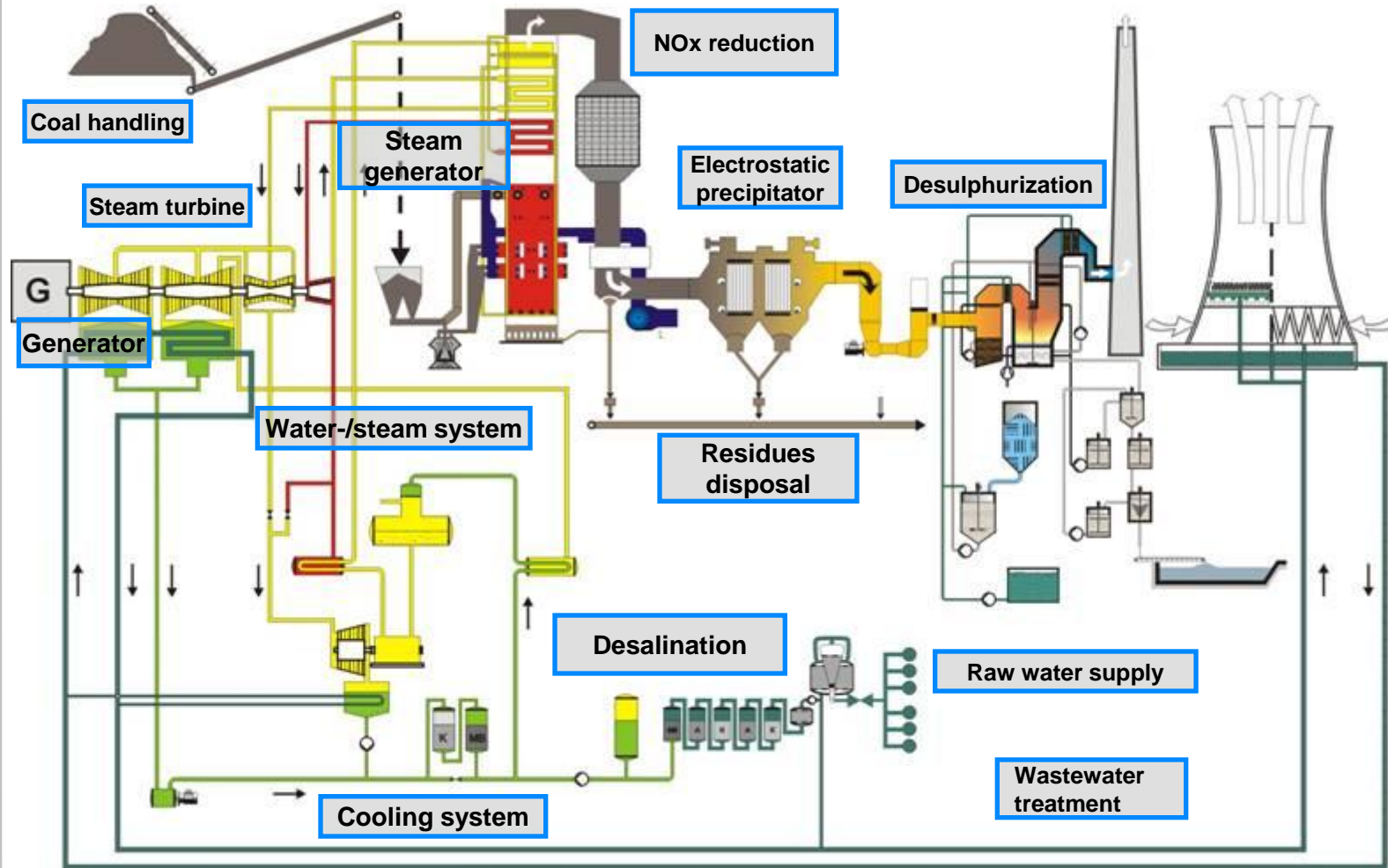
Ultrasonic



PROMASS

Mass flowmeter

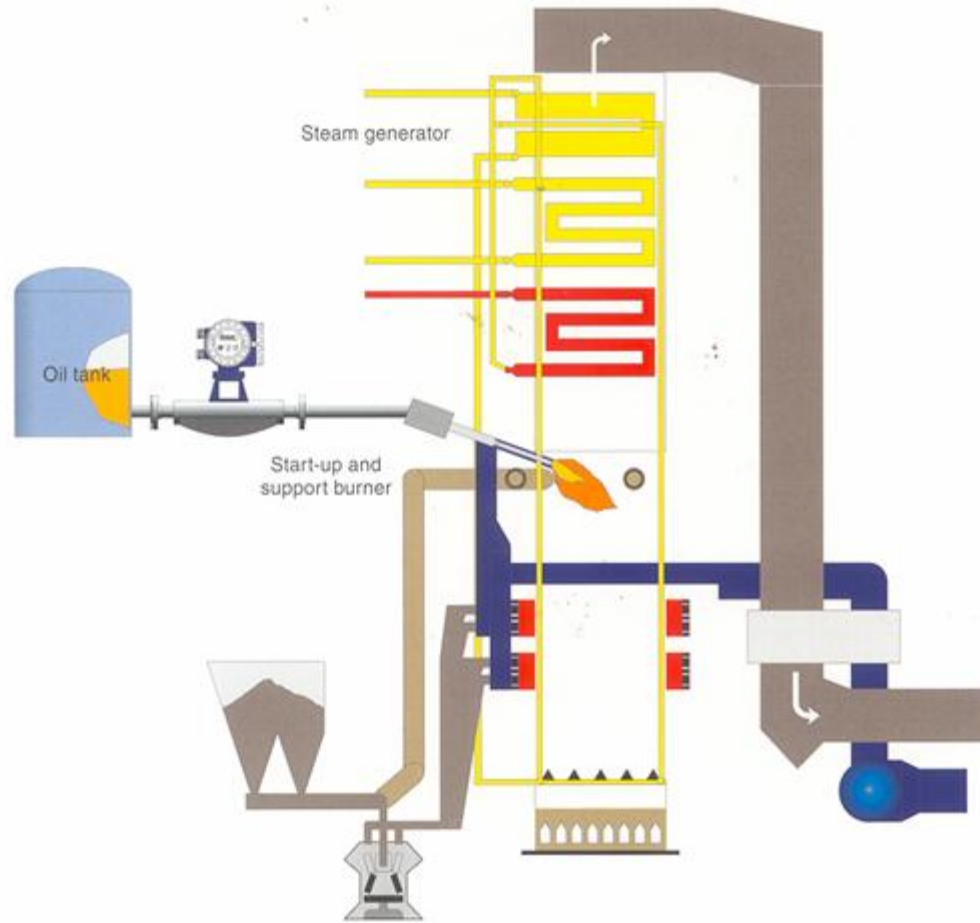
Coal fired power plant operations



Measuring point / Product matrix

	pressure	level								flow									T	R		
	process pressure (rel./abs.)	differential pressure	capacitive	vibronics (liquids)	vibronics (solids)	radiometrics	guided micro impulse	ultrasonics	electromechanical systems	microwave	electromagnetic	vortex	ultrasonics	mass meter	conductivity	pH-value	turbidity	sludge measurement	oxygen	temperature	data acquisition	
coal supply	●	●	●		●		●	●												●		
oil supply	●	●		●				●		●		●		●							●	●
ash removal/slag removal			●		●	●	●	●													●	
gypsum processing					●			●			●					●						
raw water supply								●			●		●								●	
full desalination	●	●		●				●		●	●	●			●	●	●				●	
waste water treatment	●	●	●	●				●			●				●	●	●	●			●	
steam generator (main firing)	●	●																			●	
detoxification (DeNOx)	●	●		●						●	●	●				●					●	
dust removal (electrofilter)			●		●	●	●														●	
flue gas desulphurisation	●	●	●			●		●		●	●			●		●					●	
water/steam-circuit	●	●								●		●			●	●			●		●	
steam turbine	●	●	●								●										●	
generator			●	●																	●	
main cooling water system	●	●						●			●		●		●	●						

Monitoring and start-up of oil burner systems



Application 1

Using Coriolis mass meters



Coriolis mass flowmeter
PROline Promass

Positive displacers versus Coriolis flow meters

Application at the start-up burners of the steam generator



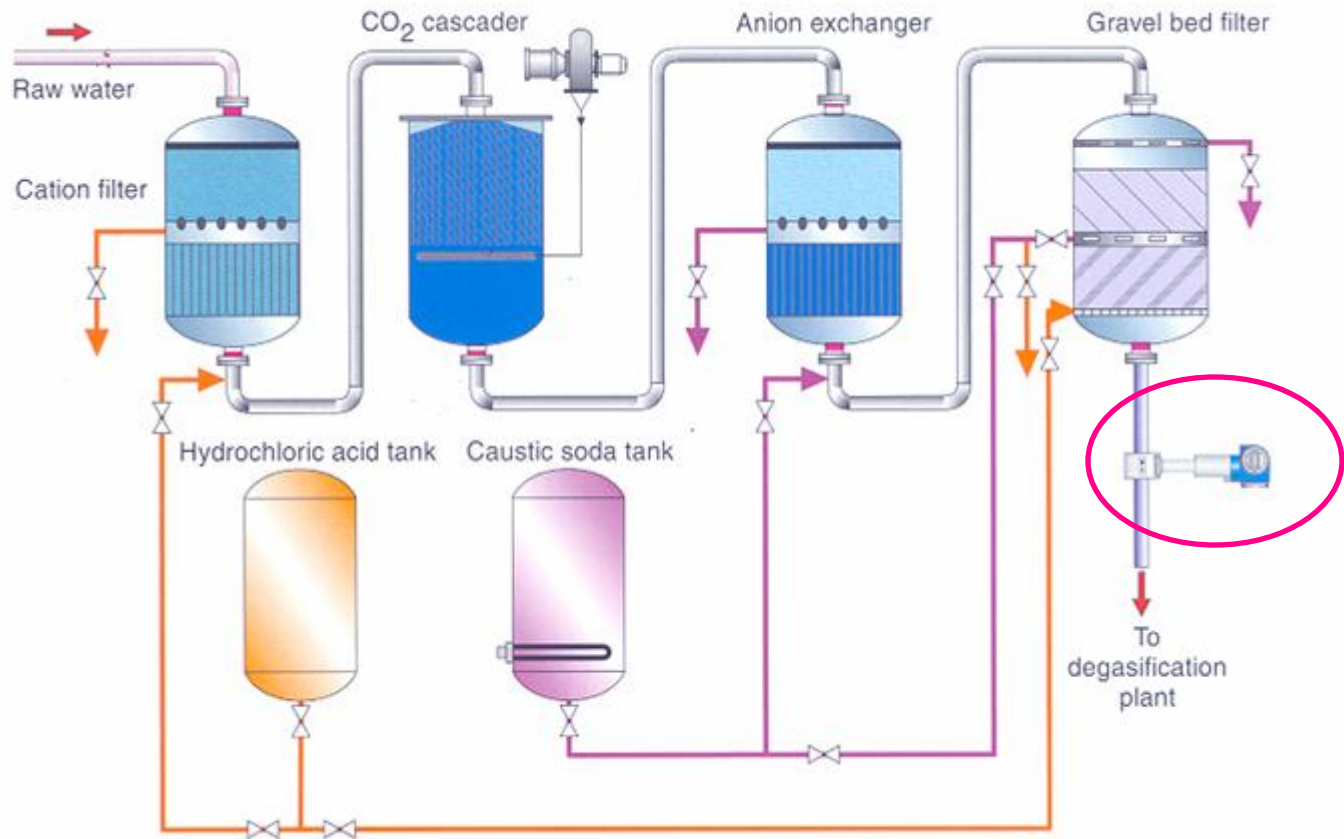
BEFORE

Positive displacers with a major effort from the instrumentation and a danger of blocking

AFTER

Promass without moving parts.
Direct mass flow signal and open system without danger of blocking

Volume flow measurements in desalination plants



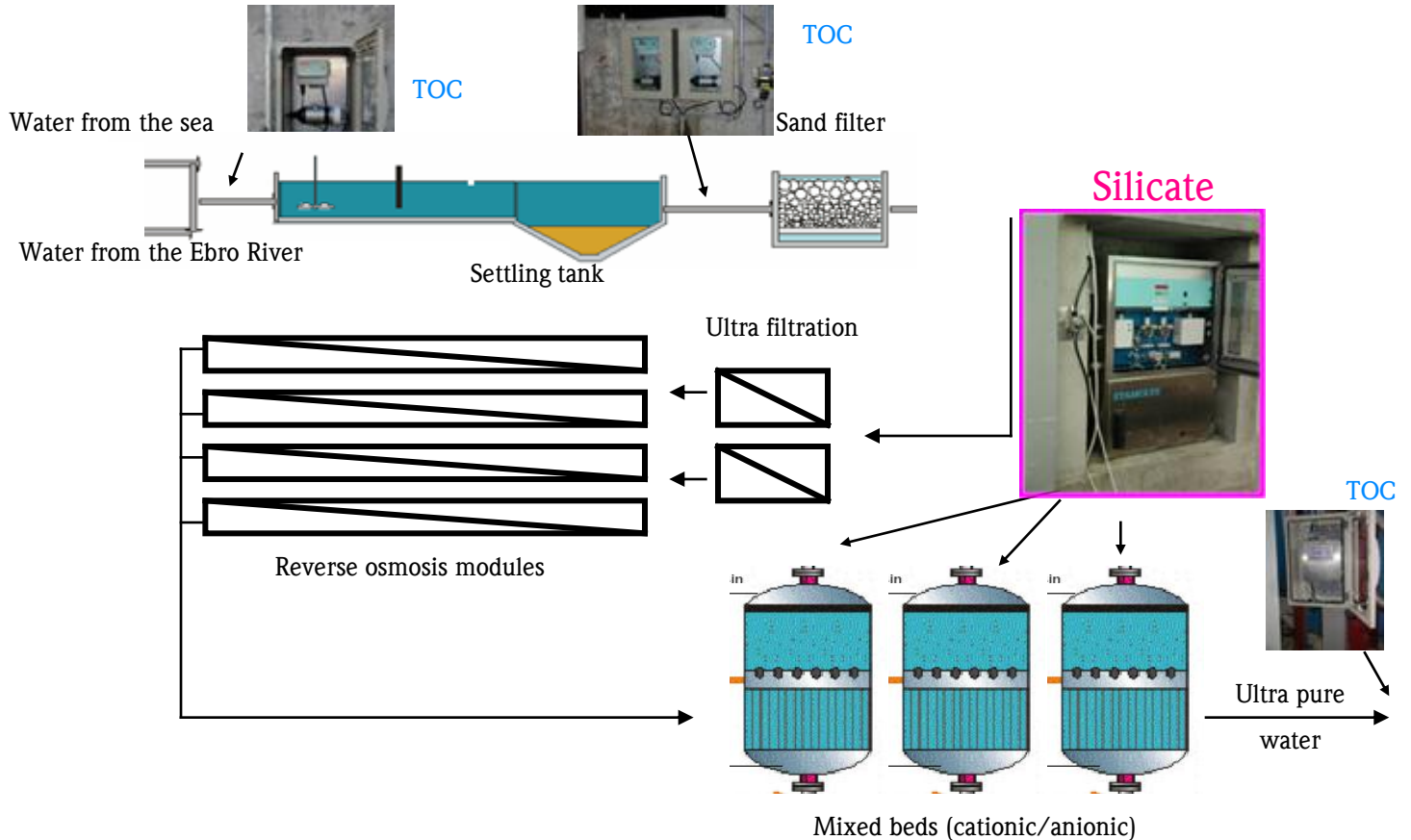
Application 2

Using vortex meters

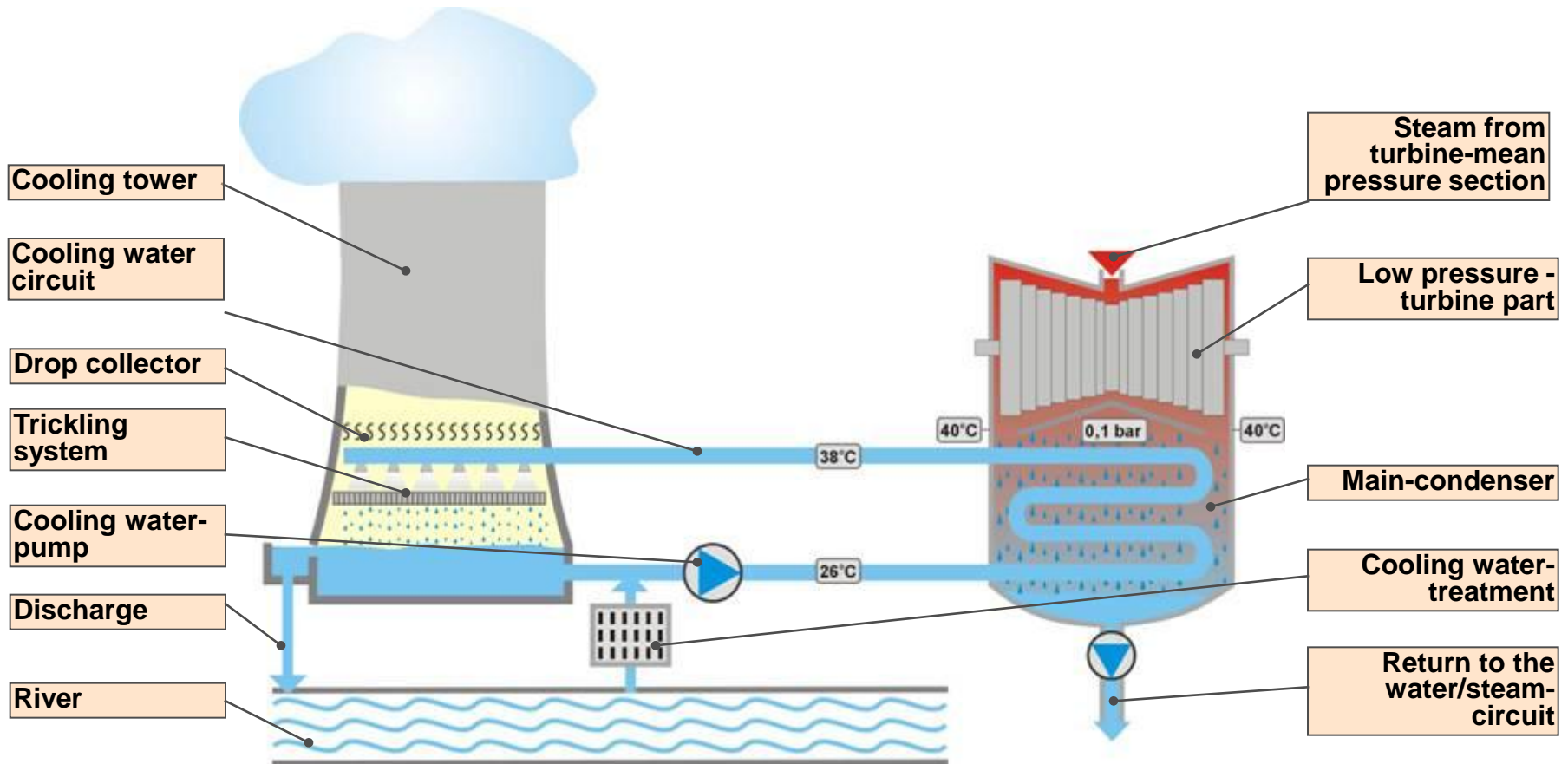
Desalination of brackish water

BASF – Tarragona, Spain

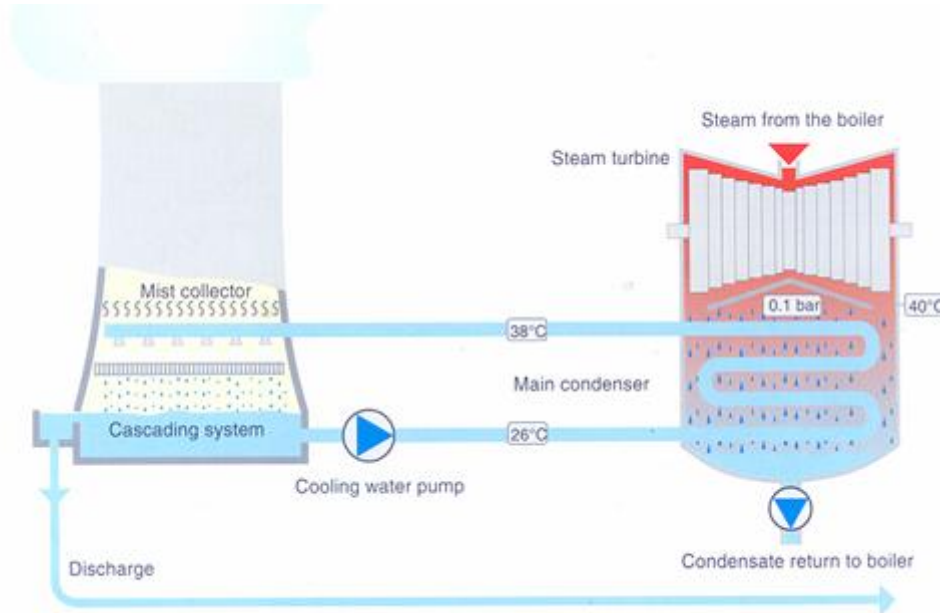
Use of Stamolys **Silicate** analyzer triggers regeneration of ion-exchangers



Main cooling system



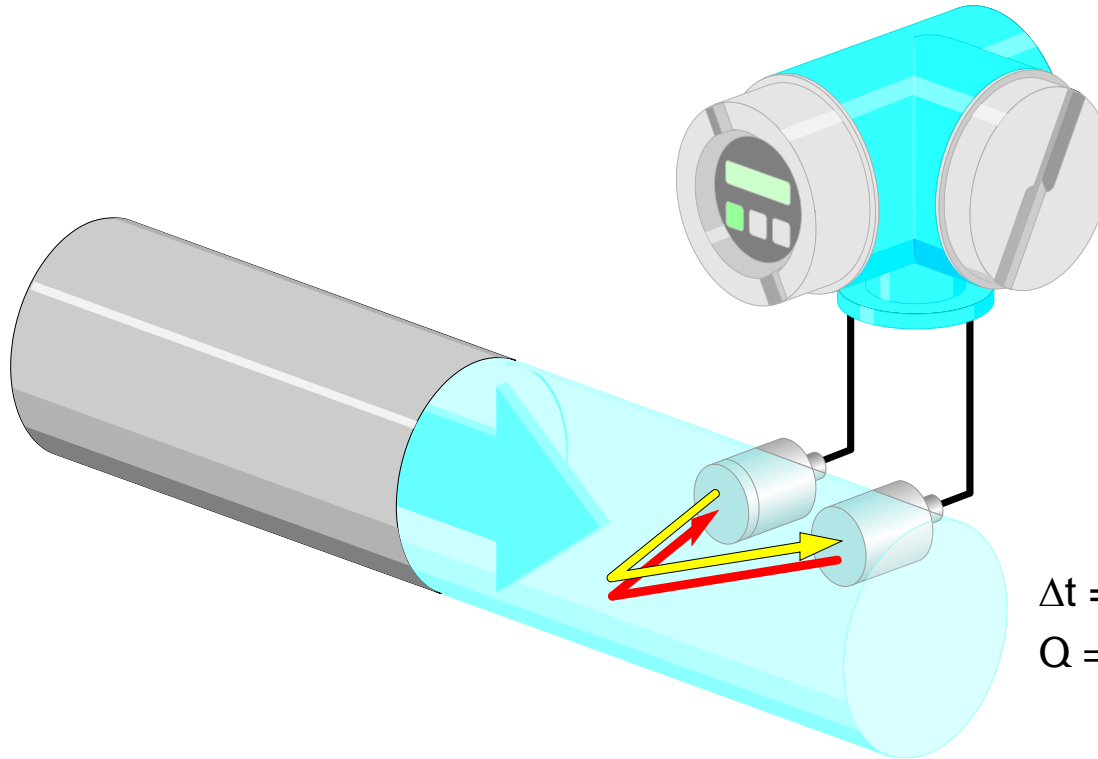
Water volumes in the cooling systems



Application 3
Using ultrasonic
meters



The principle of PROline Prosonic Flow

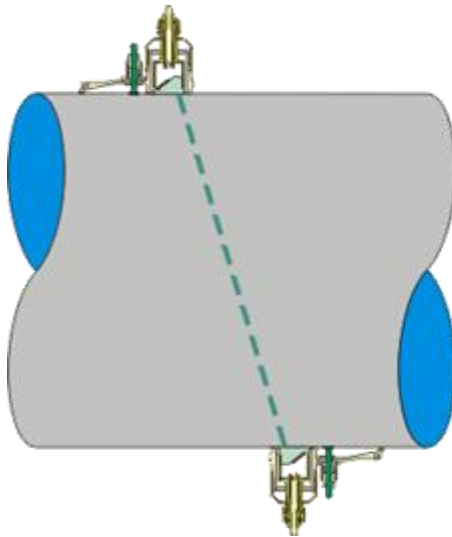


Δt = Time differential

Q = Volume flow

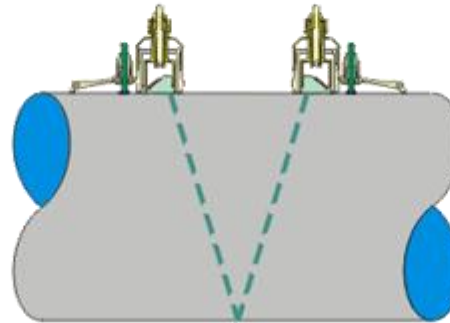
$$\Delta t \sim Q$$

Sensor configuration



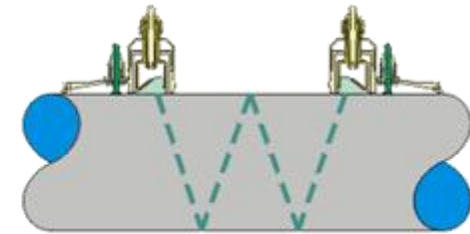
1 Traverse

> DN 600



2 Traverses

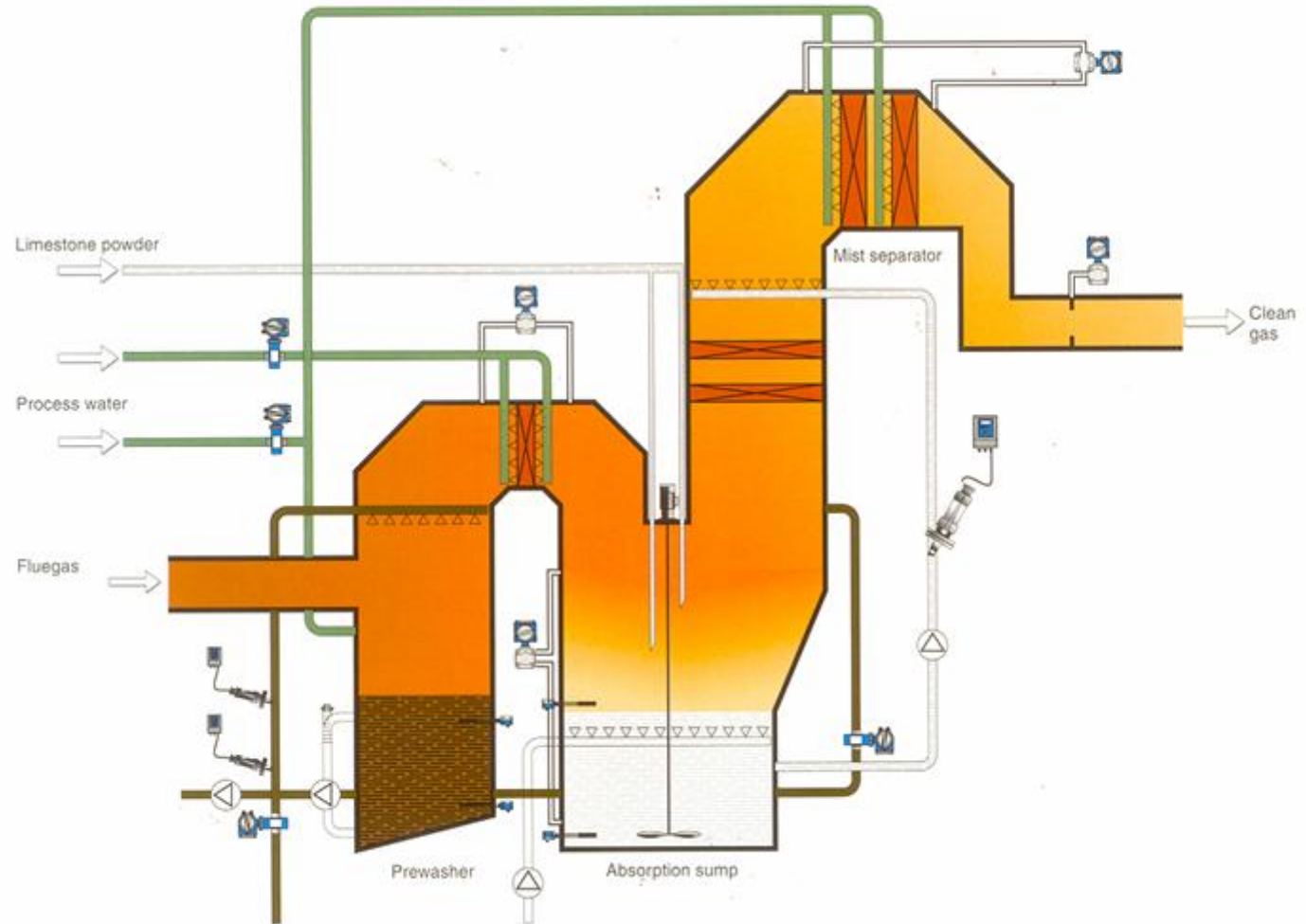
DN 50 ... DN 600



4 Traverses

DN 50

Desulphurization system – typical process



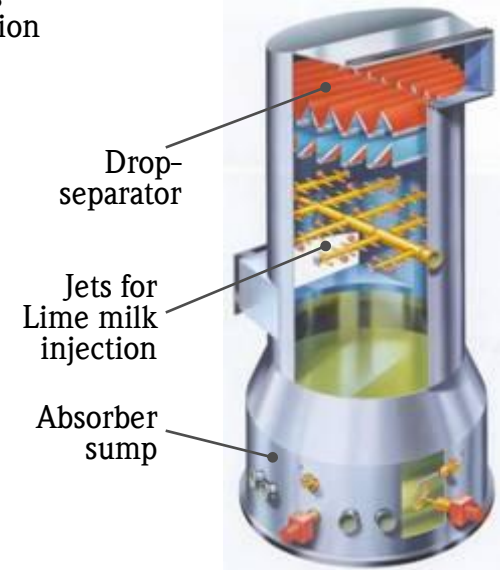
Flue gas desulphurization - typical plant example

Building with
Flue gas desulphurization



Washing tower
of the flue gas
desulphurization
absorber

Gypsum store

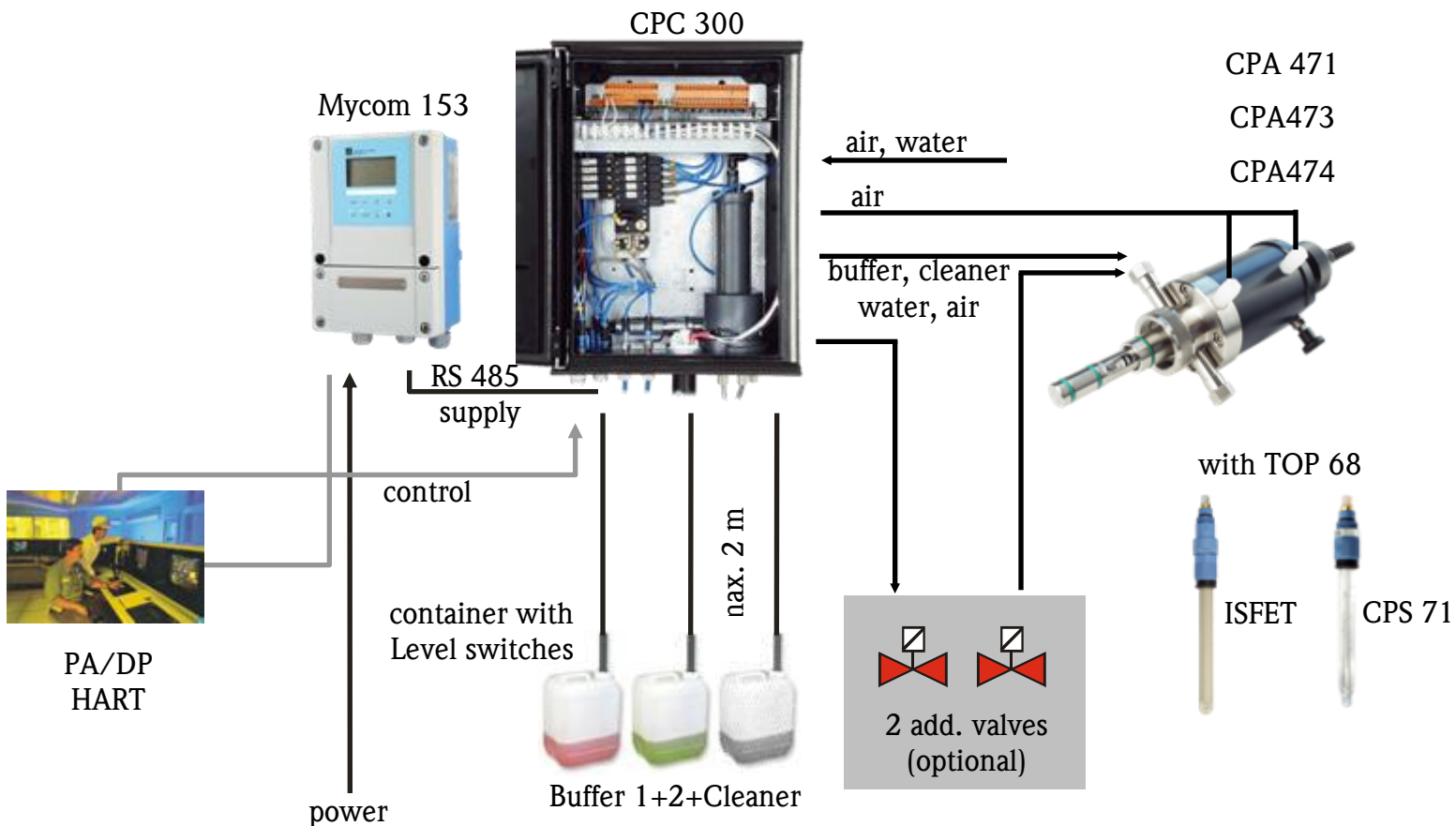


Sectional view of a typical flue gas
desulphurization main washing
system

TopCal S – Automatic cleaning & calibration system

Full automatic cleaning and calibration system for

/ non , FM, CSA 



Automated pH in flue gas desulphurization

Process:

- gas washing

Process condition:

- pH 0,5-0,6; T=75°C
- continuous measuring
- lifetime electrode >4 weeks

Solution:

- TopCal with CPS11
- CPA463



Triple TopCal S in flue gas desulphurization

Vresova Power Plant, Czech Republic



Power plant - gas washing

Process:

-CaSO₄ dispersion

Process condition:

- pH 7-7,5, T=50°C

- Continuous measuring

- Abrasive

- Lifetime electrode < 2 weeks

Solution:

- TopCal with CPS11

- CPA463



Power plant - gas washing

Customer benefit:

- Less maintenance
- Less electrodes

Situation before:

- Calibration and cleaning every day

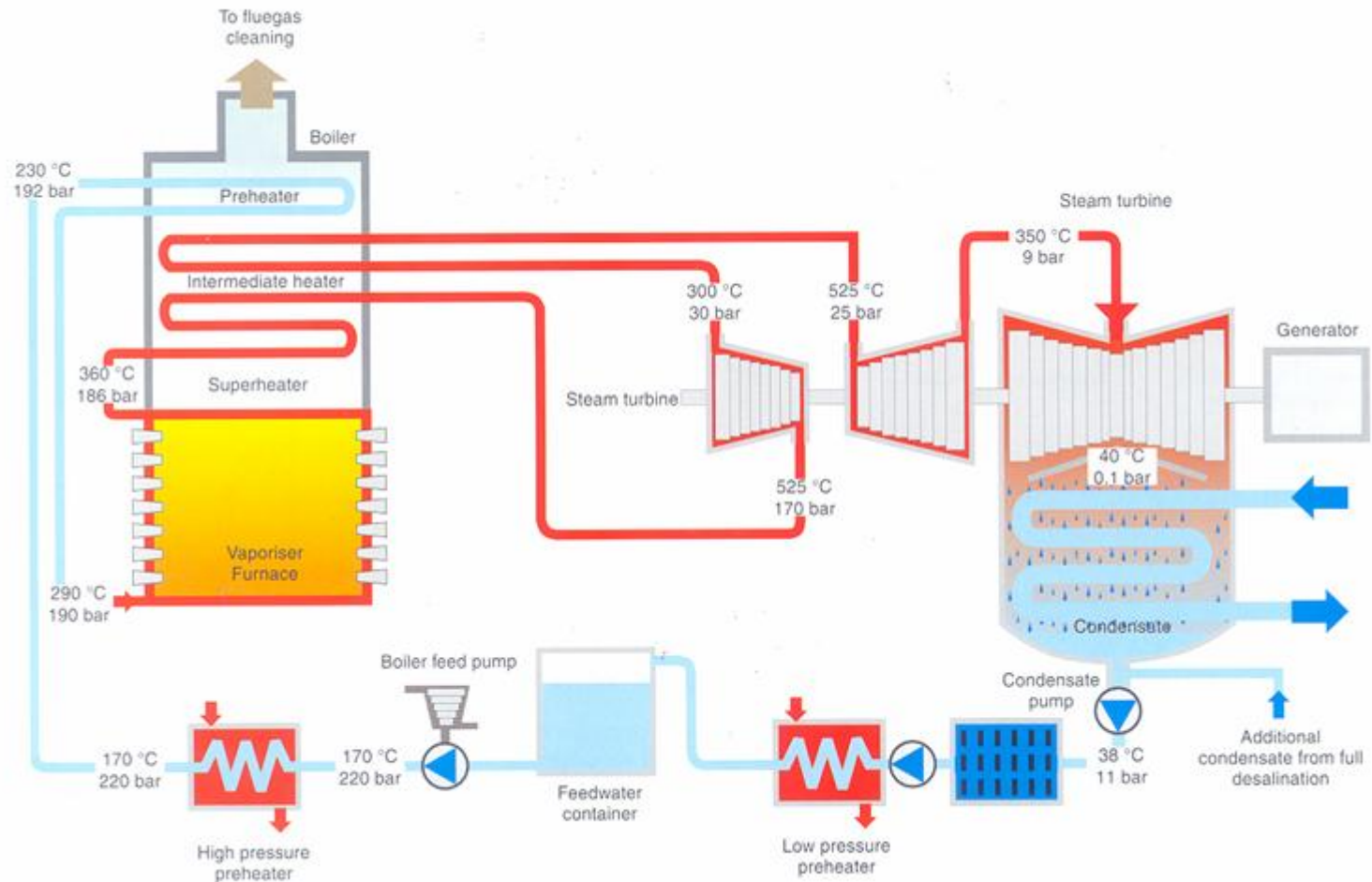
- Every 2 weeks new electrodes, now every 8 weeks

Armortization time:

- 16 months

Cost savings with automatic pH measuring point TopCal					
Cost calculation manual measuring point versus automatic measuring point					
just fill in the:	<input type="text"/>				
in Euro		manual	costs p.a.	TopCal S	costs p.a.
acquisition costs:					
electrode			156		156
cable			128		128
assembly			300		2400
instrument/TopCal			850		7840
installation			250		450
maintenance costs p.a.:					
calibration with cleaning:					
times per week		5		5	
time/min.		15	2275		working cost/hour: 35
puffer vol./ml*		100	390	80	puffer cost/liter: 15
cleaner vol./ml*		100	260	80	208 cleaner cost/liter: 10
only cleaning:					
times per week		5		5	
time/min.		10	1516,6667		
cleaner vol./ml.*		100	260	80	208
electrode/cable costs p.a.:					
electrode pieces p.a.**		26	4056	7	1092
electrode damages p.a.		1	156	0	0
time per electrode change/min.		20	303,33333	10	40,833333
cable damages p.a.		0	0		
time per cable change/min.		0	0		
acquisition costs:			1684		10974
costs per year:			9217		1860,83
break even time:			1,26 years		

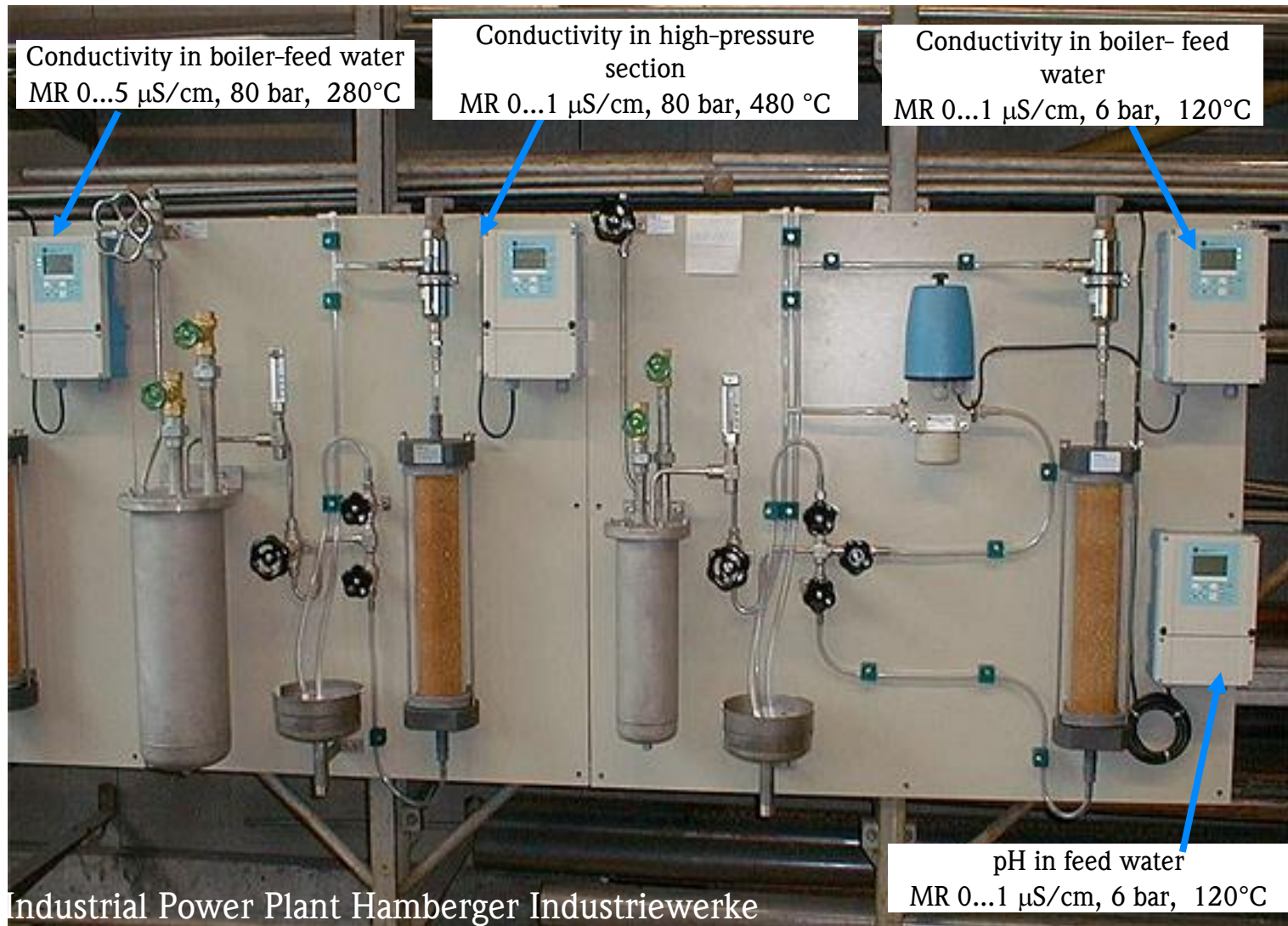
Quality control in the water/steam system



Typical process: Application 5
 Conductivity monitoring

Conductivity/pH monitoring in water steam circulation

with temp/pressure reduction system

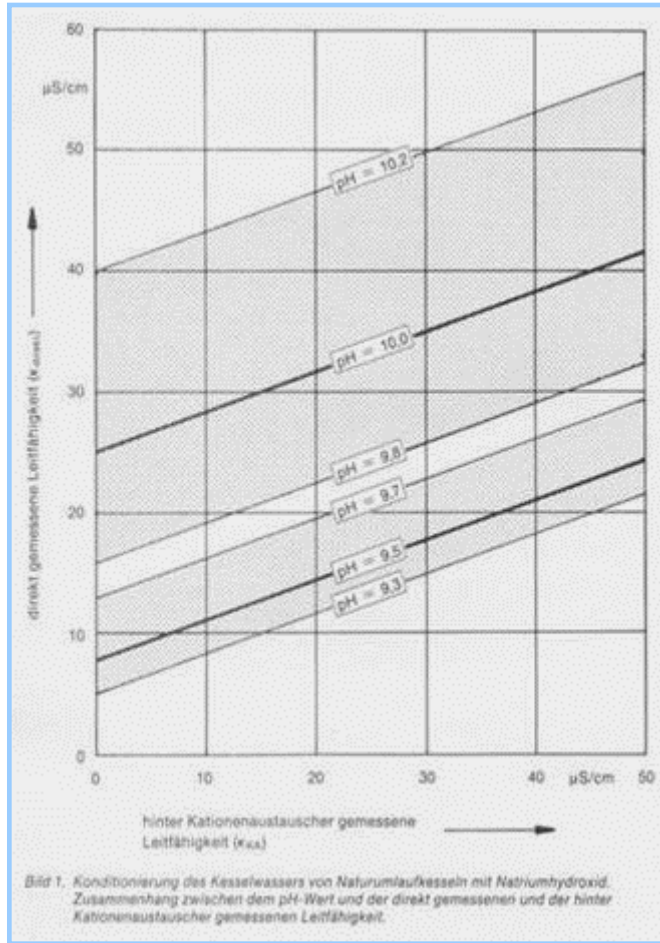


Purpose designed sampling system - Conductivity

Application 5: customer specific needs



pH with differential conductivity in water/steam system

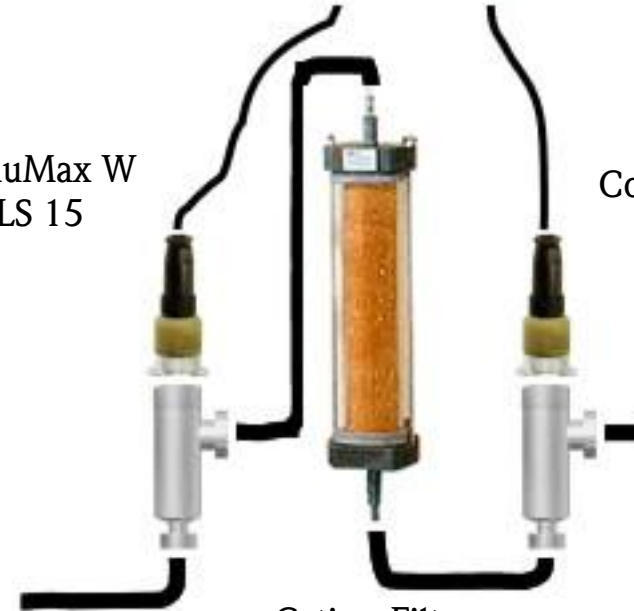


Mycom S
CLM 153



ConduMax W
CLS 15

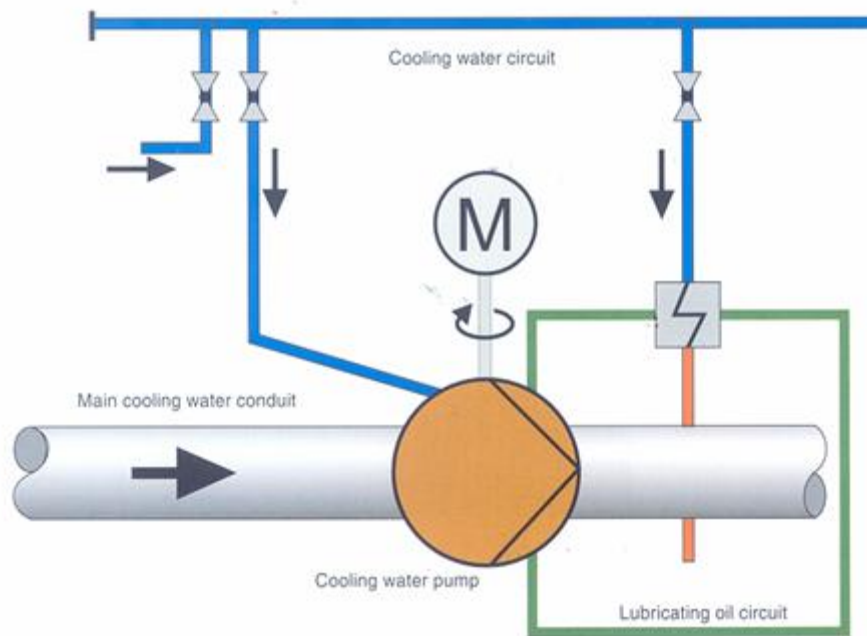
ConduMax W
CLS 15



Cation-Filter

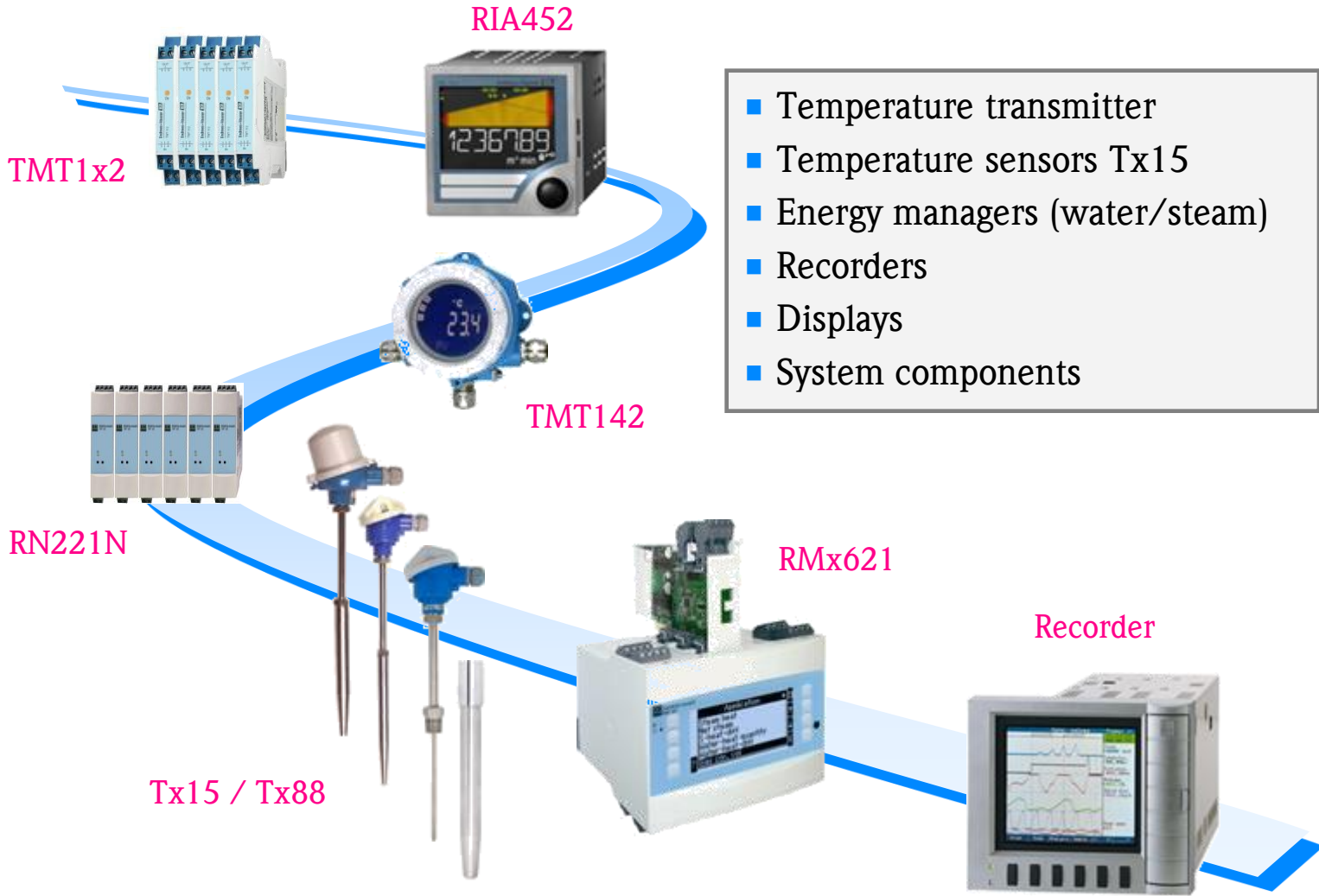
Application 5: special needs

Temperature measurement: cooling systems



Application 6: Omnigrad sensors

Temperature, system components, solutions ...

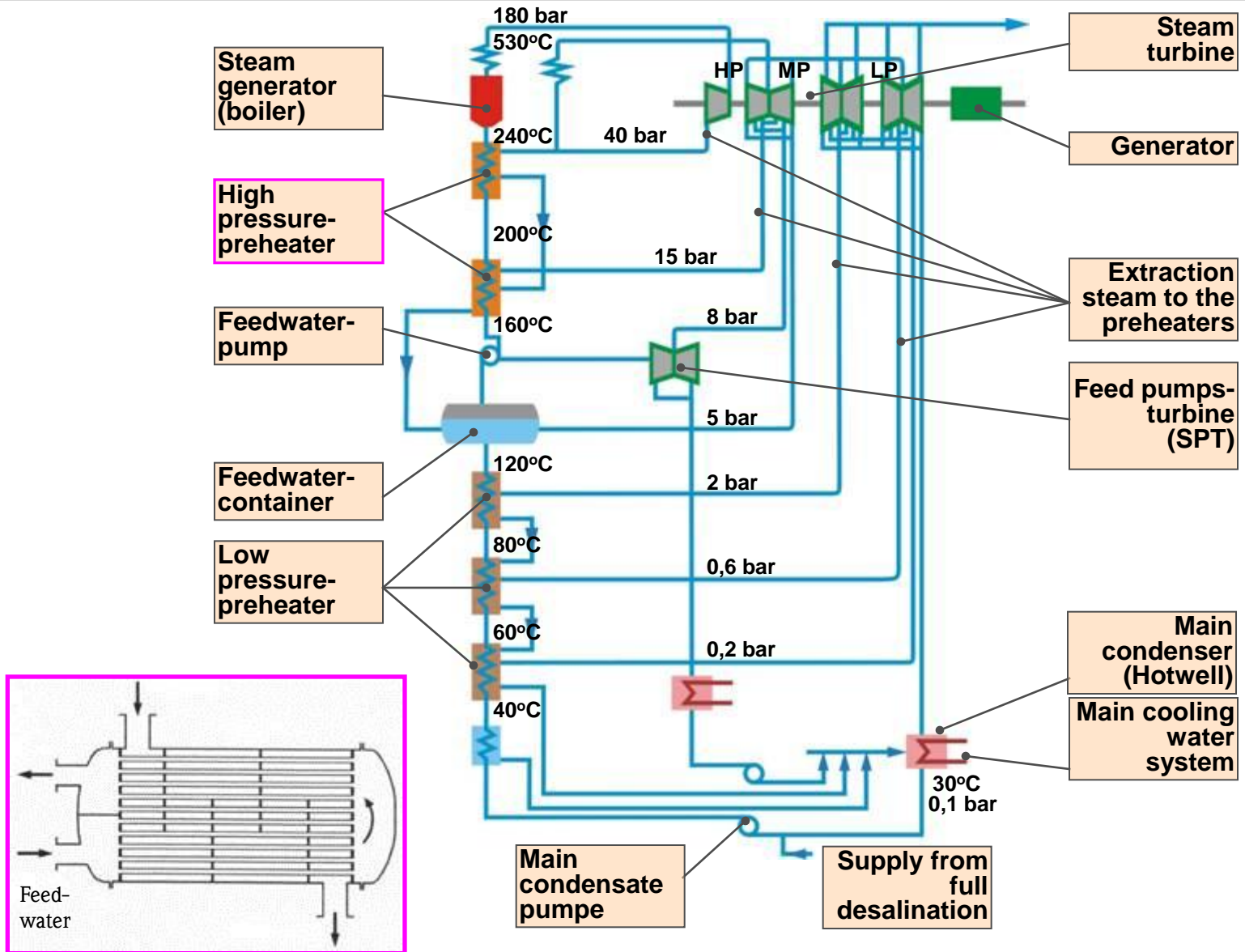


Vizualization/archiving with ECOGRAPH

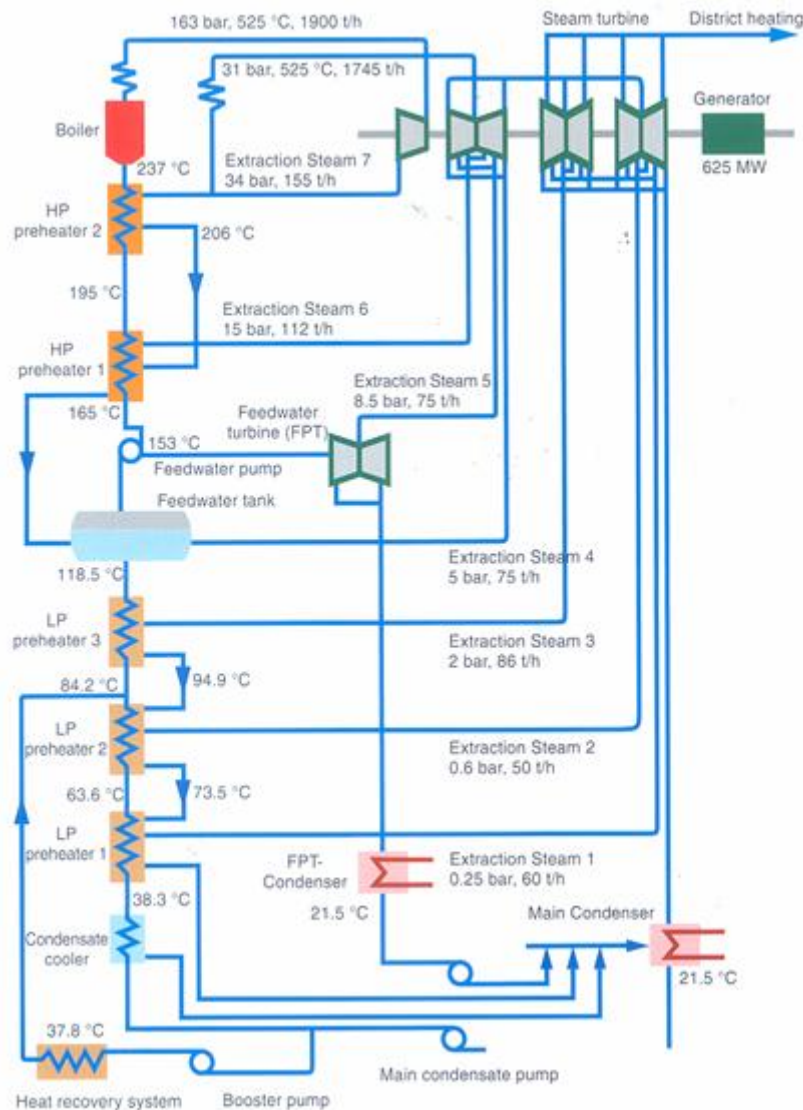
Use of 30 Ecograph paperless recorders in power station Marbach, Baden-Württemberg, Germany.



Water-/ Steam system



Level and flow in the water-/steam system



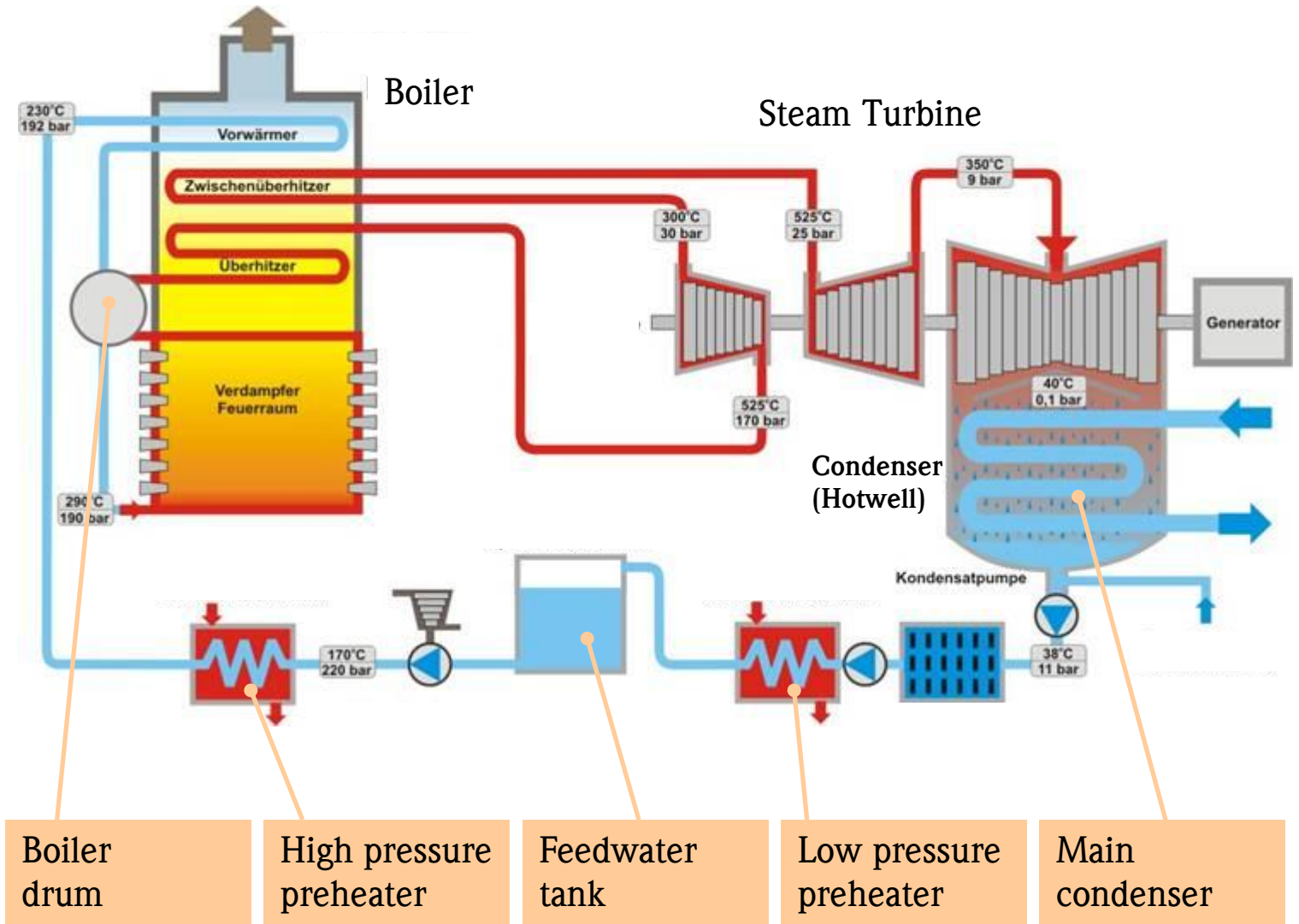
Application 7: dp-level measurement



Differential pressure transmitter Deltabar S is used for level measurement on the low pressure preheaters (top). Together with valve block and orifice plate, Deltabar S constitutes the complete measuring point for the steam flow measurement (below).

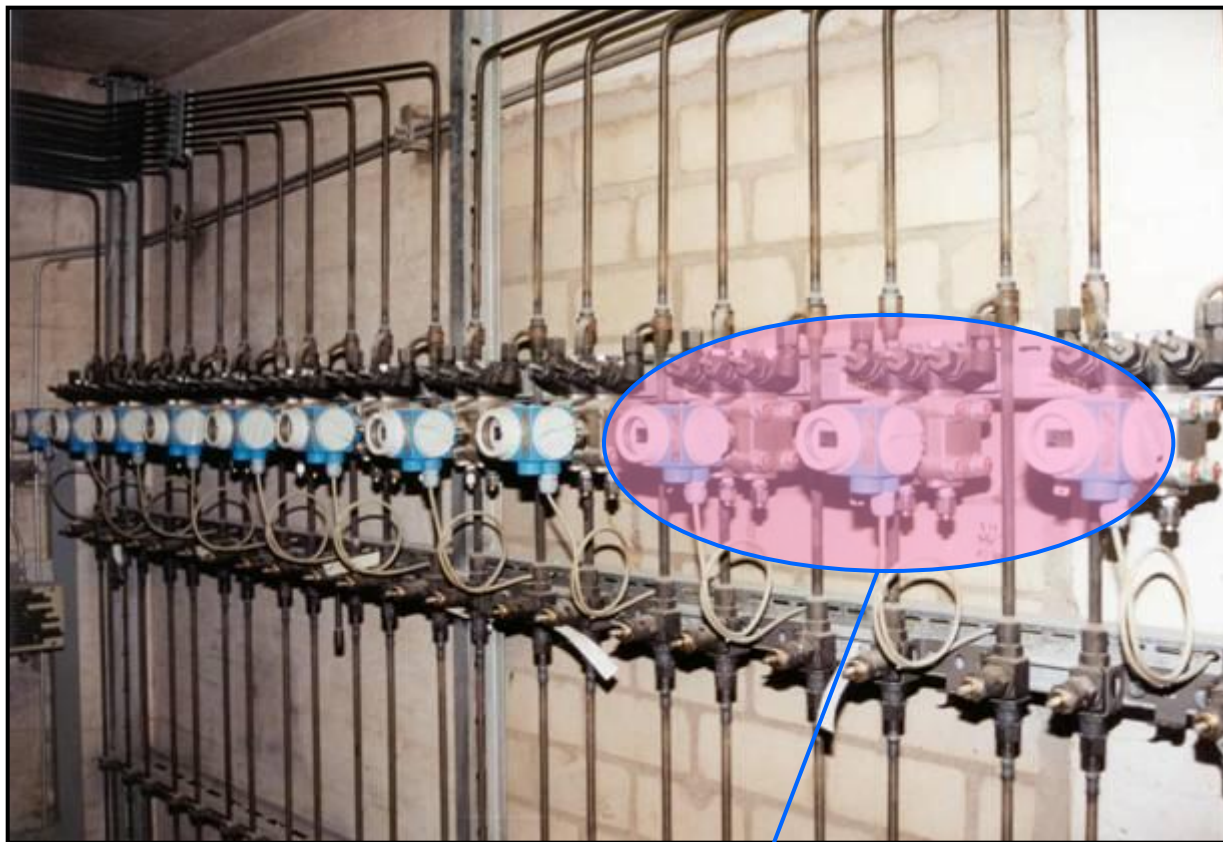


Water-/ Steam system



Traditional dp-level measurement at the boiler

In the water-/ steam system




Installation via impulse pipes (2oo3) ESD loop

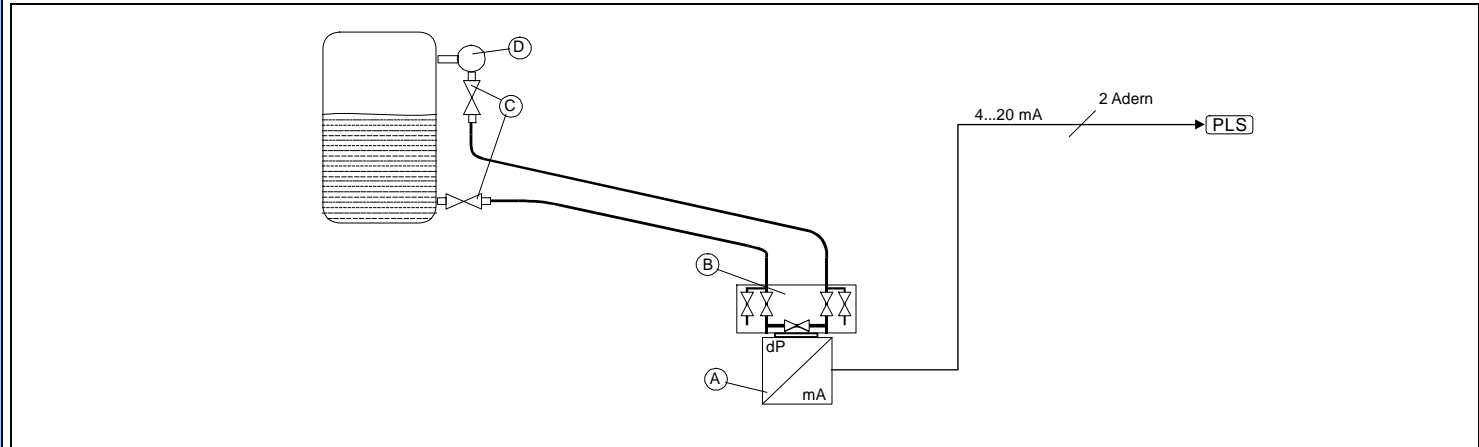
Traditional dp-level measurement at the preheaters



Hook-Up for power stations

©	Type:	Level measurement differential pressure	L_PD220
	Name:	dp e.g. 500 mbar, steam layered, SMART	
	Material:	Liquid/steam	

Endress + Hauser 



KKS - sample	measuring point	plant
10 LAD 20 CL001	level high pressure heater	water/steam-circuit, supply water heater
10 LCC 20 CL001	level low pressure preheater	water/steam-circuit, main condensate heating

Pos.	units	instruments	product name	order no	unit price	total price
					price base	
A	1	Diff.-pressure MU, HART, PN420, FI. DIN19213, display	Deltabar S			
B	1	5-x valve block, PN400/DN5, FI. DIN19213, Ermeto 12S, steel C22.8	valve block			
C	1	2 units. Shutoff valve, PN320, SA 21.3x6.3/14x2.5, steel	shutoff valve			
D	1	compensation vessels	condensate vessel			
					total price	

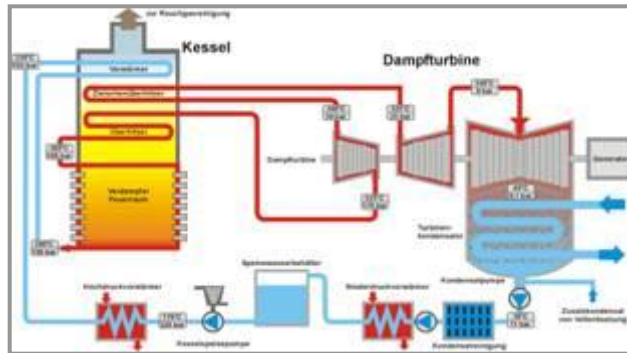
customer: engineering/operator sample	order: sample order
project: sample power plant	date: sample date

Optimization of the plant utilizing innovations

Levelflex is the newcomer in power plants

- No longer need to shut down due to vacuum at the hotwell
- Traditional dp-level has been replaced due to the performance of Levelflex

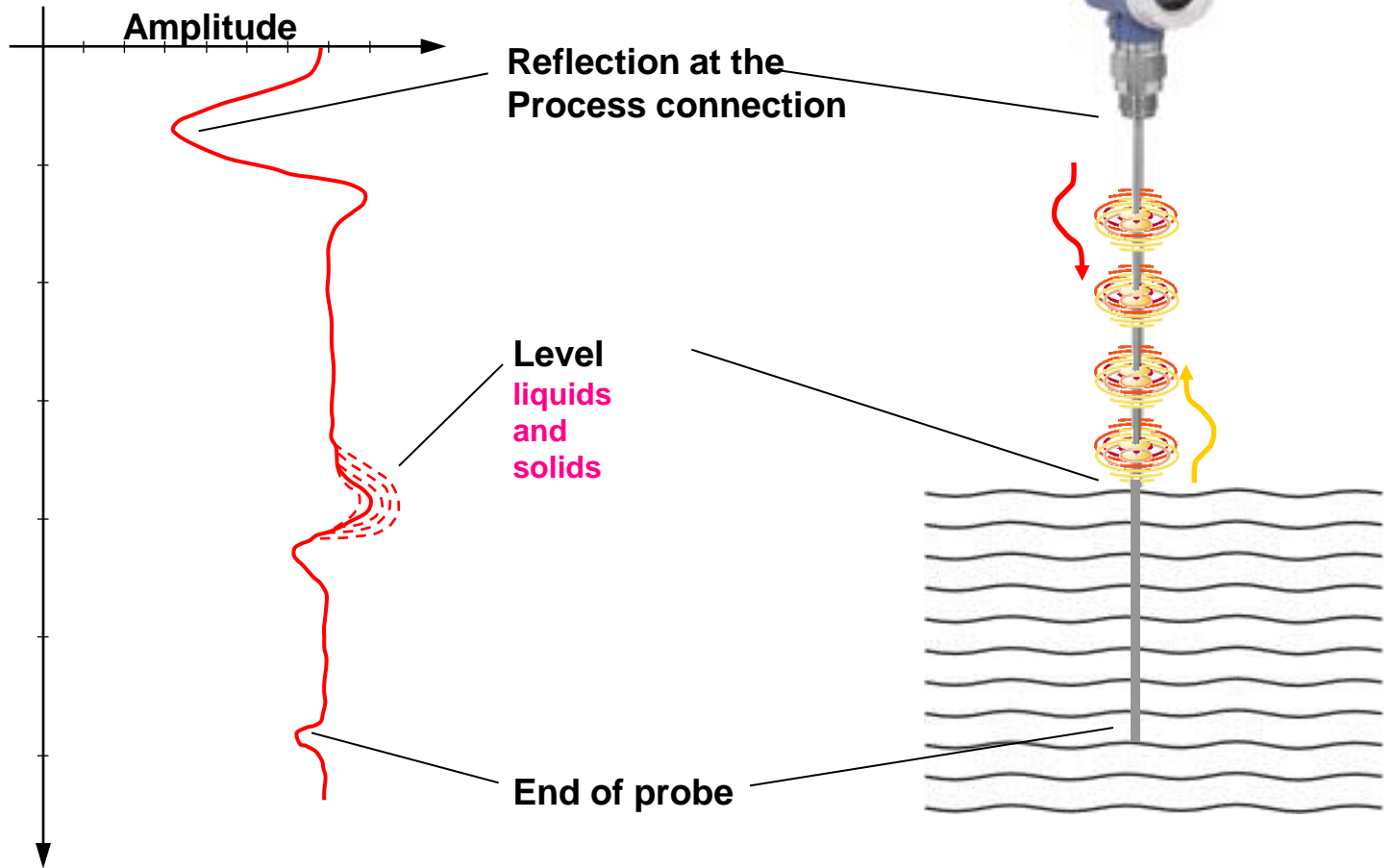
**Level at hotwell
Improves
maintenance**



Level measurement with radar technology

Measuring principle - basics

Typical signal curve:



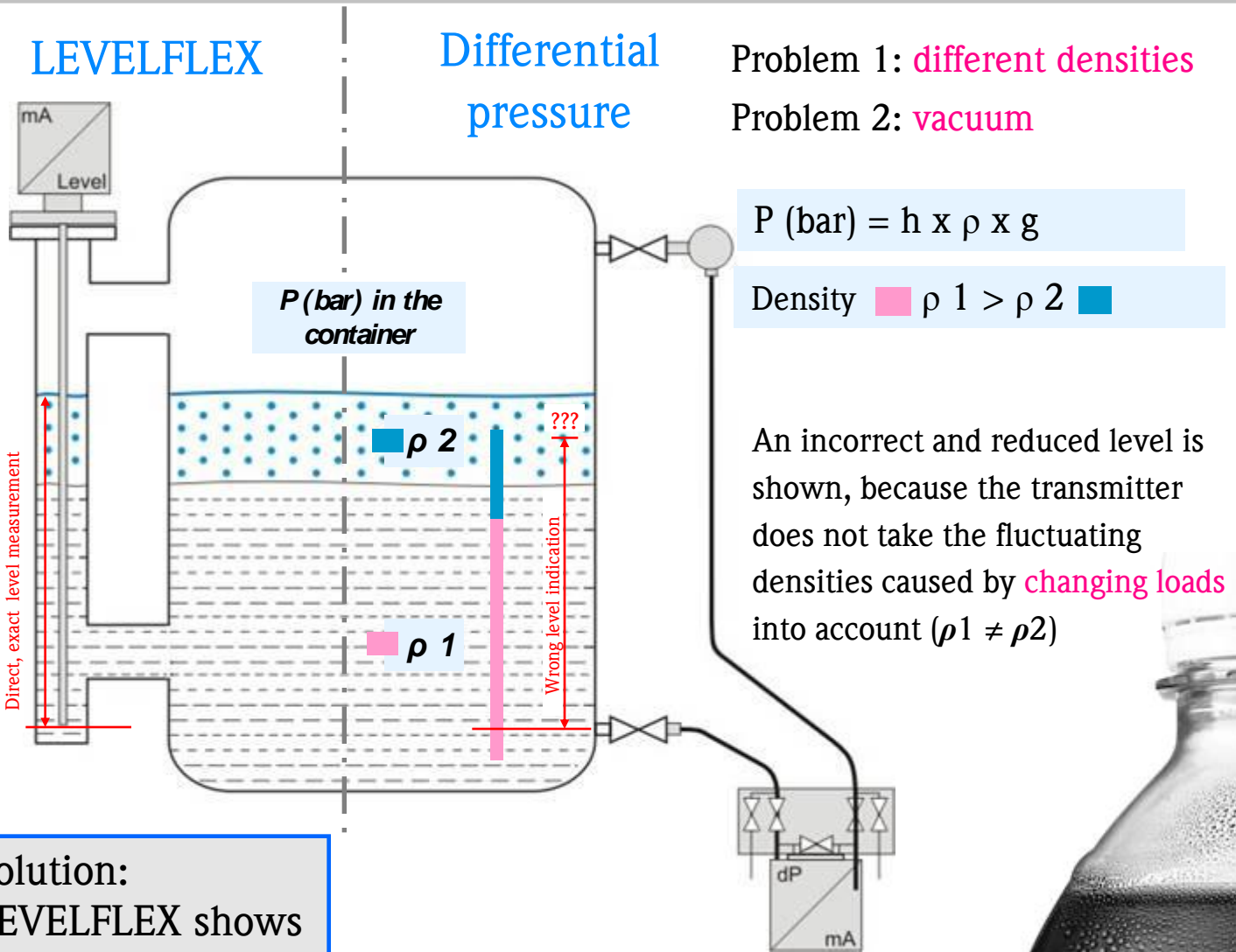
Level measurement with radar technology

LEVELFLEX works independently

- of **density** fluctuations
- of fluctuating **dielectric numbers**
- of **gas covering**
- of **pressure** and **temperature** fluctuations
- of **vacuum**



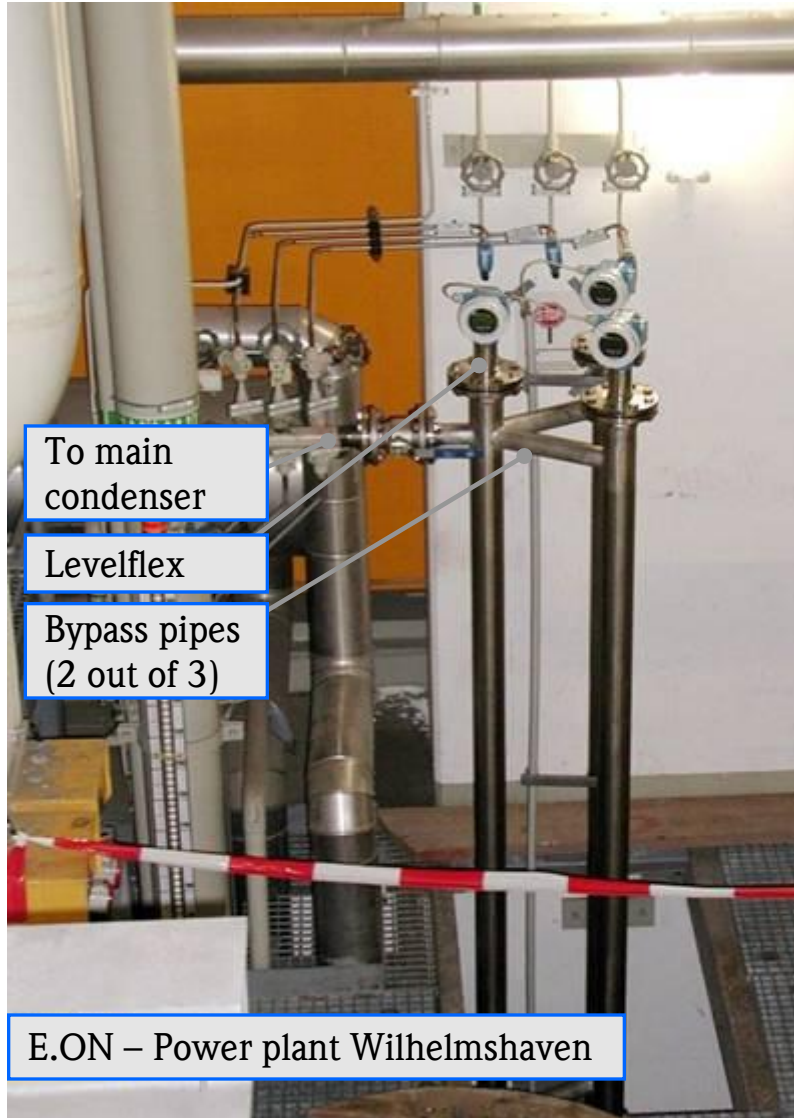
First example: Levelflex vs. traditional dp-level



Solution:
LEVELFLEX shows the correct level



Levelflex - THE newcomer in power plants



Application

- **Level measurement** of the condensed steam in front of the turbine in the **main condenser** (Hotwell)
- Process: 0.1 bar, max. 40 °C
Measuring range: ca. 2.5 m

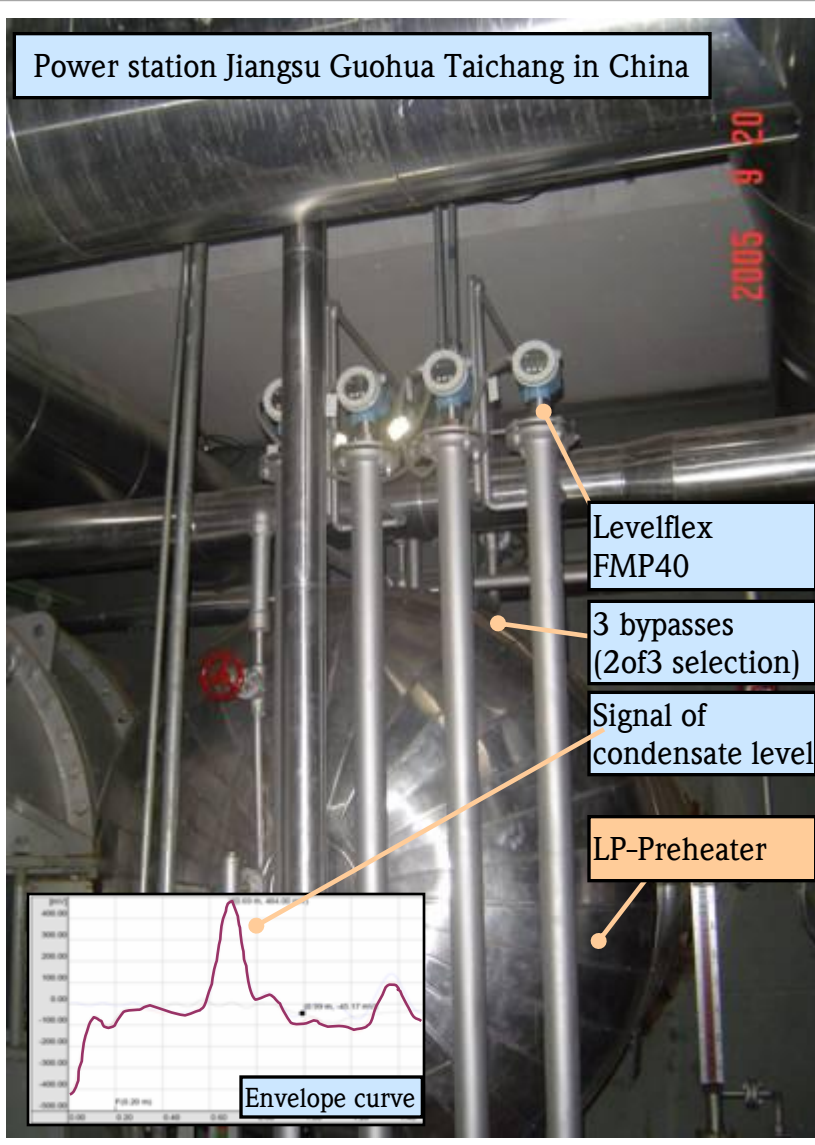
Benefits

- Measurement with Levelflex is **not influenced by vacuum** => better solution than differential pressure
- More **reliable** measurement
- Increased **safety**
- **Easier** installation



Level measurement with radar technology

Applications in the power plant => example of low pressure preheater



Measuring technology

- Level-transmitter (radar instrument)
LEVELFLEX FMP40

Process

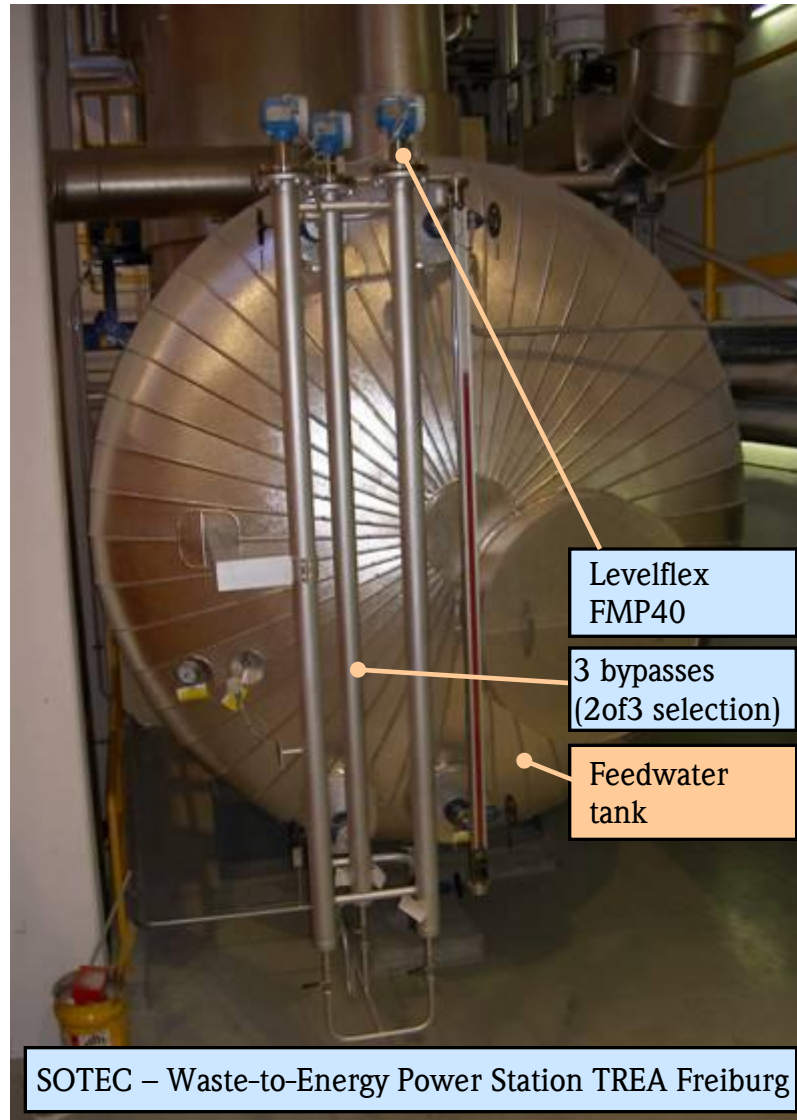
- Control the level of the condensed extraction steam to protect the steam turbine from damage.
- Medium: Condensate (demi-water)
- Operation: 7 bar, 180 °C
- Measuring range : 2100 mm

Features

- **LEVELFLEX** is installed in a redundant installation with three bypasses (2 of 3 selection) to implement the safety concept of the power station
- The measurement is not influenced by fluctuations in the process or fluctuations in density (pressure, temp.)

Level measurement with radar technology

Application in power plant => example of feedwater tank



Measuring technology

- Level transmitter **LEVELFLEX FMP40**

Process

- Level measurement of feedwater in the feedwater tank of water/steam circuit

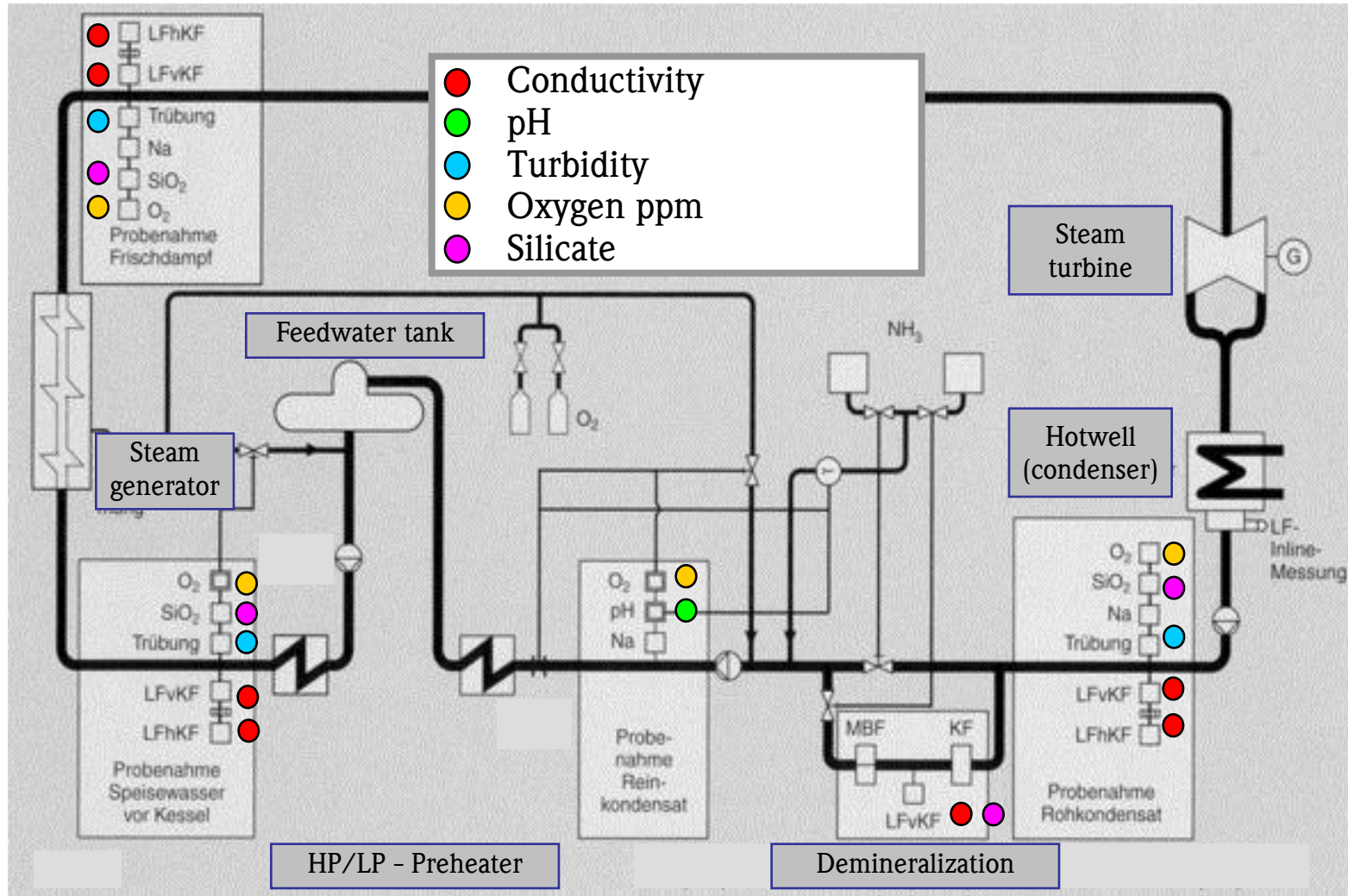
Medium: Feedwater

- Operation: app. 10 bar, app. 170 °C
Measuring range: app. 1600 mm

Features

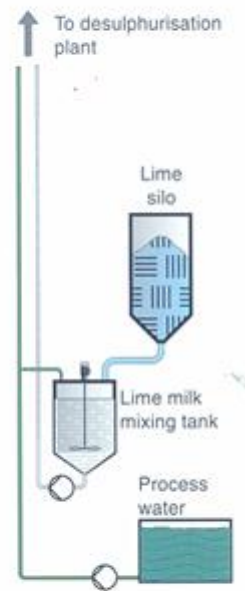
- **LEVELFLEX** has no moving parts, therefore no wear and tear
- **LEVELFLEX** has no mechanical moving parts, therefore no wear
- **LEVELFLEX** is suited for pressure up to 400 bar or 400 °C

P&I scheme - steam/water system – summary



Level measurements: lime stored in the silo

Lime is a primary element and when mixed with water it is used to reduce the SO_2 in the fluegas desulphurisation plant. The lime is stored in silos, where the level is measured continuously in order to ensure trouble-free operation. Limit switches are installed to protect against overfilling.



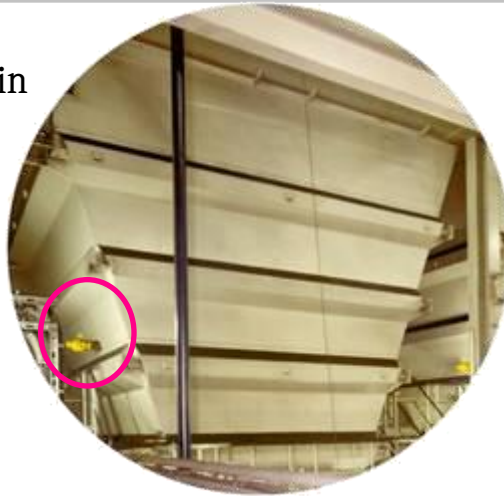
Solphant measures max. limits in the lime silo, Levelflex monitors the level



Application 8: level sensors Levelflex

Coal supply bunker

Coal bin



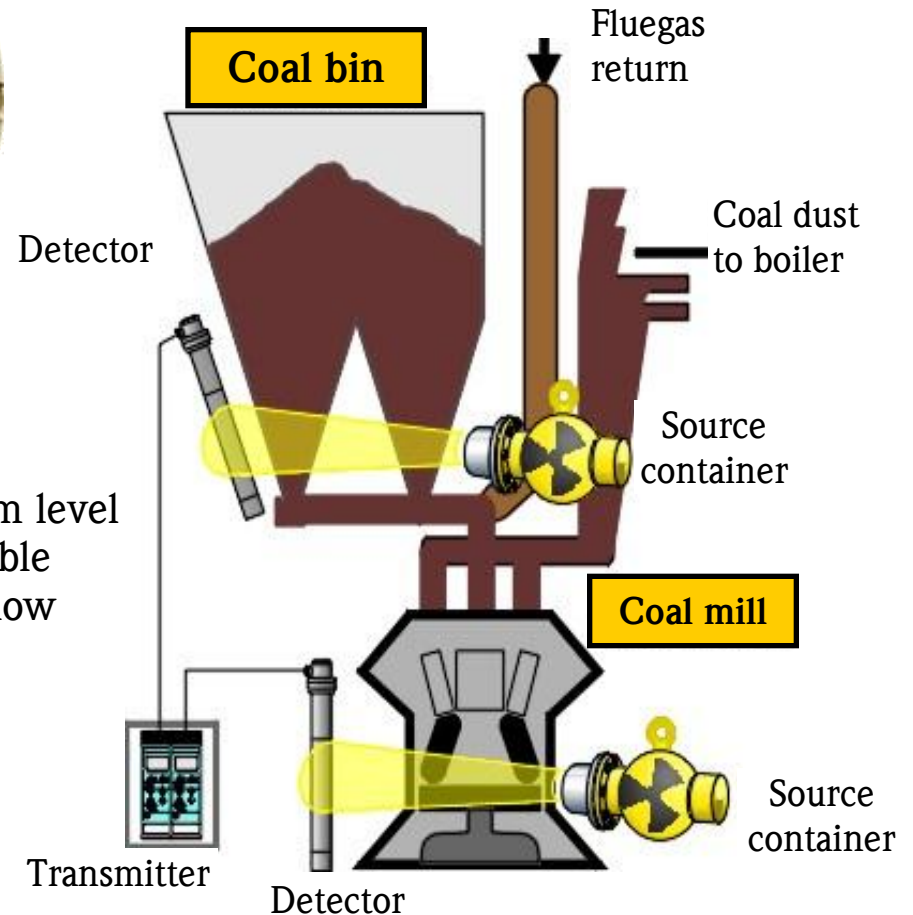
Application 9: Radiometric limit detection

Application

Limit detection - detects minimum level in the coal bin to ensure the reliable supply of coal for the coal mill below

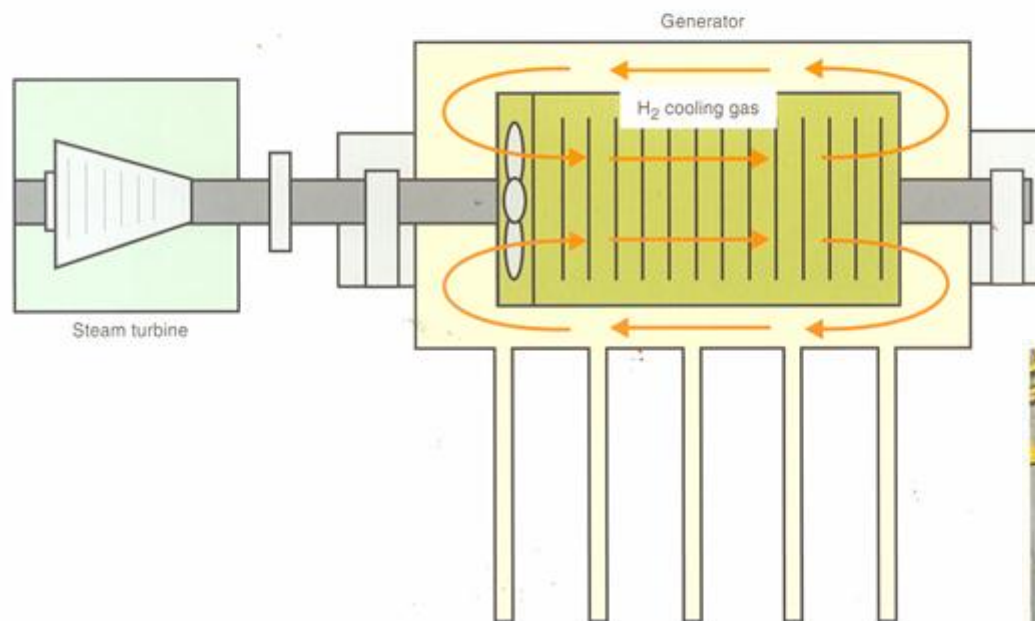
Advantages

- Build-up and bridging do not influence the measurement
- Reliable function even in extreme process conditions



Monitoring the steam generator

Because of the heat build-up, generators in the power plant must be cooled, usually with hydrogen (H_2) cooling gas. Discharge lines are located at the generator housing. If lubricants reach the housing due to leakage in the thrust bearings, the rise in liquid is detected by a limit switch at the end of the discharge lines. The fault is then recognised and can be eliminated.



Application 10: Vibration sensing of liquids

DeNOx system enhancements

Nitrogen oxides are reduced by absorption using ammonia. This is injected into a catalyser reactor. Careful monitoring is required for safety reasons to prevent overspill or excess emissions.

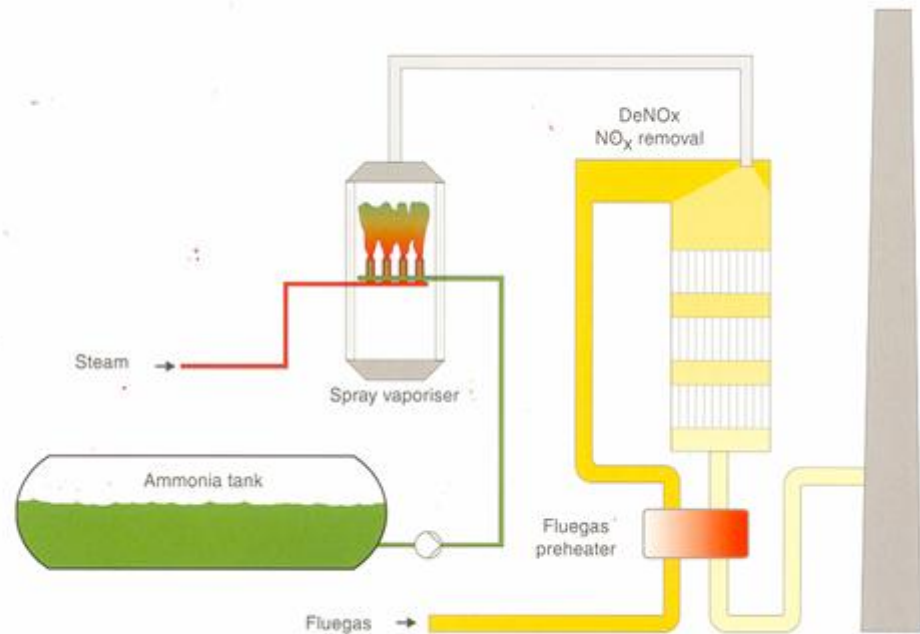
15

Microwave radar level measurement Micropilot M

Low frequency microwaves along with a stilling well have proved to deliver very reliable measurement results in ammonia tanks as they are only slightly affected by the high absorption in ammonia vapour.

Micropilot M is a compact radar instrument for continuous, non-contact level measurement.

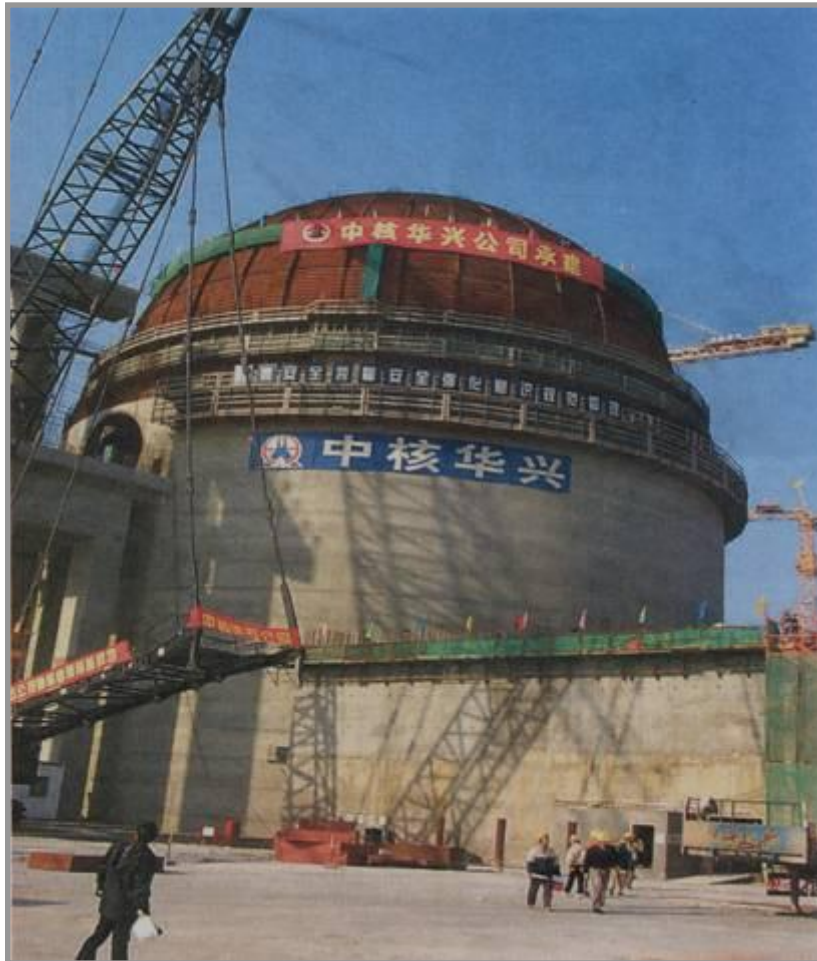
- Measurement is independent of the characteristics of the medium (density, D_k value)
- Measuring frequency 6 GHz
- Maintenance-free – no moving parts
- Can be used to replace mechanical displacers



Application 11: Safety monitoring of hazardous chemicals

Reference example - nuclear power station

Nuclear power station TIANWAN (China)



Operator:

Jiangsu Nuclear
Power Co. Ltd

Control system:

Framatome (Germany)
Siemens Power Generation
(Germany)



Project details:

- Pressurized water reactors
- 2 x 1000 Megawatt capacity
- Total investment: US \$3.2 billion
- Commissioning in 2004

**Complete instrumentation
by Endress+Hauser**

Power industry instrumentation summary - 1



 Recommended device
 Optional device

	Relative, Absolute Differential pressure	Capacitance Vibration (Liquids) Vibration (Solids)	Radiometric Guided microimpulse Ultrasonic	Electromechanical system Radar	Electromagnetic Vortex	Ultrasonic Coriolis mass flowmeter DP Flow	Conductivity pH value Turbidity Oxygen	Temperature	Data acquisition
Fuel supply									
Coal handling									
Coal mill									
Oil supply									
Natural gas supply									
Residue disposal									
Ash and slag removal									
Flyash									
Gypsum treatment									
Water supply and water treatment									
Raw water supply									
Chemicals supply system									
Desalination									
Drain water									
Heat generation									
Pressure system (water, steam)									
Ash and slag removal									
Main firing system									
Combustion air system									
Electrostatic precipitator									
Desulphurisation plant									
Denitrification (DeNOx)									

Power industry instrumentation summary - 2



	Relative, Absolute Differential pressure	Capacitance	Vibration (Liquids)	Vibration (Solids)	Radiometric	Guided microimpulse	Ultrasonic	Electromechanical system	Radar	Electromagnetic	Vortex	Ultrasonic	Coriolis mass flowmeter	DP Flow	Conductivity	pH value	Turbidity	Oxygen	Temperature	Data acquisition
Steam/Water/Gas circuits																				
Feedwater system	■	■							■			■		■	■	■	■	■	■	■
Steam system	■	■										■		■	■	■	■	■	■	■
Condensate system	■	■							■			■		■	■	■	■	■	■	■
Main machine systems																				
Steam turbine	■	■												■						■
Gas turbine	■	■										■		■						■
Generator																				■
Lubricant supply system	■	■	■	■						■	■	■	■	■						■
External energy supply																				
District heating	■	■									■	■	■		■	■				■
Cooling water system																				
Main water circuit	■	■		■			■			■		■				■	■			
Auxiliary systems																				
Chemicals supply	■	■	■	■			■	■	■	■	■	■								■
Compressed air supply	■	■										■		■						
Auxiliary steam generating system	■	■										■		■	■	■	■	■	■	■

Endress+Hauser in power stations - summary

- Our product basket provides solutions for **90% of all application in the power industry**
- Offers **best solution** corresponding to “Best Practice” in power business
- Offering innovations to **reduce cost of ownership** and improve **overall performance** projects in power
- Your partner for projects and maintenance

**For more information, we invite you to
visit our Web site
www.power.endress.com**