Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Power Plants-

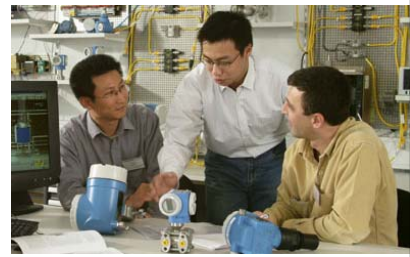
Instrumentation Applications

Endress+Hauser
People for Process Automation

Endress+Hauser

Company Profile :

- International solution supplier with a wide range of process measurement instrumentation for production and logistics in the process industries
- Consultancy and service for our customers in 85 countries
- One of the largest privately owned companies in the automation industry
- Headquarter in Reinach (Switzerland)
- CEO: Klaus Endress



Endress+Hauser

Our Offering: Leading Edge Field Instrumentation

- Level
- Pressure
- Flow
- Temperature
- Liquid Analysis
- Registration
- Systems Components
- Services
- Solutions














Endress+Hauser

Segmentation of different processes (general information)

Power stations

Fossil fired power plant

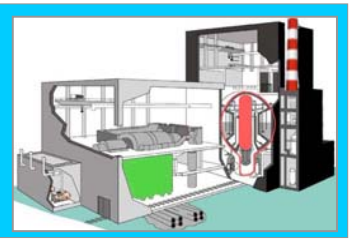
- Coal fired power plant
- Oil fired power plant

Gas turbine-power plant

- Combined cycle gas turbine (CCGT)
- Cogeneration power plant

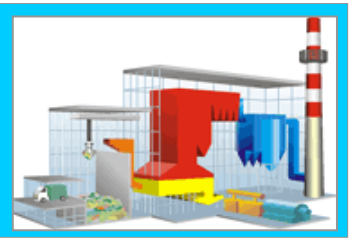
Nuclear power plant

- Boiling water reactor
- Pressurised water reactor



Waste to energy power plant

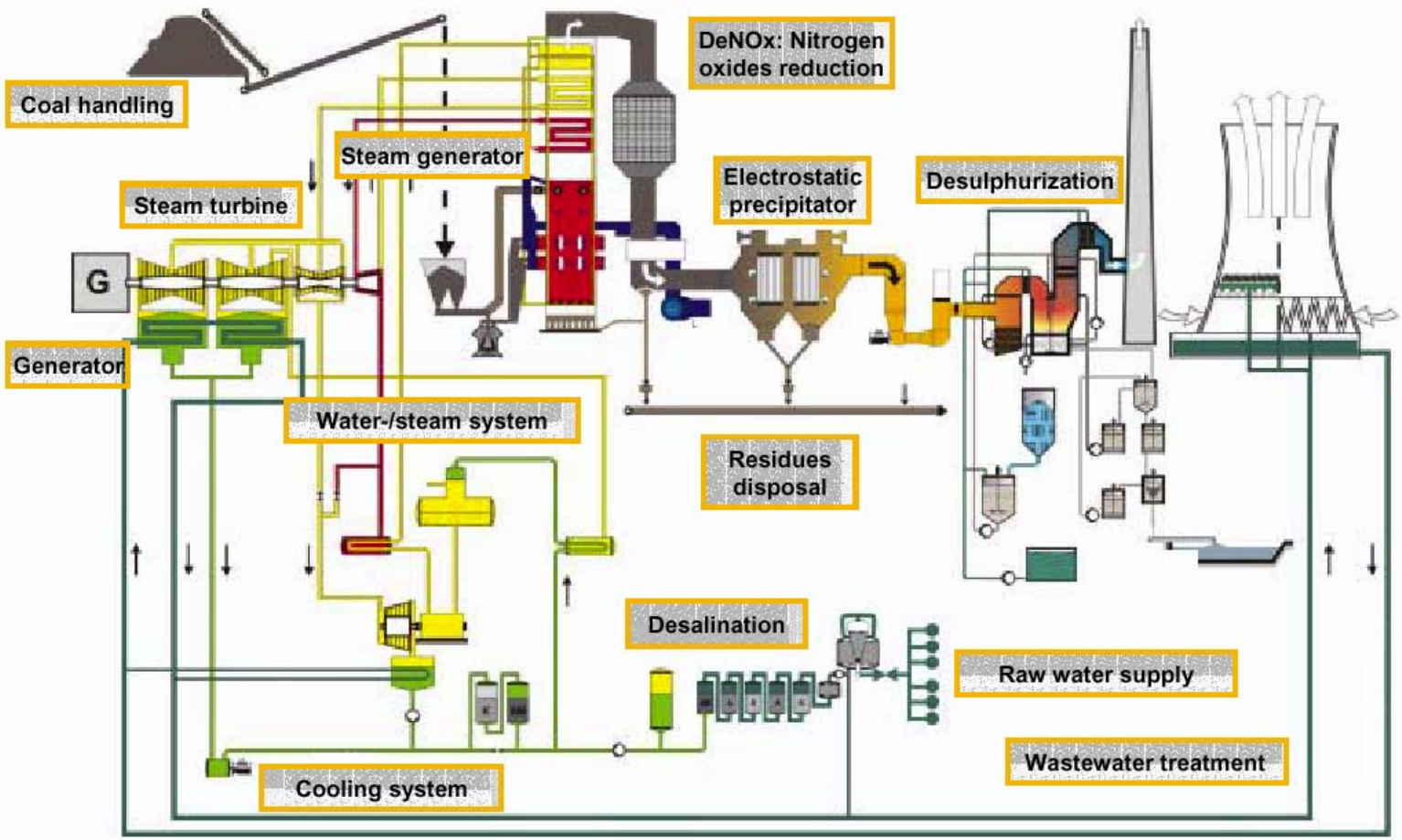
- Incinerator plant
- Biomass power plant



Endress+Hauser

Coal Fired Power Plant

Process



Endress+Hauser

Temperature Applications

- Air/Ignition System : Air pre-heater and Ignitors,
- Environmental System : Preipitator Inlet and outlet temperatures
- Steam generation/System : water flowing from hotwell condensor, feedwater heaters and lines in/out of steam drum, steam drum to superheater, main steam line to turbine, and cold and hot reheat steam lines.
- Steam Quality :
  - Feedwater Heaters
  - Turbines
  - Stuffing Box

Endress+Hauser

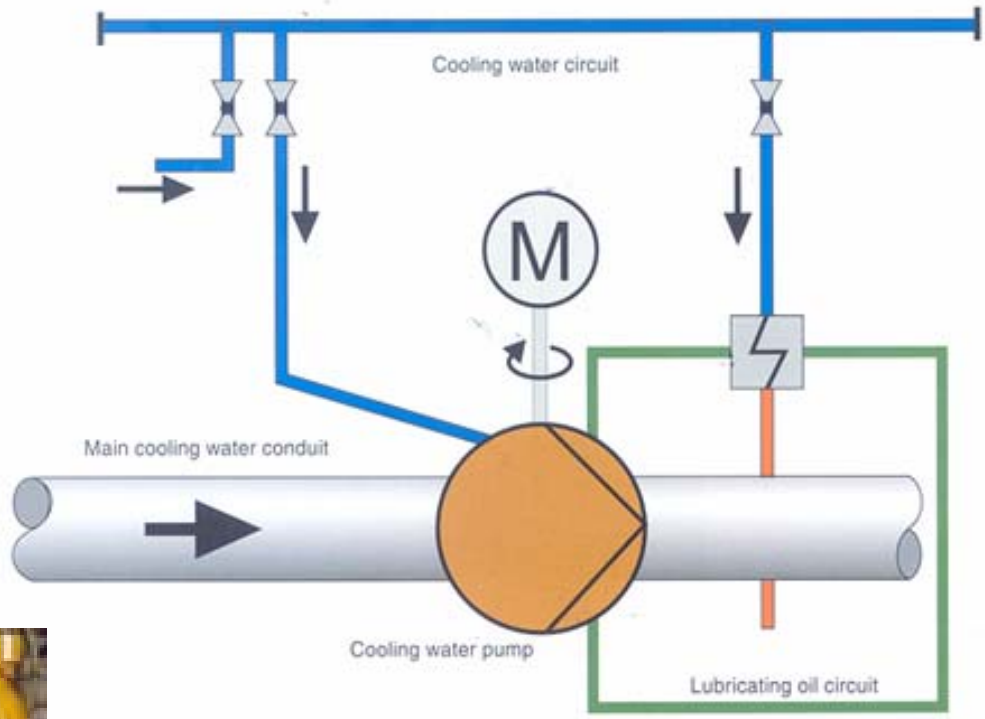
Temperature – Conventional power plants

- Thermocouples and transmitters in use throughout the plant
- Electric fuel gas preheaters
- Electric fuel oil heaters and forwarding systems
- Lube oil heaters and systems
- Turbine water wash systems
- Turbine inlet and exhaust flow heating systems
- Water storage tank heating systems
- Steam superheaters

Endress+Hauser

Temperature measurement: cooling systems

Resistance Thermometer TR1x



Monitoring of the lube oil circuit at the cooling water pump to avoid damages to the pumps

Endress+Hauser

Temperature measurement: oil lines

Temperature monitoring in the oil lines to the main combustion

Thermocouple TC15 + weld in thermowell (bar stock) for high temperature and high pressure applications

Flue Gas temperatures

Temperature Measurement up to 1600 °C

TAF16

in different steel grades (INCONEL, SS446,…)

TAF12

with ceramic thermowell for high temperature applications

EEx-d loop powered field display RIA141

Endress+Hauser

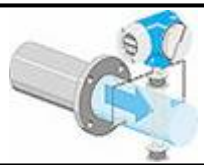
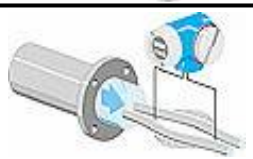
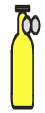
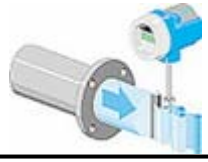
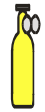
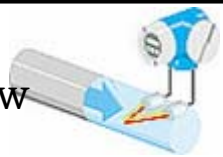
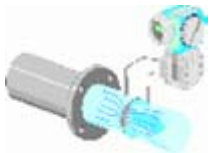
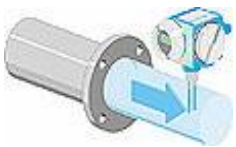
People for Process Automation

Custom Temperature sensors

Heavy duty multipoint

18 inserts, 900 °F, 3000 psi Application

Flow Measuring Principles Segmentation

	Conductive liquids	Non conductive liquids	Gas	Steam
PROline Promag 				
PROline Promass 				
Prowirl 				
PROline Prosonic Flow 				
Deltatop Deltaset 				
T-mass 				

Raw Water Flow Metering

Measurement technology

- Electromagnetic flowmeter
  Promag
  (DN80, hard rubber)

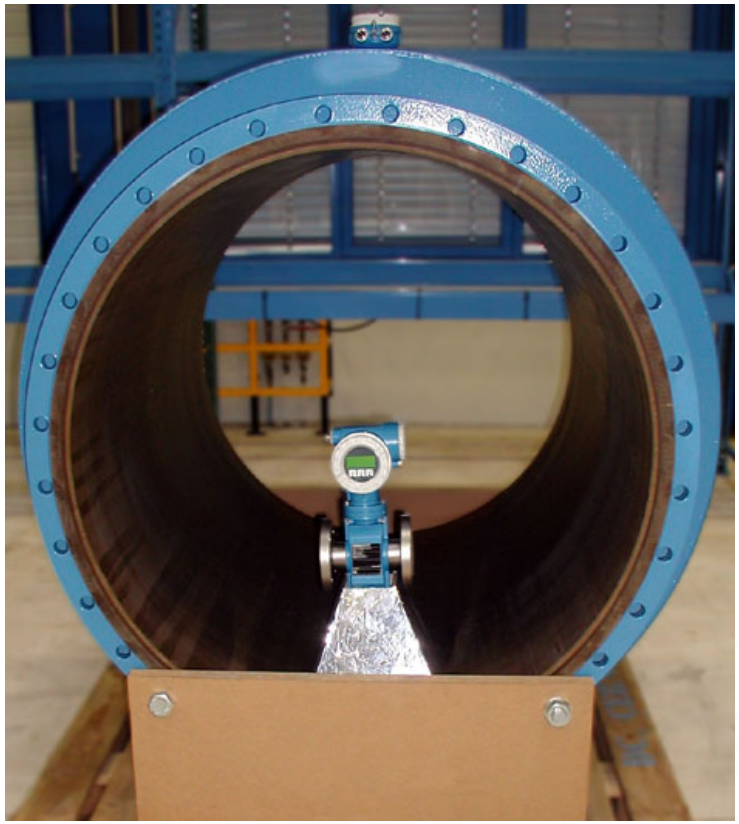
Process

- Measurement of the raw water volume, which is supplied to the water desalination system
- Material: raw water
  Operation: max. 4 bar, max. 25 °C
  Meas. range: to 160 m /h^3

Characteristics

- Promag is well suited for standard applications in the water and wastewater sector
- Simple and straightforward commissioning with Quick Setup
  saves time
- The flange instrument Promag requires no additonal instrumentation

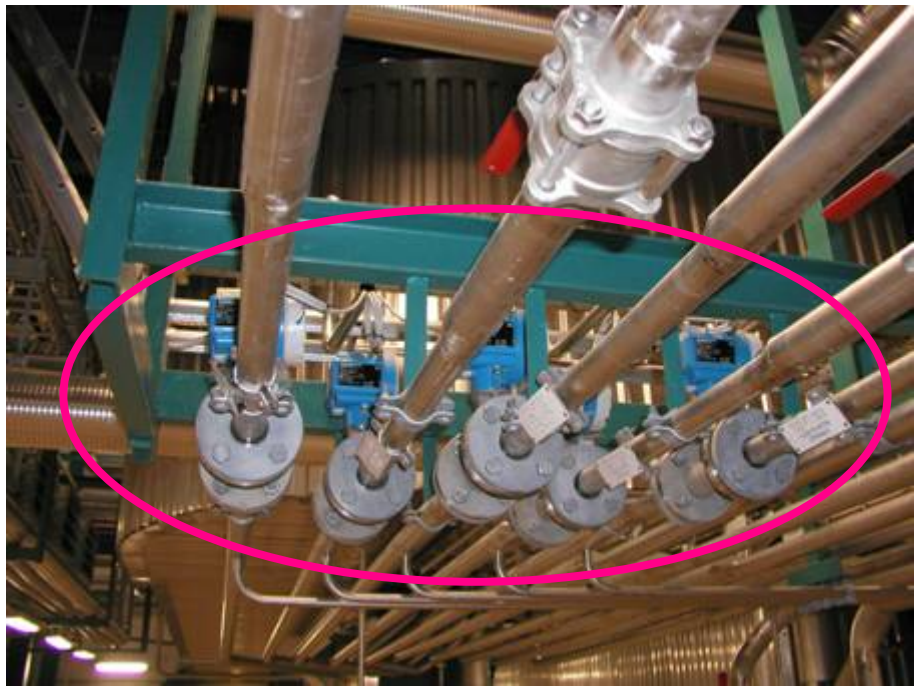
Electromagnetic flow meter



- No pressure loss
- Unobstructed sensor tube (piggable)
- Wide diameter range (+ wid measuring range)
- High measuring accuracy
- Largely independent of flow profile

Endress+Hauser

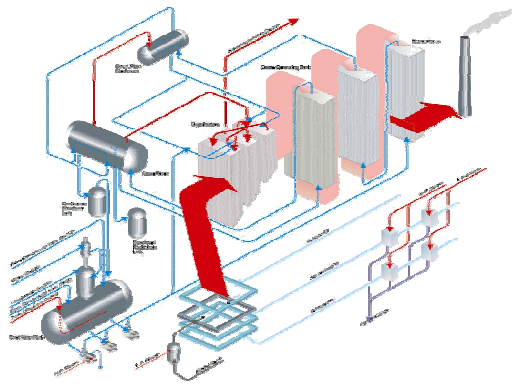
Flow: Cooling Water



Vortex Flow meter

Type:	**Prowirl 72F DN40/1.5”**
Media:	**Cooling Water**
Temp:	**+55-100C/130F-212F**
Pressure:	**150 PSI**

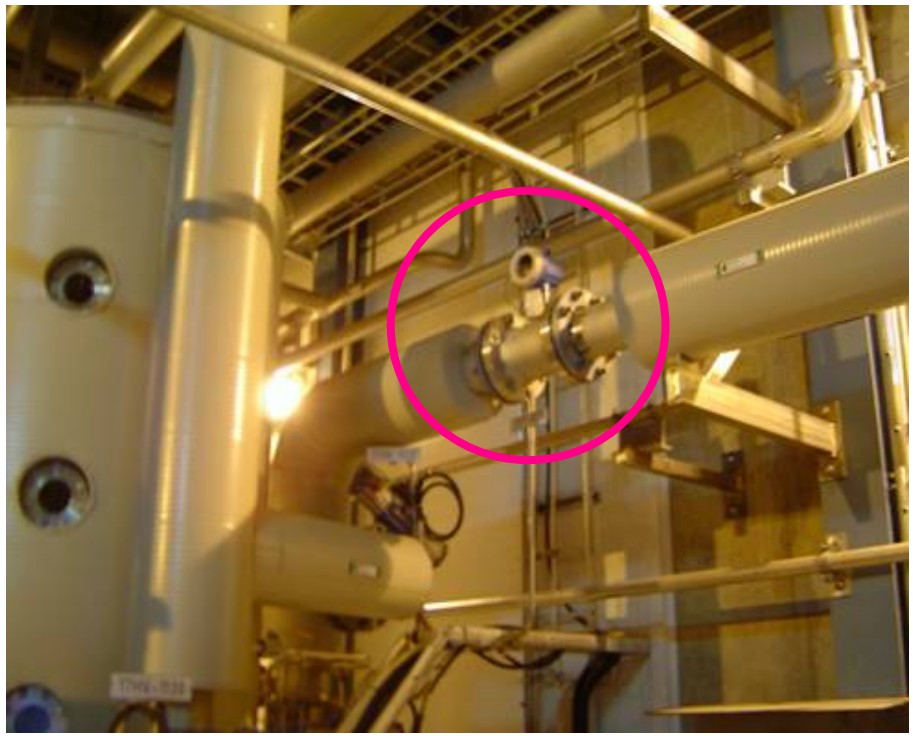
Other info:
Process required a minimum D/P to be present.
Vortex flow allows for higher efficiency and
Higher accuracy over a wider flow range than
DP flow with a primary element.



Endress+Hauser

Flow: Boiler feed water supply

Power



Vortex flow measurement

Type: Prowirl 72F
Media: Demineralised water

Other info:
Flow measurement of demineralised water, steam and vapors using vortex principle
gives wider range and no long term wear influence like DP flow and orifice plate elements.

Flow: compressed air supply

Common

Thermal mass flow measurement

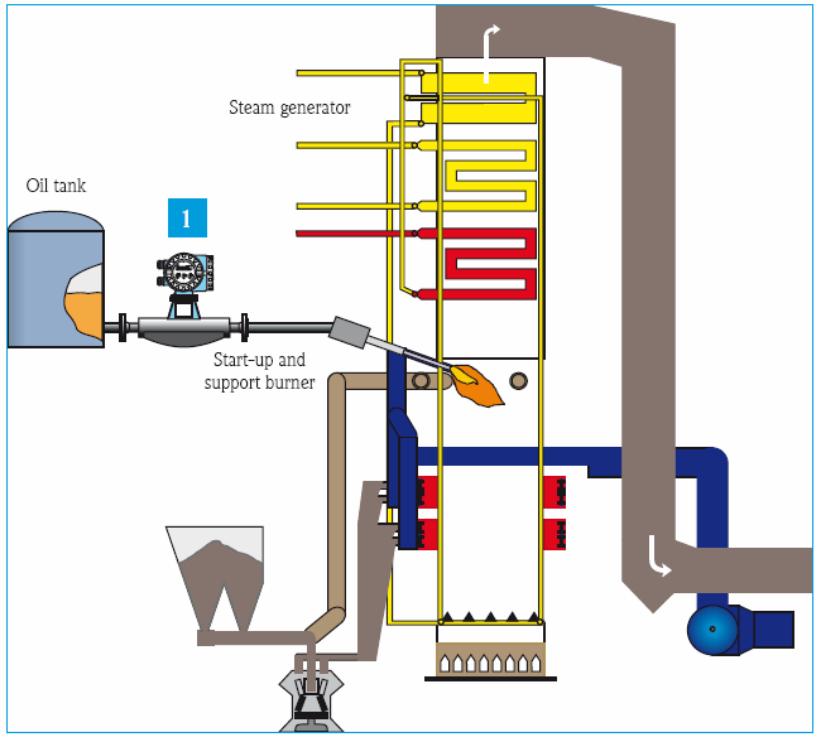
Type: T-mass
Media: Air

Other info:

True mass flow with thermal principle. Low pressure loss and wide turn down. No added expense of temperature, primary element, error in calculations like DP flow.

Monitoring the start-up/support burner

- To initiate combustion and/or support coal firing of the boiler, oil is used for the booster and supporting burner
- A precise mass measurement installed in the oil flow line is required for the exact batching and control of the combustion process

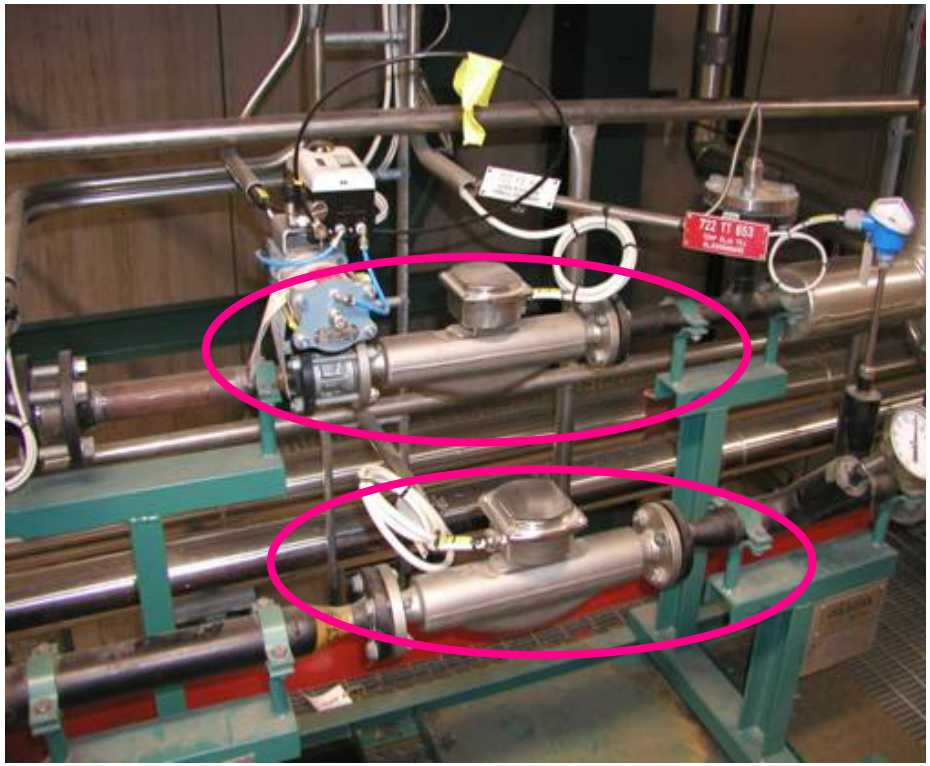


Coriolis mass flow meter

- Promass
  - Compact device for direct, precise mass measurement (kg/h) – no additional instruments required
  - Replaces mechanical systems that can obstruct and block the furnace oil flow line
  - No moving parts for unimpeded flow and operation of the furnace
  - Safe measurement, even with poor quality oil

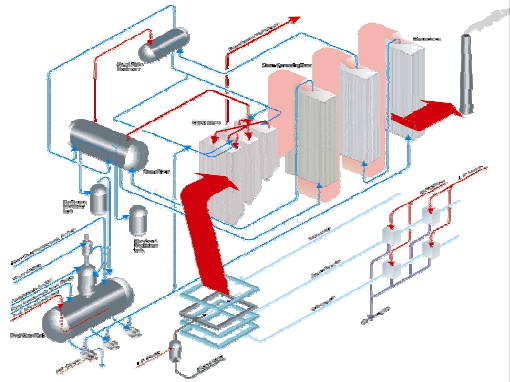
Endress+Hauser

Flow: Burning Oil in and outlet



Massflow meter

Type:	Promass 83F
Media:	Burning Oil
Range:	0-2 kg/s/ 4lbs/s
Temp:	+95-200 C/200-390F
Pressure:	10-25 BAR/ 150-350PSI

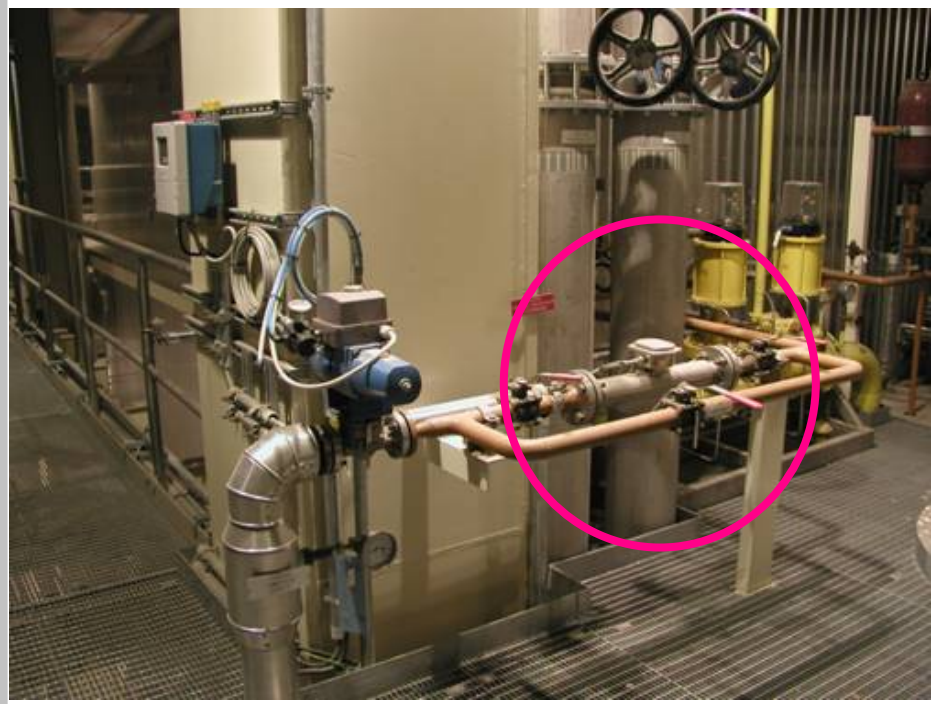


Other info:
Promass Mass Flow meters allow the flow rate to the recovery boilers to measured in mass units to account for changes in the volume due to integrated temperature and density measurement. Proper density ensures less water content and a higher burn rate with less unwanted condensation/steam.

Endress+Hauser

Flow: Burning Oil to burner

Chemical Recovery



Massflow measurement

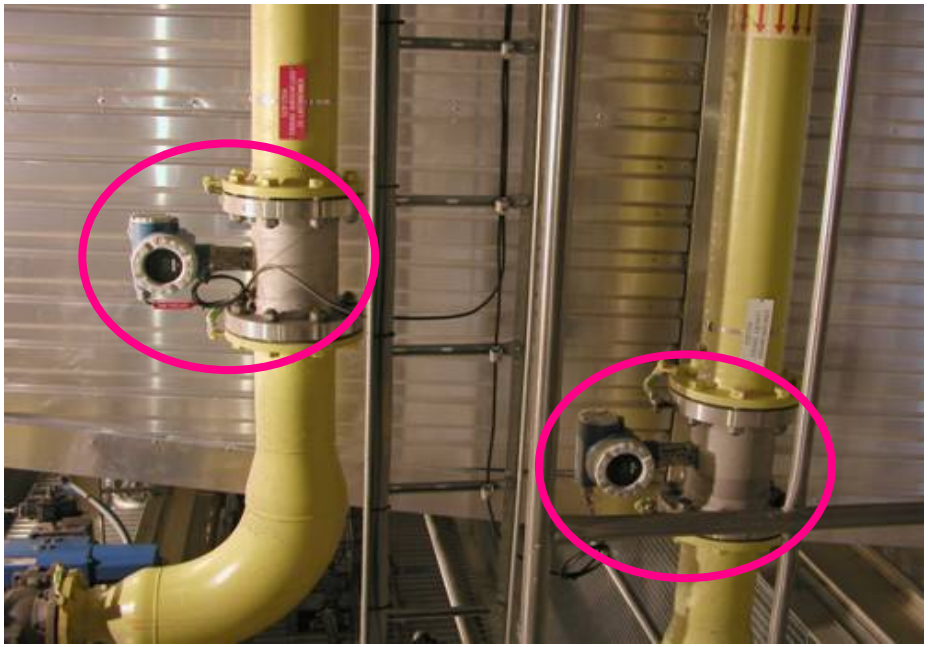
Type:	Promass 83 F DN40/1.5”
Range:	0-2,5 kg/s / 0-5.5lbs/s
Media:	Burning Oil
Temp:	+60 C/140 F
Pressure:	200-300 kPa/30-45 PSI

Other info:
Promass provides precision mass and
Density measurement of bunker c fuel
Oil to the boilers without the need for
Long straight run piping or interference
From 90 degree elbows and valves due
To it’s compact size.

Endress+Hauser

Flow: Natural Gas

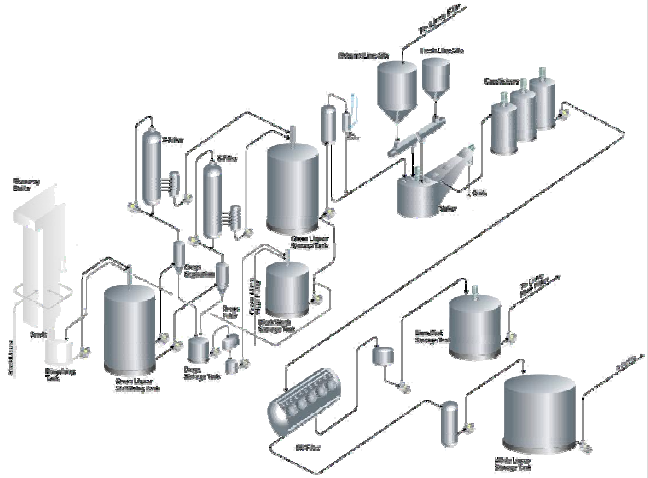
Chemical Recovery



Vortex Flow meter measurement

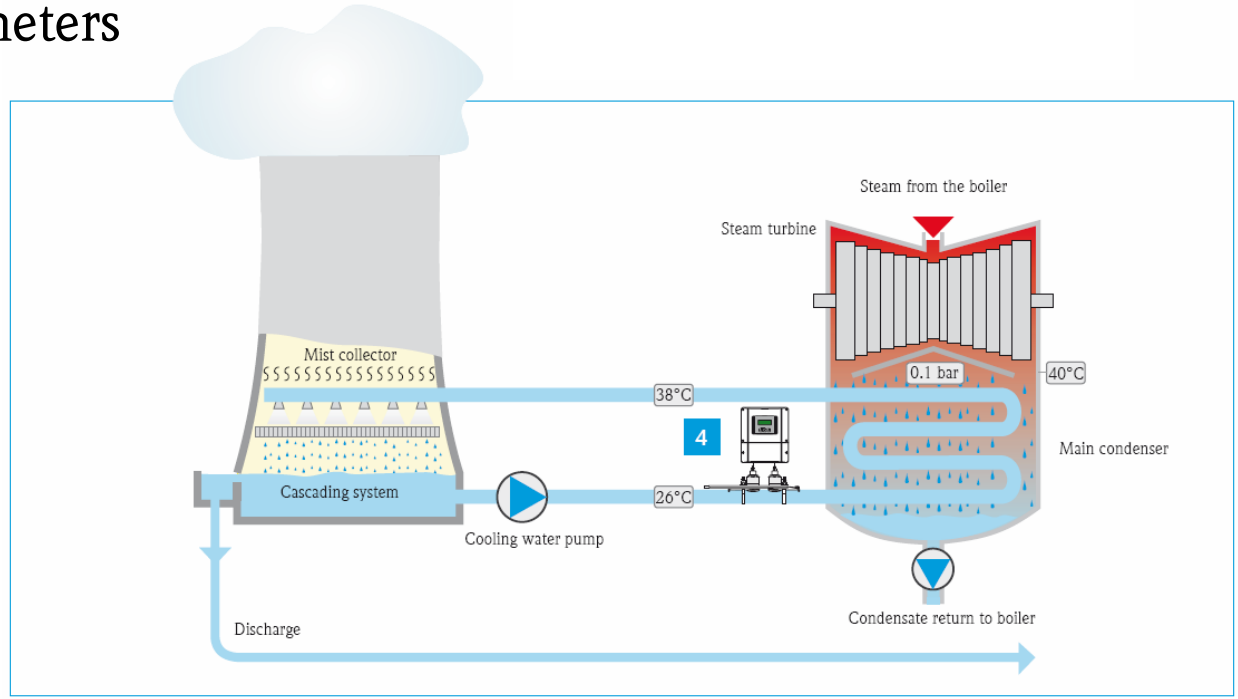
Type:	Prowirl 73 F DN 150/6”
Range:	0-3 Nm3 /s/ 0-105 ft3/s
Media:	Natural Gas
Temp:	+25 C/77F
Pressure:	200 kPa/30 PSI

Other info:
Prowirl 73 with integrated temperature
Measurement allowed for a real time
Calculated volume flow without the
Need of an external flow computer.
In addition, the device accommodated a
Larger operating flow range than DP.



Water volumes in the main cooling water system

- Large volumes of cooling water flow through the main condenser, helping to create a high degree of efficiency in the power plant
- In order to measure cooling water volumes, a measuring device is required which supplies reliable values even with large pipe diameters



Ultrasonic flow meter

Prosonic Flow

- Installed directly on pipelines via detecting sensors with transmitter mounted separately
- External installation allowing easy retrofit with no intrusion into the pipe
- Maintenance free with no moving parts
- No obstructions in the pipeline and no pressure loss
- Economical alternative for large diameters up to 4000 mm

Prosonic Flow ultrasonic flow meter

Portable version

Prosonic Flow (clamp on version shown) is used to control cooling water for the main condenser

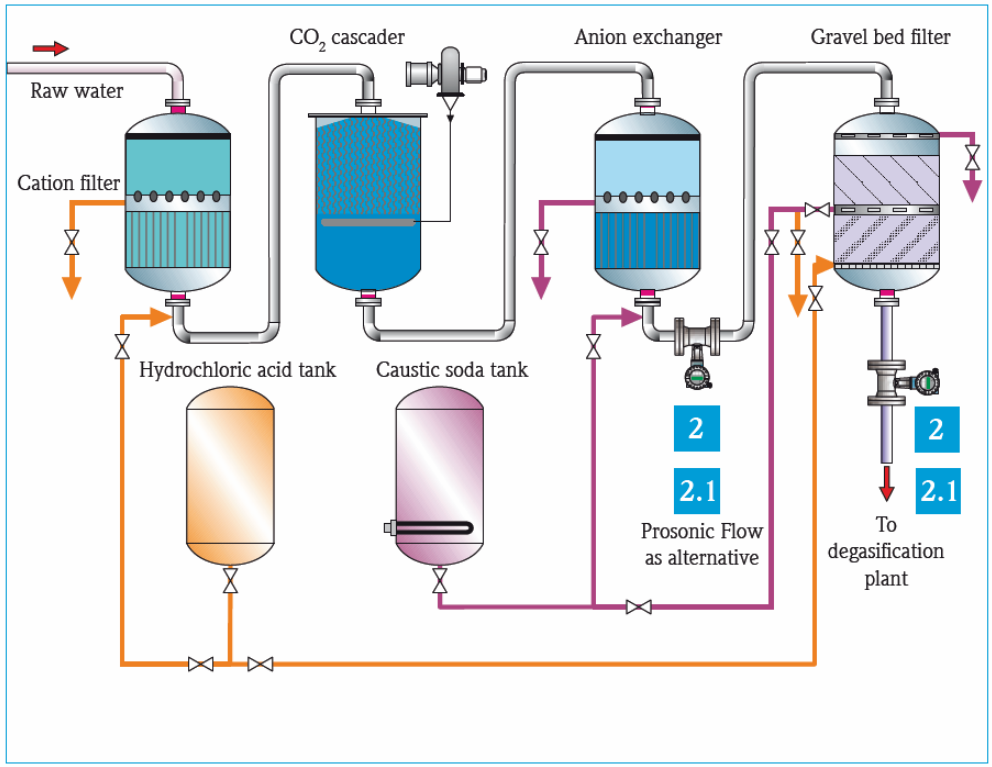
Welded version

Ultrasonic inline flow meter

- Prosonic Flow inline
  - Ideally suited for applications in process control and utility measurement in energy production
  - Short inlet and outlet length reducing the space required for installation in comparison to orifice plates and Vortex meters
  - Loop powered transmitter with accuracy up to ±0.3%
  - Measures the flow of conductive and especially non-conductive liquids

Volume measurement in desalination

- Full desalination requires the production of pure water necessary for the operation of steam boilers
- Volumetric flow meters are required for the measuring of deionized water in the water/steam circuit



Vortex flow meter

- Prowirl
  - Alternative to dp-flow with orifice plates
  - Compact device for volume measurement in deionized water
  - Reliable measurement independent of deionate conductivity
  - Large measuring dynamics, i.e. high turndown
  - Little Pressure loss

Endress+Hauser

Ultrasonic: outlet water

Effluent

Ultrasonic Flowmeter

Type: Prosonic Flow 93W

Media: Factory outlet water

Other info:
Traditionally, a large diameter magnetic Flow meter was used in this application. During a failure, it was not accessible for Replace or repair. A non-intrusive Prosonic 93 W unit was used temporarily. It became A permanent meter with more than $10K Price difference between magnetic flow and Ultrasonic.

Endress+Hauser

Level Applications – Capacitance /Radar

- Air/Ignition System
  - Fuel Oil Storage Level
- Environmental System : Ash levels inside precipitator
- Steam Generation : Dearator water storage level
- Steam System : Hotwell Condenser level
- Water System : Makeup water system supply

Endress+Hauser

Level Applications

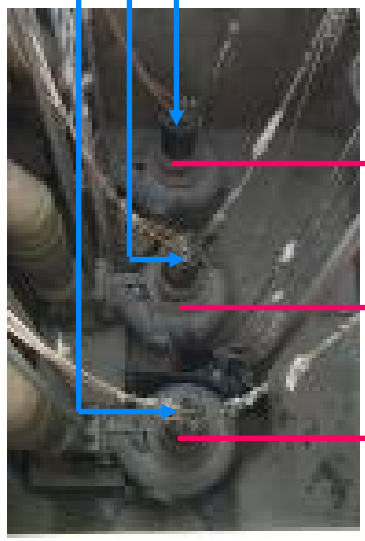
- Coal System : Storage pile, Conveyor control, coal silos
- Environmental System : Scrubber lime slurry, fly ash storage
- Water System : Pond/River level treatment plant cooling tower
- All rotating equipment needs lubrication to avoid excess friction and damage. Lubrication systems typically include a reservoir which must be monitored for loss of lubrication and lube oil pressure. (Point Level Switch i.e., Liquiphant)

Endress+Hauser

RIA452– Level/Pump control

Pump control
"Start/stop" using alarm
Set point relays

Level measurement



Feed back pump is "running/not running" using a digital signal

- Up to 8 relays (alarm set points) possible
- Pump failure is recognized
- Replacement pump can be controlled
- Up to four pumps can be monitored
- Running times for each pump can be monitored
- Dry run protection
- Cyclic pump start on long down times
- Fault conditioning (e.g. cable open circuit) in accordance to NAMUR NE43 or freely definable.

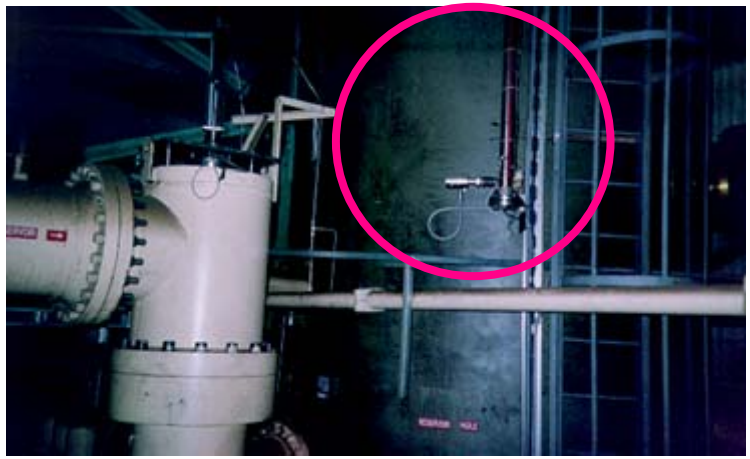
Endress+Hauser

Level: Hydraulic oil tank

Other

Pressure / Level Measurement

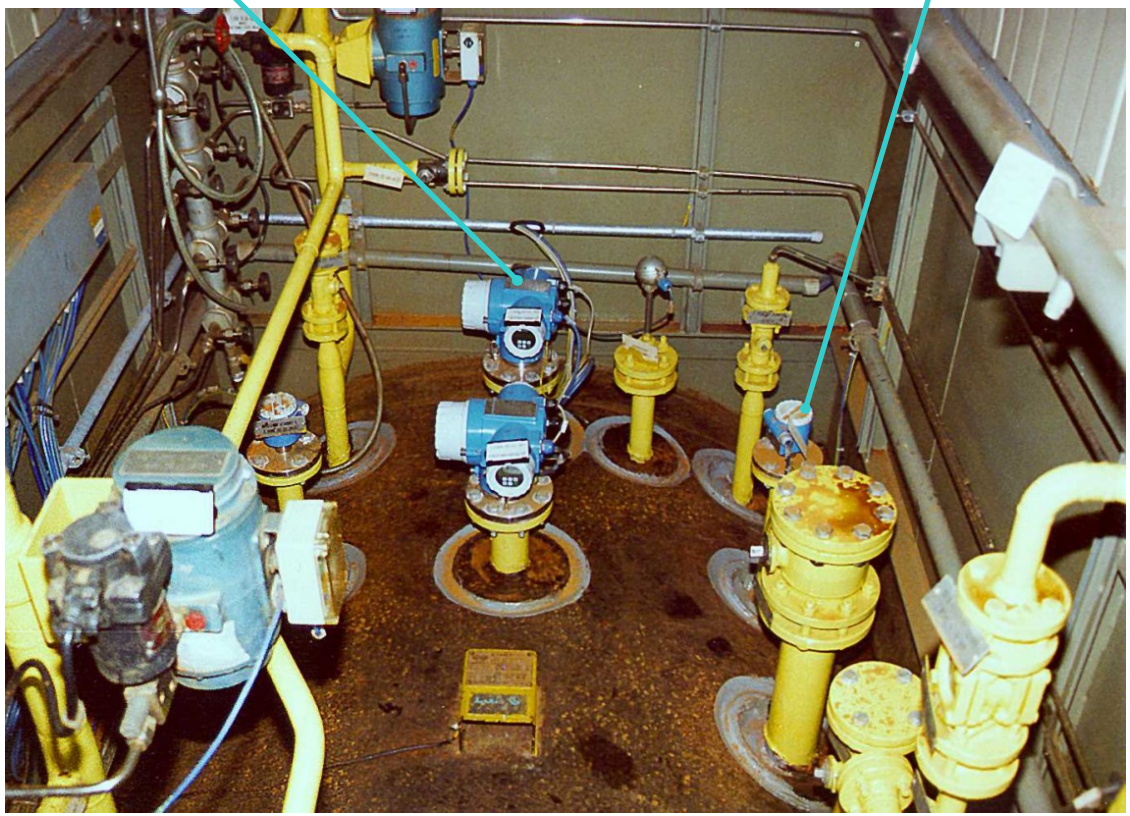
Type: **Delta Pilot DB 50S**
Media: Hydraulic oil



Other info:
Deltapilot S is used to measure hydraulic oil in utility storage tanks.
Deltapilot uses a flush mount weld socket and Hastelloy diaphragm.

Endress+Hauser

Controlling the level in the ammonia storage tank



Measuring technology

- level transmitter **Levelflex**

Process

- Controlling the level of the ammoniac storage tank to guarantee the operation of the DeNOx-Catalysator
- Medium: Ammoniac (100%)
  Operation: app. 6 bar, app. 15 oC
  M-range: up to 2m

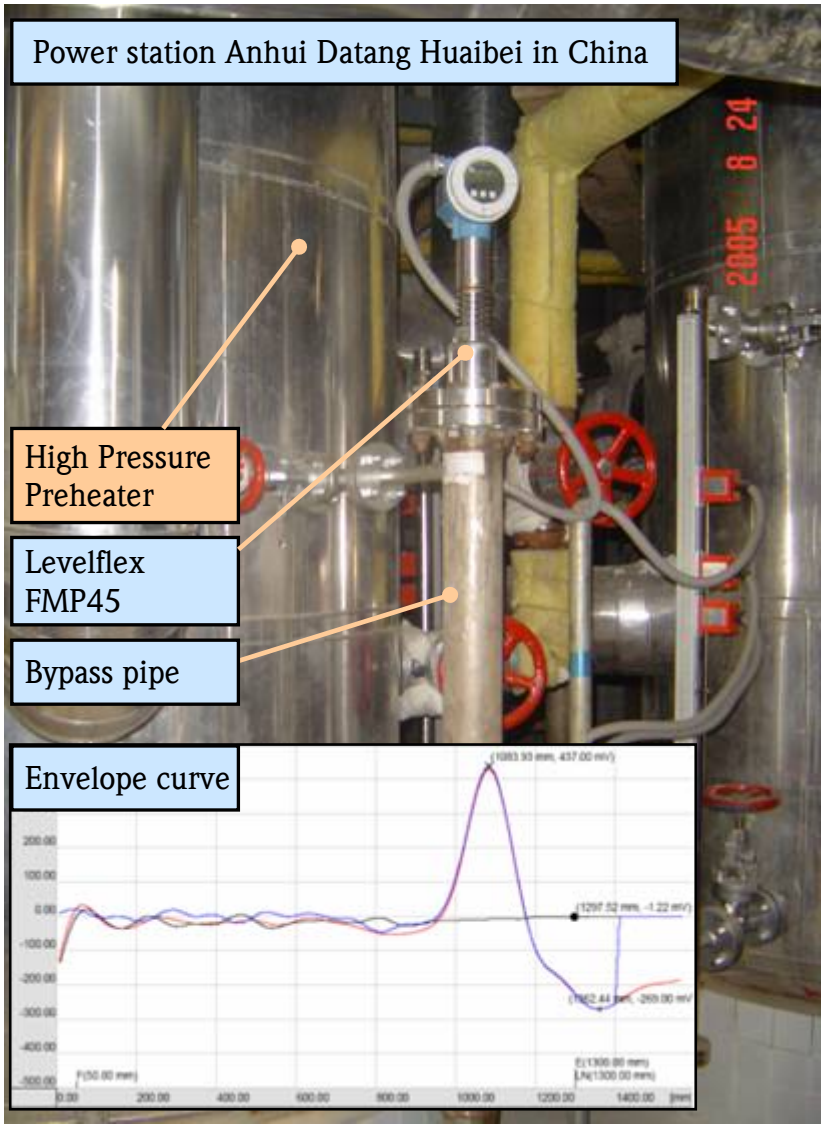
Features

- Device works without moving parts. A better solution than displacers or floating assembly.

Endress+Hauser

Level measurement with radar technology

Application in power plant => example High Pressure preheater



Measuring technology

- Level transmitter LEVELFLEX FMP45 – Installation bypass at HP Preheater

Process

- Level measurement of the condensed extraction steam (auxiliary condensate) in the High Pressure preheater.
- Medium: Condensate (Demi-Water)
  Operation: 42,4 bar / 300 °C
  Measuring range: app. 1100 mm

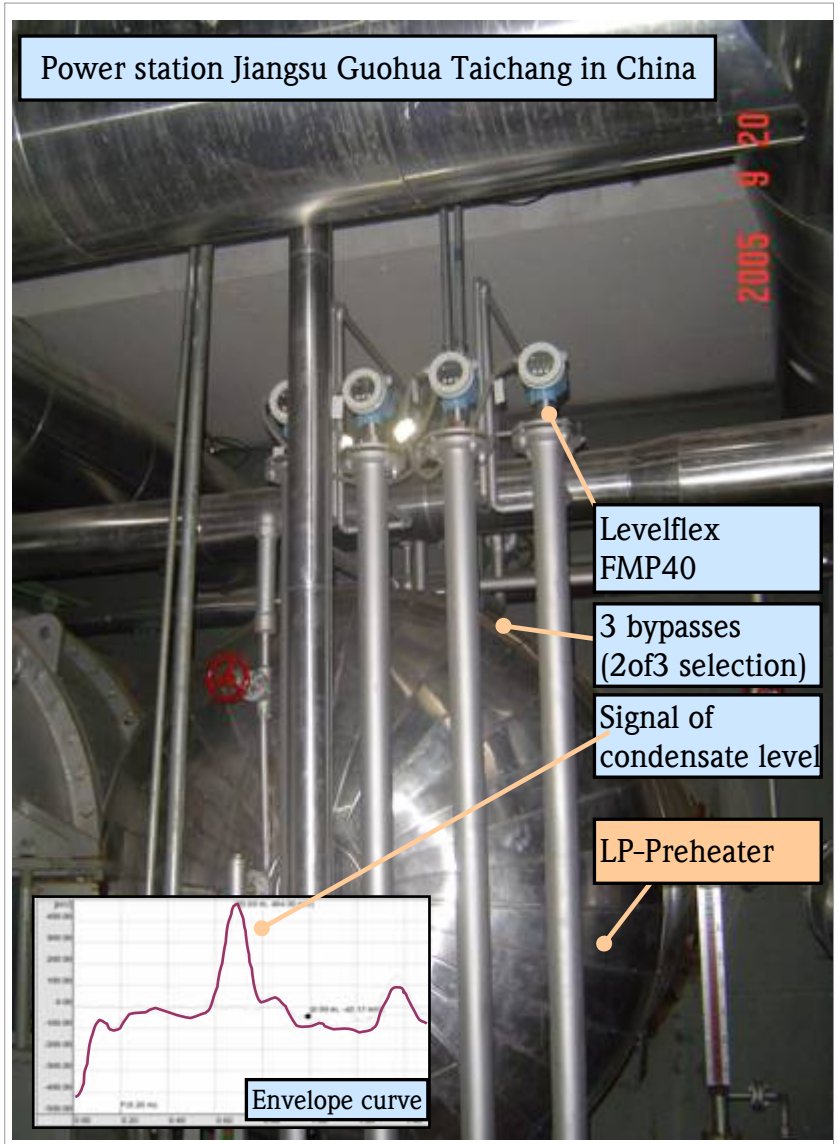
Features

- LEVELFEX is suited very well for high pressure and temperature parameters in High Pressure preheaters.
- Analysis of the signal via the envelope curve of the transmitter, that can be viewed on the display or with a laptop.
- The measurement is not influenced by fluctuations in the process or fluctuations in density. (pressure, temp.).

Endress+Hauser

Level measurement with radar technology

Applications in the power plant => example Low Pressure preheater



Measuring technology

- Level-transmitter (radar instrument) LEVELFLEX FMP40

Process

- Control the level of the condensed extraction steam to safe the steam turbine for damaging.
- Medium: Condensate (Demi-Water)
  Operation: 7 bar, 180 °C
  Measuring range : 2100 mm

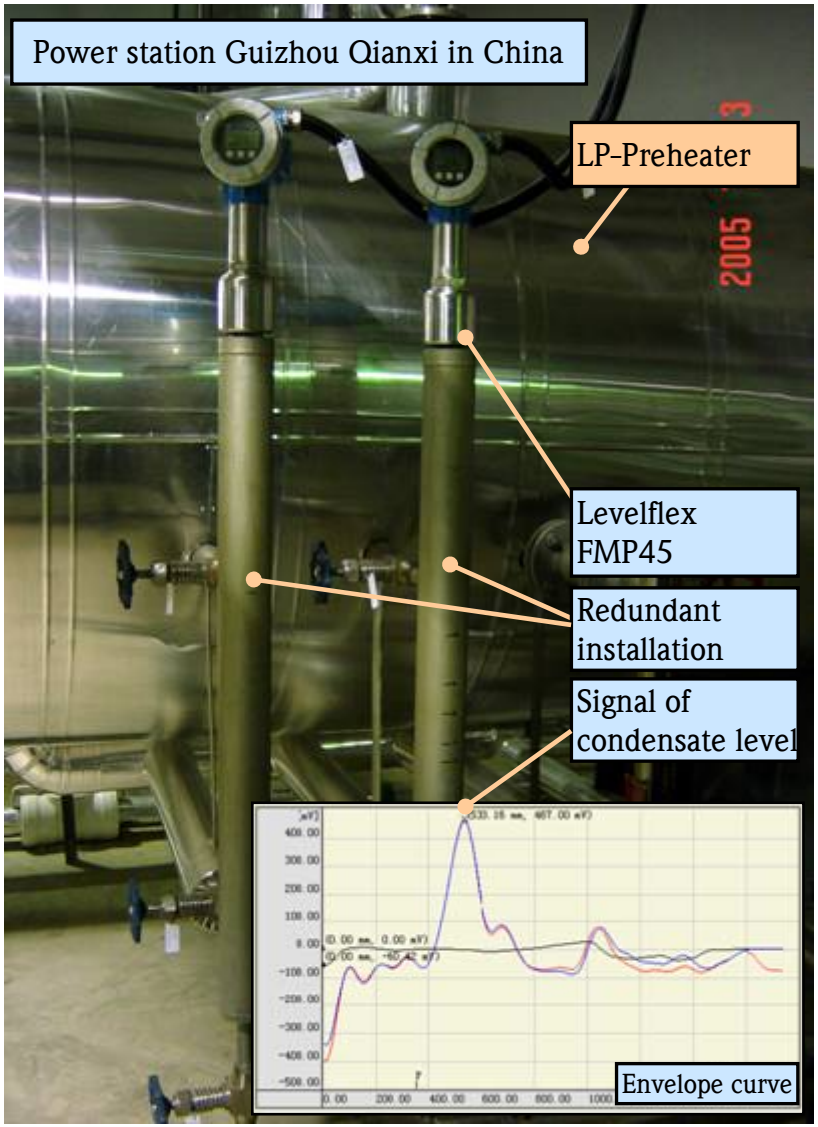
Features

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

Endress+Hauser

Level measurement with radar technology

Applications in the power plant => example Low Pressure preheater



Measuring technology

- Level-transmitter (radar instrument) LEVELFLEX FMP45

Process

- Control the level of the condensed extraction steam to safe the steam turbine for damaging.
- Medium: Condensate (Demi-Water)
  Operation: 1 bar, 170 °C
  Measuring range : 600 mm

Features

- For safety reasons the LEVELFEX is installed in a redundant installation.
- The measurement is not influenced by fluctuations in the process or fluctuations in density. (pressure, temp.).
- For operating the application with the envelope curve you can use the display or the E+H software TOF-Tool together with a laptop.

Levelflex - Fly Ash Measurement

Levelflex on Fly Ash Bins

SC 0106

Replacement of a plum-bob (mechanical) device

- Fly Ash silo
- Measurement range: approx. 100ft
- Fly Ash build up does not disturb the measurement
- Previously used mechanical Plum-bob instrument failed due to cable breaking

Soliphant – Solid/Liquid Interface Module

Soliphant Interface Module in a Fly Ash De-Watering Bin

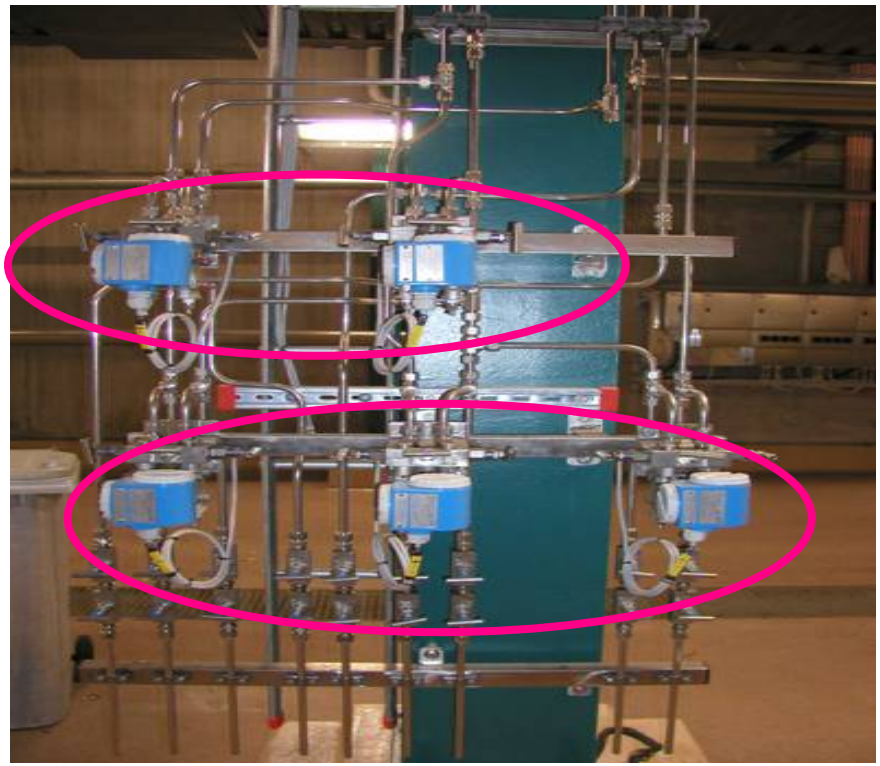
SC 0108

Replacement of a mechanical rotating paddle switches

- Coal fired power plant.
- Soliphant detects the rising level of fly ash under water
- Soliphant II FTM30/31 solids / liquids interface module (#TSP9266)

Endress+Hauser

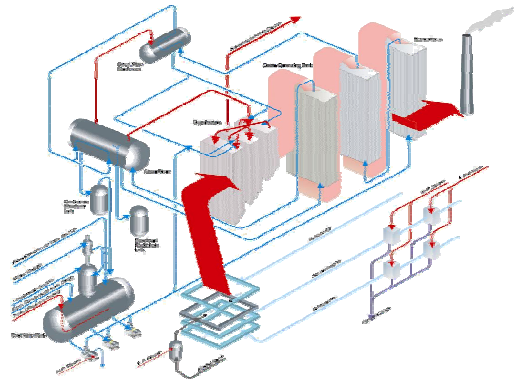
Level: Water level in the boiler (safety circuit)



Pressure/Level measurement

Type:	PMD75 with 3-valve manifolds
Media:	Water level
Pressure:	0-509,5 kPa/ 0-75 PSI

Other info:
Standard and simple DP level measurement integrated into the boiler for level /pressure measurement to ensure safety. 2000PSI overpressure rating standard with HISTOROM event recording capability.



Ultrasonic – Pond Level Measurement

Potable water level measurement in large ponds

SC 0127

Solar charged battery powered instruments

- FMU41 (battery powered)
- installed in 4” PVC stilling wel
- Pond size: 40 – 500 Acres
- Measurement cycle
  - FMU41 is powered up for 2 min. 4 x per hour
  - the reading is taken into SCADA system
  - the unit is powered back off

Levelflex Remote Housing – Displacer Replacer

FMP40 for High Temperature Application

SC 0136

Replacement of Displacer Level Instrument

- FMP40 + remote housing
- Temperature
  - 167°C (333°F) operating temp
  - 249°C (480°F) max temp
- Pressure: Ambient to 1 bar
- Measuring range: 76”

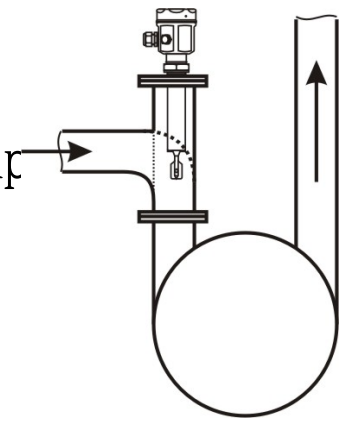
Liquiphant – PD Pump Protection

Liquiphant for empty pipe detection

SC 0103

PD pump protection from running dry

- Empty pipe detection
- Prevents PD pumps (Positive Displacement Pump) from running dry
- Saves repair costs ($1,500 - $2,000) and prevents from purchase of new pump ($4,500)

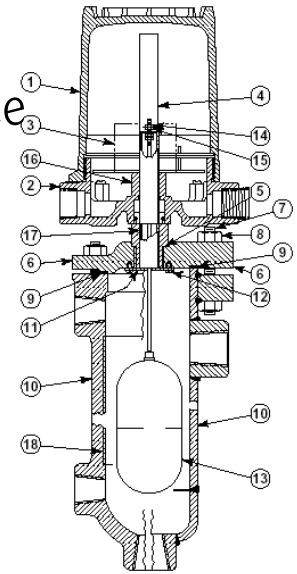


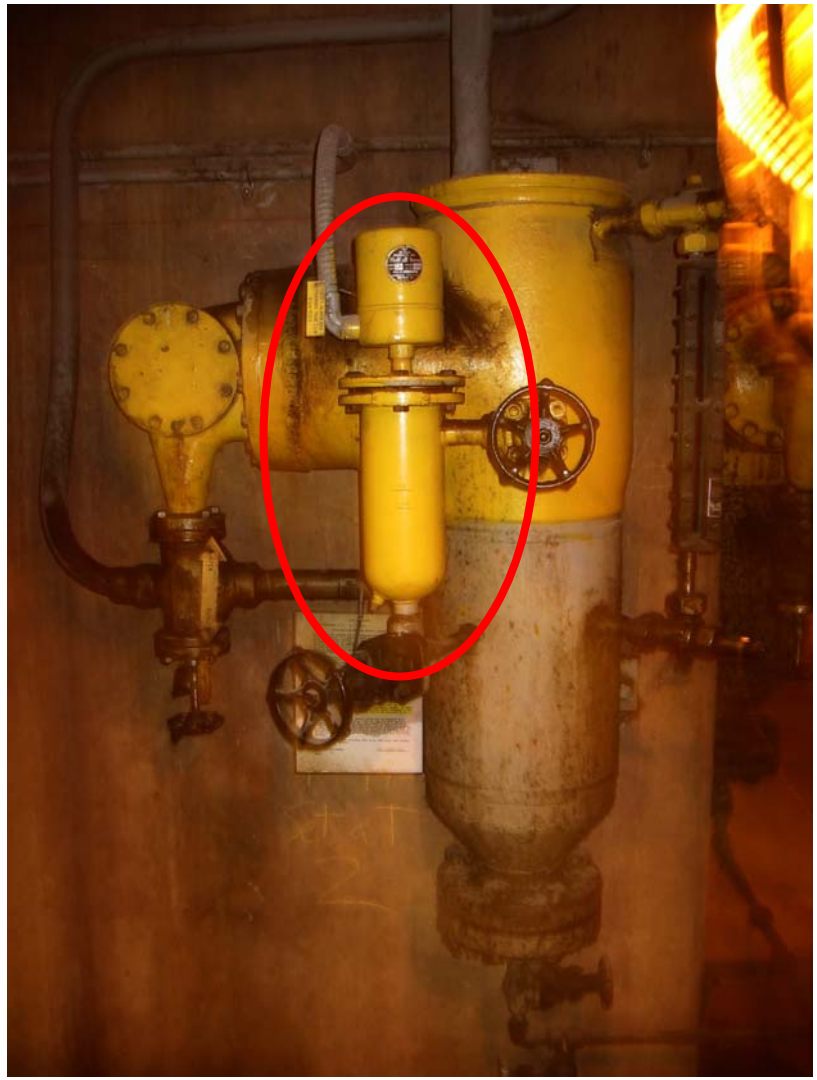
Endress+Hauser

Float Chambers in Power Plants

Float switches + Chambers

- corrode + sink or stick
- need maintenance
- do not fit to any installation position
- need more space
- are expensive
- ...



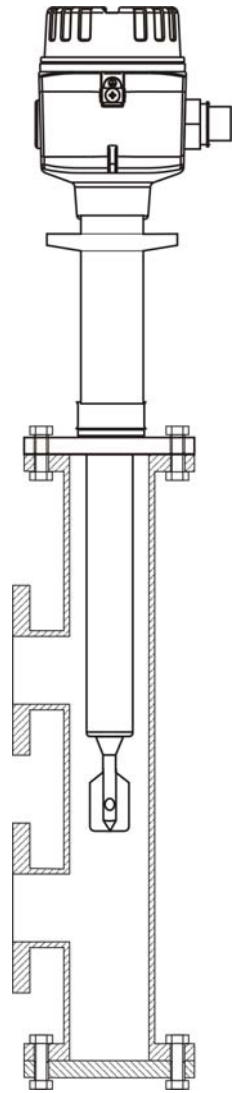


Endress+Hauser

Replacement of Float Switches

Replacement of high temperature float switches with Liquiphant

- 23 Liquiphant M + Liquiphant (HT) in an old power plant
- Bypass provided to get rid of expensive float chambers



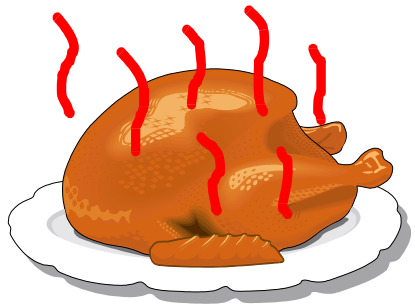
Endress+Hauser

WATER TREATMENT CONTROL ROOM WITH REMOTE DISPLAYS INSTALLED

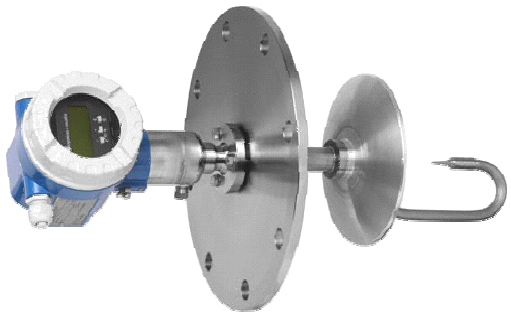
Microwave Energy

Effects on humans?

Inside:
appr. 1 W/cm²
Leakage with door closed:
appr. 0.005 W/cm²



With transmitting power of 2 W:
ca. 0.000‘1 W/cm²

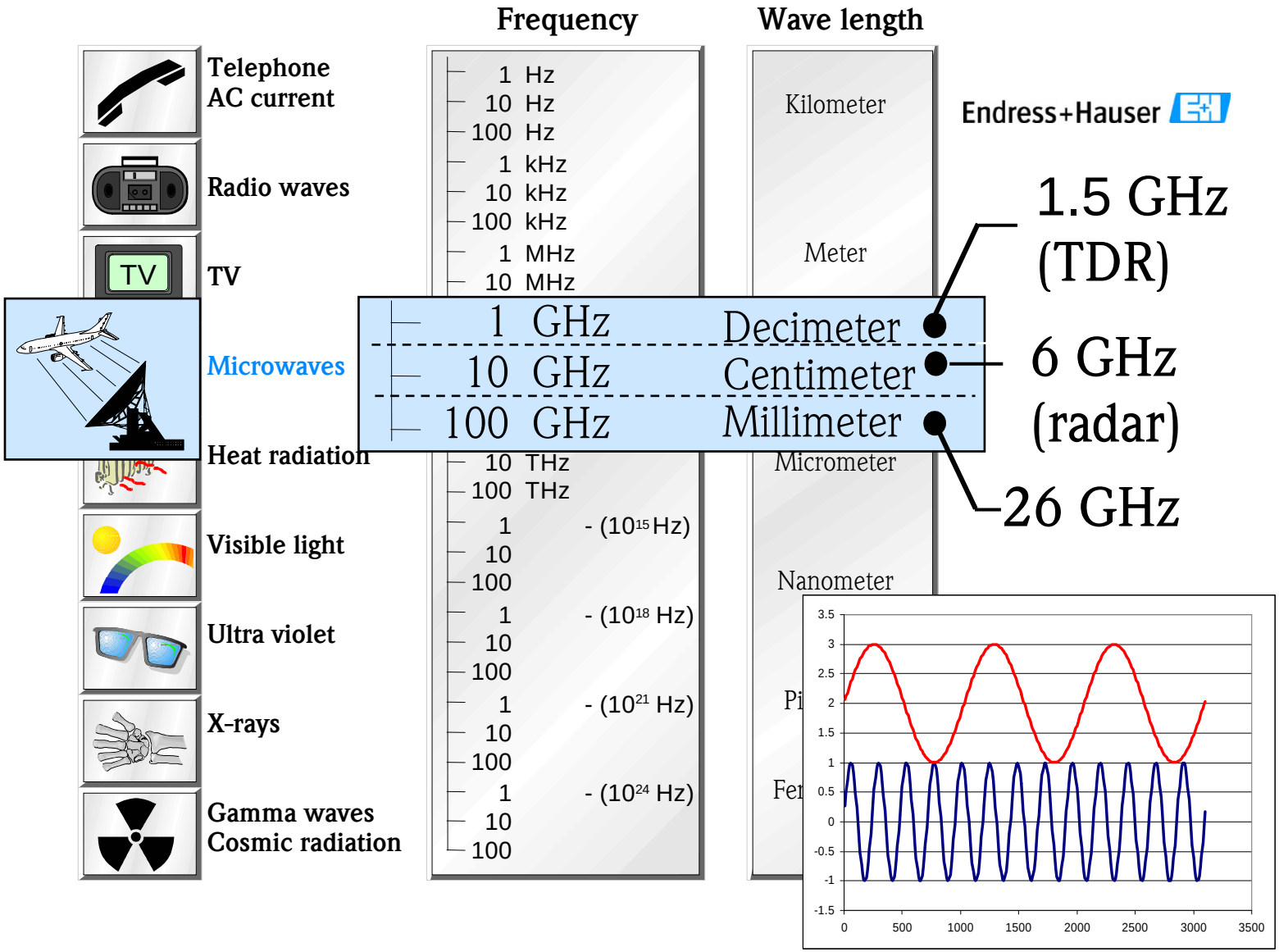


Pulse:
appr. 0.000’15 W/cm²
Average:
appr. 0.000’000’21 W/cm²

Endress+Hauser

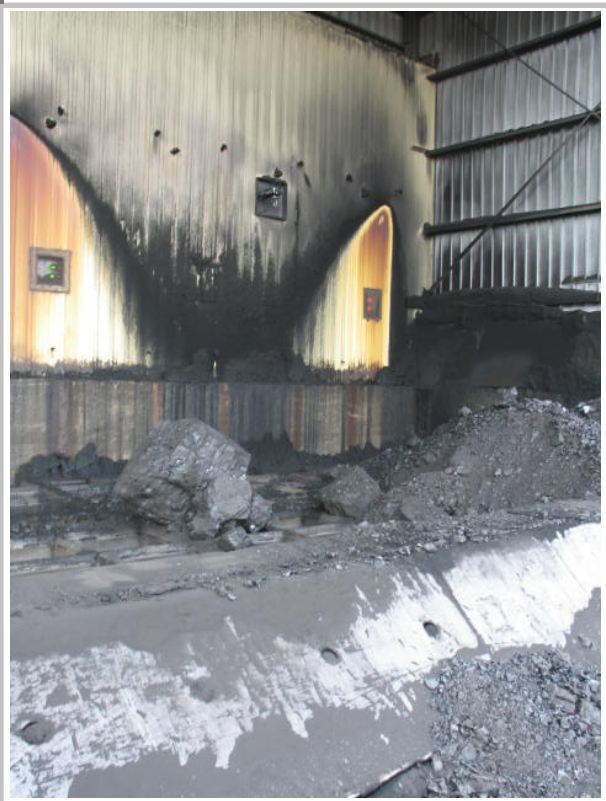
Level

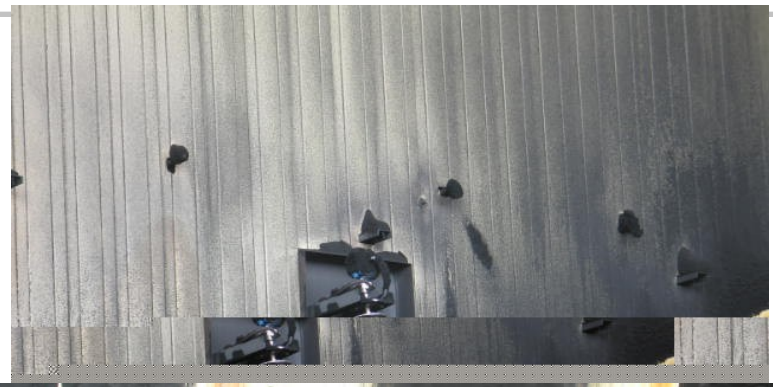
Electromagnetic Waves



Endress+Hauser

Power plant in the USA





Free space radar shooting through a grid on coal in a bunker

Distance is 62 ft.

DP or Vortex?

Similar Operational Concept

- Cheaper for smaller line sizes
- Better long-term stability (less subject to wear) than orifice
- Calibrated, not only calculated
- Low installation costs
- Low maintenance requirements
- Higher turndown
- Lower pressure drop
- Fewer emission points
- Primarily linear signal
- Direct measurement
- Robust against changing T and p
- Non-clogging (E+H)

- Installed base, widely accepted
- Standardized since 1929
- More DN/PN available
- Availabe for T>450°C
- More special materials
- Measures down to 0 (however with 0 accuracy…)
- Works at lower Reynolds #
- Attractive Pricing for bigger DN
- Faster Response Time

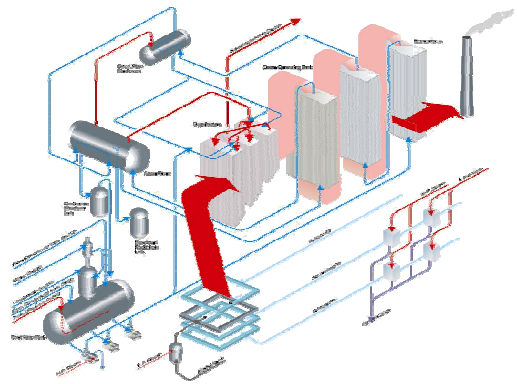
Pressure: Gas pressure in burning process

Chemical Recovery

Pressure measurement

Type:	PMP 631 with 2-valve manifolds
Media:	Propane, Air
Temp:	+200-250 C/390-480F
Pressure:	10-12 bar/ 145-175 PSI

Other info: Direct Measurement of gases at the boiler reduces error with capillary tubes, leak points with "plugged" ports, and minimize error with density factor adjustment for individual gases.



Endress+Hauser

Pressure Applications

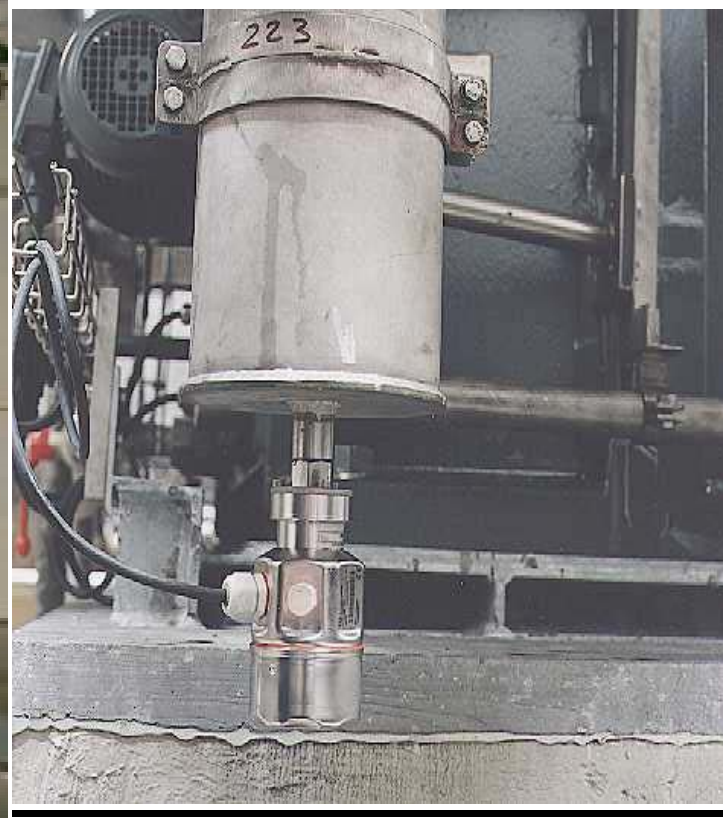
- Air /Ignition System : Fuel Cutoff (shutdown) , Fan Performance , Fuel flow between pulverizers and burners, air pre-heater and ignitors
- Steam Generation : Boiler Alarm, Water flowing from hotwell condensor, supply pump performance and steam lines in and out of drum, feedwater heaters and steam drum
- Steam System : Steam drum to superheaters, main steam line to turbine, cold and hot reheat steam lines, steam turbine throttle valve position
- Water System : Pump Monitoring

Endress+Hauser

- Application examples

Power plant
Pressure measurement in de-sulphurization process

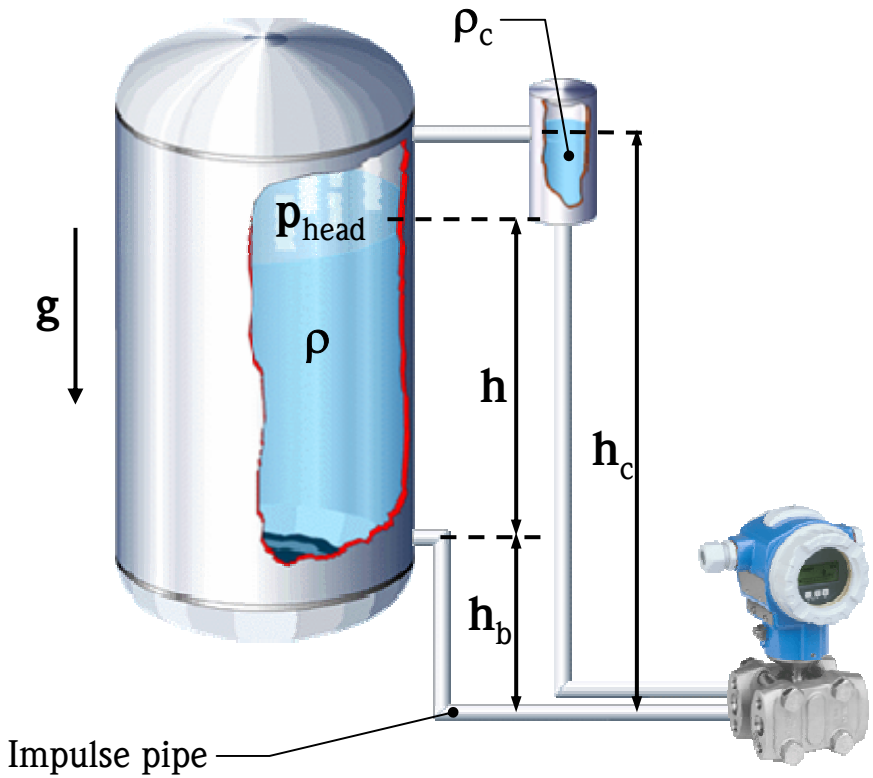
Utilities
Level measurement in the gear box of a cooling tower fan



Level Applications

With impulse piping and condensate chamber for liquids with condensing vapours

$$Dp = (\rho \cdot g \cdot (h + h_b) + p_{head}) - (\rho_c \cdot g \cdot h_c - p_{head})$$



Coal fired power plant

Endress+Hauser

Product matrix

	pressure		level								flow				analysis					T	R
	process pressure (rel./abs.)	differential pressure	capacitive	vibronics (liquids)	vibronics (solids)	radiometrics	guided microimpulse	ultrasonics	electromechanical systems	microwave	electromagnetic	vortex	ultrasonics	massmeter	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)			●		●	●	●													●	
fluegas desulpherisation	●	●	●			●		●		●	●			●		●				●	
water/steam-circuit	●	●								●		●			●	●			●	●	
steam turbine	●	●	●								●									●	
generator			●	●																●	
main cooling water system	●	●						●			●		●		●	●					

Product Matrix

	Pressure		Level								Flow				Analysis				T
	Pressure (relative, absolute)	Differential Pressure	Capacitance	Vibration (Liquids)	Vibration (Solids)	Radiometric	Guided Microimpulse	Ultrasonic	Electromechanical System	Radar	Electromagnetic	Vortex principle	Ultrasonic	Mass flowmeter	Conductivity	pH	Turbidity	Oygen	Temperature
Natural gas supply	●	●										●		●					●
Water supply	●	●	●					●			●		●						
Desalination	●	●		●				●			●	●			●	●	●		●
Heat recovery steam generator	●	●																	●
Water-/Steam system	●	●								●					●	●	●	●	
Steam turbine	●	●	●	●															●
Gas turbine	●	●	●	●															●
Generator				●															
External energy supply											●		●						●
Cooling system	●	●	●	●				●			●		●						●

Endress+Hauser

Any questions ?