International Experiences in Conceptual Designing and Operation of Water Treatment Plants

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General Remarks

- EPC Projects (Turn-Key)
- EPC supplier‘s choice only driven by commercial (lowest investment costs)
- No influence of owner on sup-suppliers choice
- Consultant‘s comments often neglected
- EPC contractor without owner‘s control during design, manufacturing and installation

Basic Considerations

- Which raw water quality(ies) is(are) available?
- Which amount of raw water is available?
- Which water qualities must be reached by the treatment?
- Which net water volumes are needed by the different consumers?
- Which reserves or futures extensions have to be put into consideration?

Raw Water Quality

The existing raw water analysis is not sufficient

- **Change of water quality over the year (e. g. dry and rainy season)**
- **Insufficient ion balance**
- **Relevant substances in water not analyzed**

➔ **An insufficient raw water analysis leads to a wrong design of the water treatment plant by the supplier**

Example of a Raw Water Analysis

Parameter	RAW WATER	TREATED WATER
Alkalinity as CaCO3, mg/L	85.2	85.4
Aluminium Al, µg/L	7.39	10.6
Bromide Br mg/L	<0.05	<0.05
Cadmium Cd, µg/L	<0.1	<0.1
Calcium Ca, mg/L	20.6	23.3
Calcium Hardness as CaCO3, mg/L	37.4	36.4
Chloride, Cl mg/L	2.60	4.46
Chromium Cr, µg/L	<0.2	<0.1
Cobalt Co, µg/L	<0.2	<0.1
Conductivity uS/cm	142	148
Copper Cu, µg/L	12.4	8.223
Fluoride, F mg/L	0.44	0.18
Iron Fe, µg/L	1.06	<0.05
Lead Pb, µg/L	<1	<1
Magnesium Mg, mg/L	5.97	5.90
Manganese Mn, µg/L	<0.2	<0.2
Nickel Ni, µg/L	<0.5	<0.5
Nitrate NO3, mg/L	0.79	0.958
Nitrite NO2 mg/L	<0.1	<0.1
pH	7.75	7.78
Phosphate PO4, mg/L	<0.2	<0.2
Potassium K, mg/L	6.94	7.15
Sodium Na, mg/L	5.41	5.68
Sulphate SO4, mg/L	3.10	2.33
TDS	92.3	96.2
Temperature,Celcius,	29.1	26.6
Total Hardness as CaCO3, mg/L	70.7	75.2
Turbidity NTU	5.77	0.43
Zinc Zn, µg/L	<0.2	<0.2

Relevant parameters are missing, e. g.

- Total organic carbon (TOC)
- Total suspended solids
- Silica
- Barium (in case of RO)
- Strontium (in case of RO)

Fluctuations over the year are not to be seen

- Range or max. values

Raw Water Quality

Two raw water qualities at one site

- Groundwater
  only in case of sufficient ground water level
- Surface water
  In case of not sufficient ground water level

➔ Design of water treatment has to fit worst raw water quality

Basic Considerations

- What is the redundancy concept?
- Which automation level is needed?
- Which permits are relevant or have to be applied for?
- Will it be allowed to discharge waste water?
- What are the relevant discharge limits?
- Are there restrictions in the usage of certain chemicals?

Experiences with Chinese Suppliers

- Standard raw water treatment solution without considering local conditions like raw water qualities
- Water velocities too high
- Necessary retention times for reaction too low
- Plastic materials (piping, tanks, lamellas) not UV resistant
- Equipment which is not available locally
- Labelling in Chinese

Experiences with Chinese Suppliers

- Insufficient materials
- Chinese workers not familiar with special requirements
- Many black box systems
- Chinese Standards
- Operation manuals missing or not in English
- No calibration of measuring equipment

Corrosion after ~ 1 Year Operation

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Corrosion during Commission

Laboratory after ~ 1 Year Operation

Manuals after ~ 1 Year Operation

Measurements

Labelling


型 号 CWS350
速 比 60;1
中心距 350
模 数 10
编 号 21083
出厂日期 2011.1
兴市华正机械有限公司
电话:0510-8737683


DN3300mm
容 积
Volume
15m3
设计压力
Design Pressure
常 压
设计温度
Design Temp
常 温
Normal temperature
试验压力
Test Pressure
盛水试
Full water test
设备重量
Weight
381Ukg

Simple Raw Water Treatment Plant with PAC

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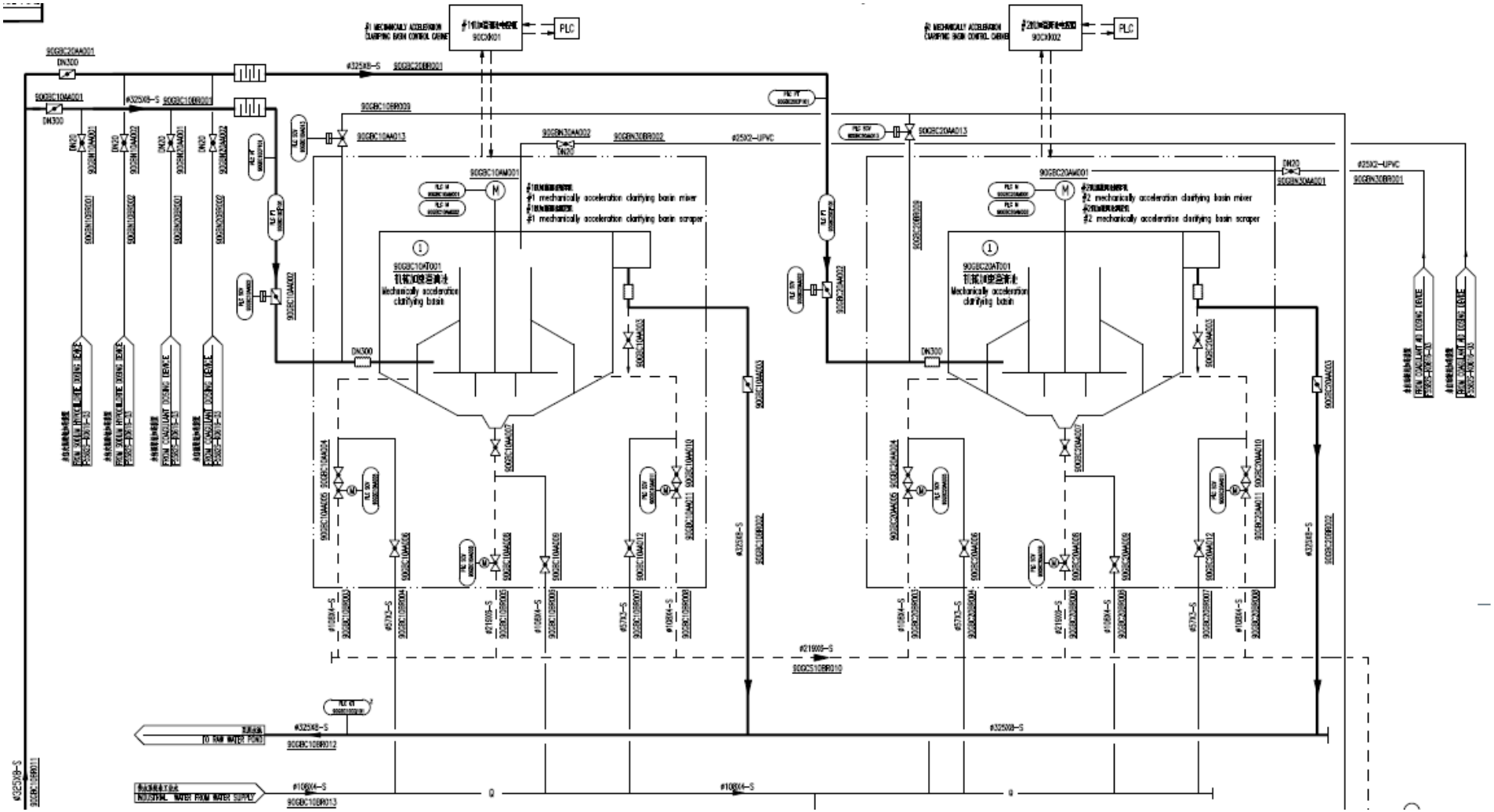

PAC Treatment in Comparison with $FeCl_3$

PAC

- **pH ~ 7**
  solubility increases if pH decreases or increases
- **Light weighted flocs**
  bad sedimentation
- **Decarbonisation with**
  pH ~ 10 not recommended because of precipitation of $Al(OH)_3$ in cooling tower basin (wet cooling)

$FeCl_3$

- **pH > 6**
  low solubility
- **Heavy weighted flocs**
  good sedimentation

Flocculation

Comparison of Water and Steam Quality Requirements for Drum Type Boiler

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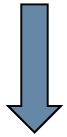
	Direct Conductivity µS/cm		Cation Conductivity µS/cm		Sodium µg/l		Silica µg/l	
	EPC	Int.	EPC	Int.	EPC	Int.	EPC	Int.
Demi water	< 0.4	< 0.2			-	< 0.5	< 20	< 5
Feed water			< 0.3	< 0.1			< 50	< 5
Superheated steam			< 0.3	< 0.1	< 10	< 5	< 20	< 5
Boiler water			< 60	< 30			< 450	< 200

IP Turbine Rotor after ~ 1 Year Operation

Closing Remark

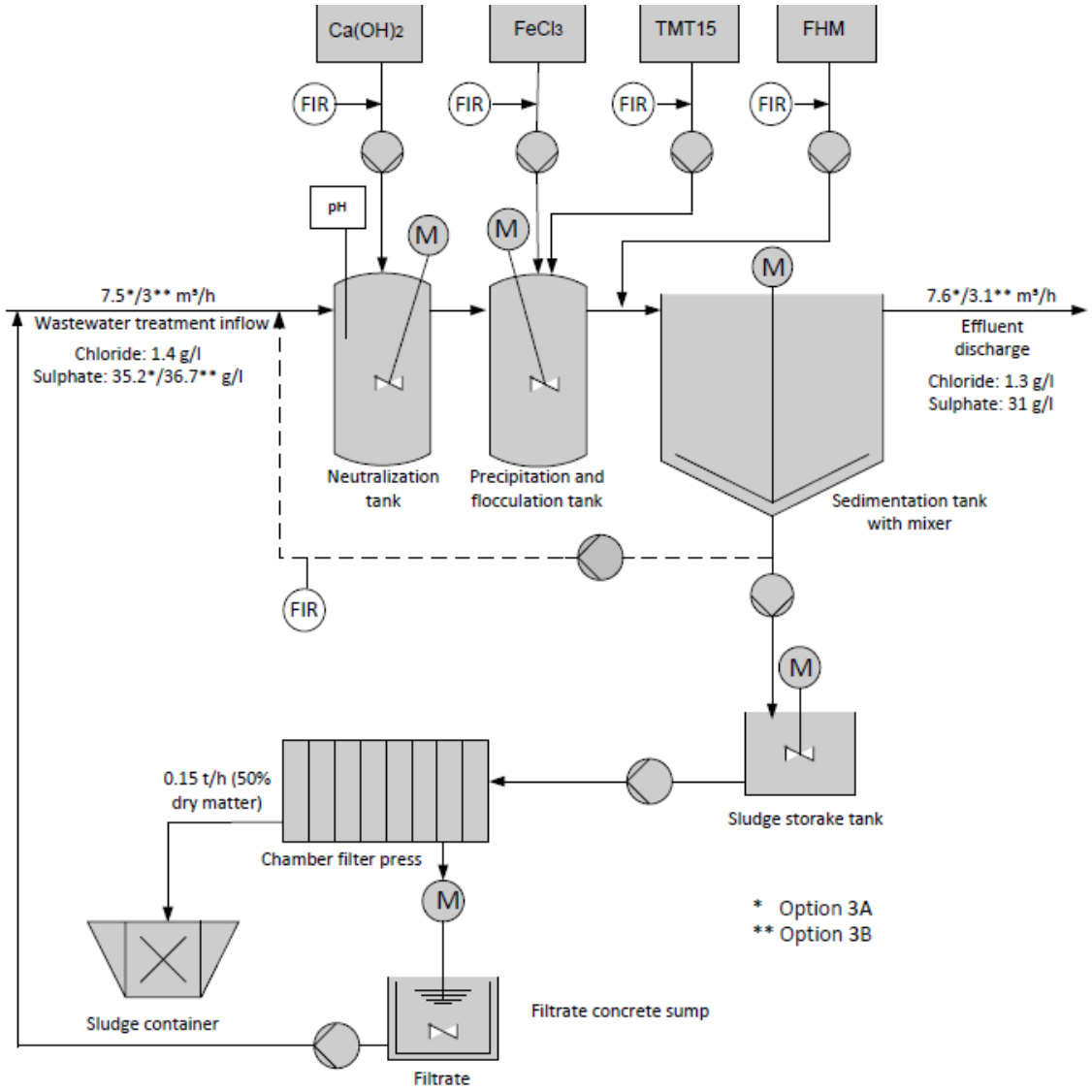
“The bitterness of poor quality remains long after the sweetness of low price is forgotten”

- Benjamin Franklin -



Take care from the early beginning until the end!

FGD Waste Water Treatment Plant
Units 5 & 6 – 2 x 210 MW



Removal of following components:

- Hg (Mercury)
- Cr (Chromium)
- Cd (Cadmium)
- Ni (Nickel)
- V (Vanadium)
- SO_4 (Sulphate)
- Solids

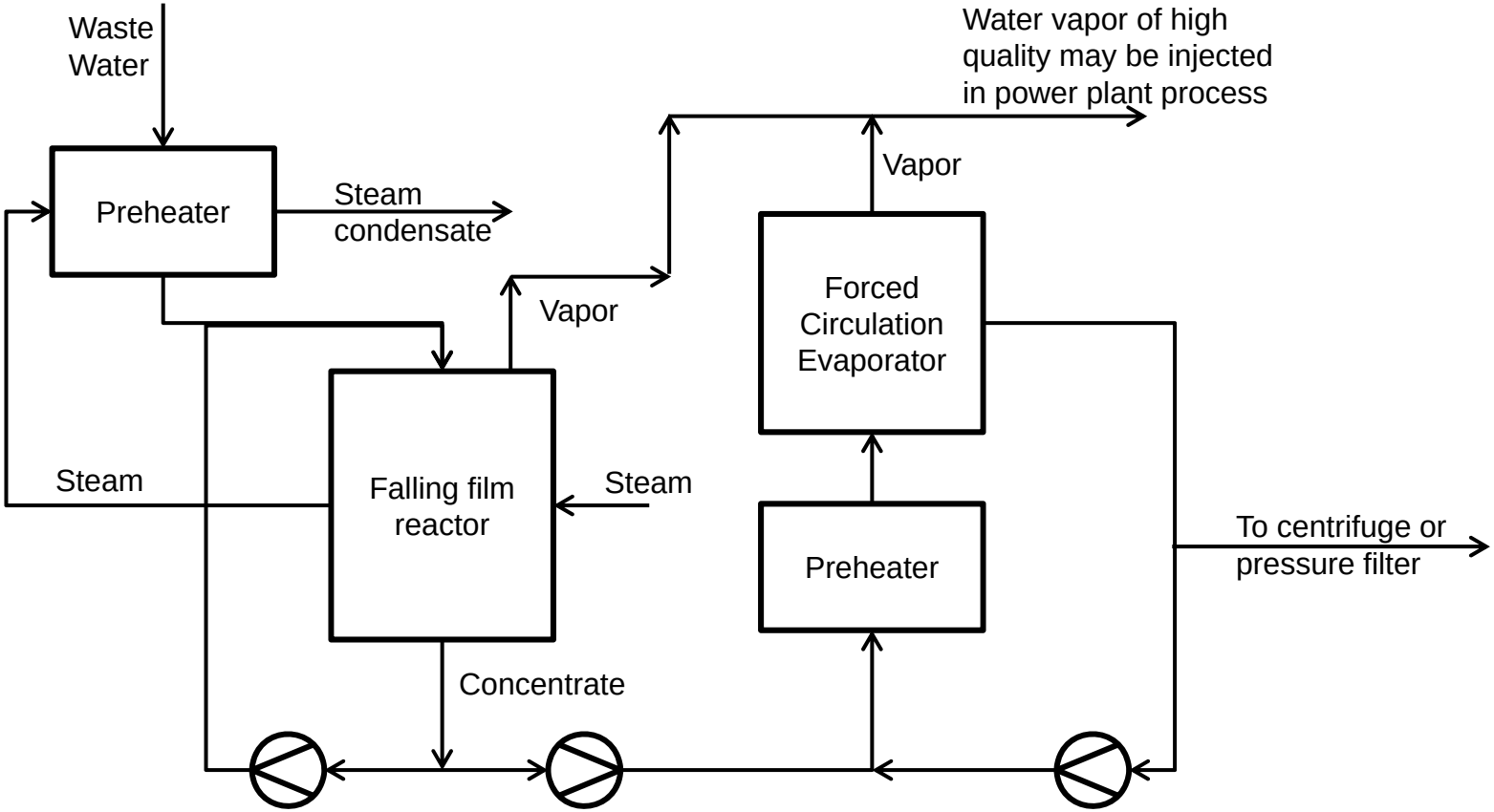
<u>No removal of Chlorides → soluble salts</u>

Dewatered sludge has to be deposited in landfill classes II or III depending on composition.

Requirements landfill class II:
- mineral drainage layer of 0,5 m

Requirements landfill class III:
- Thicker and more complex geological barrier
- Leakage detection system
- Special monitoring

Zero Liquid Discharge for humid regions
Waste Water Evaporation plant

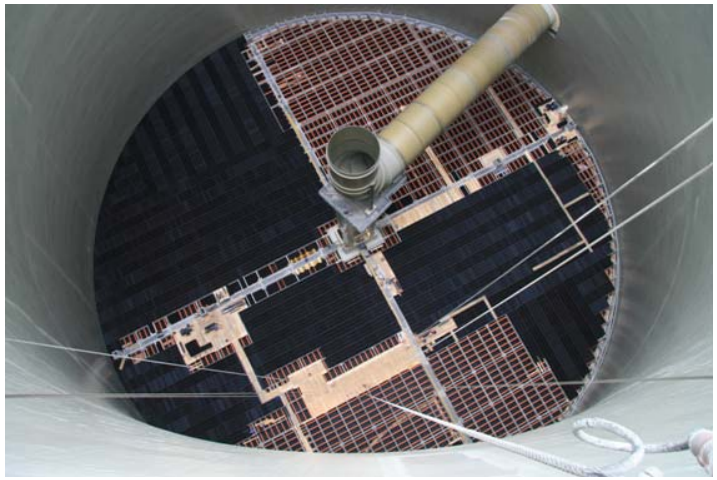


Further reduction of concentrated waste water discharge can be reached with a downstream centrifuge or pressure filter. Own consumption for 7.5 m³/h waste water is estimated to approximately 250 kWh/h, 900 kg/h steam (3bar) and 25 m³/h of cooling water.

Clean gas discharge via cooling tower

General situation

- Discharge of clean gas has to be permitted by local authority
- Coating Icosit-2406 by Sika is appropriate for cooling towers with discharge of clean gas, evaluation on technical execution should be done
- Discharge of clean gases via not operating cooling tower is not feasible



Example for possible saving of water
2 x 520 MW Power Station in India

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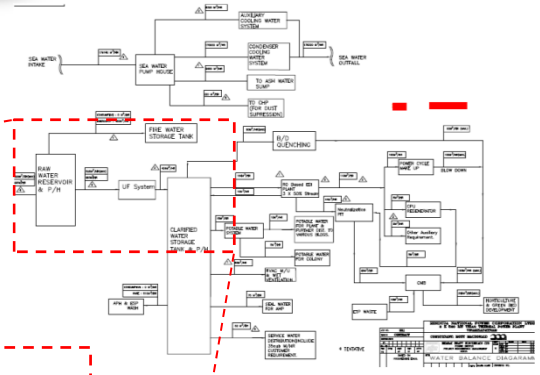
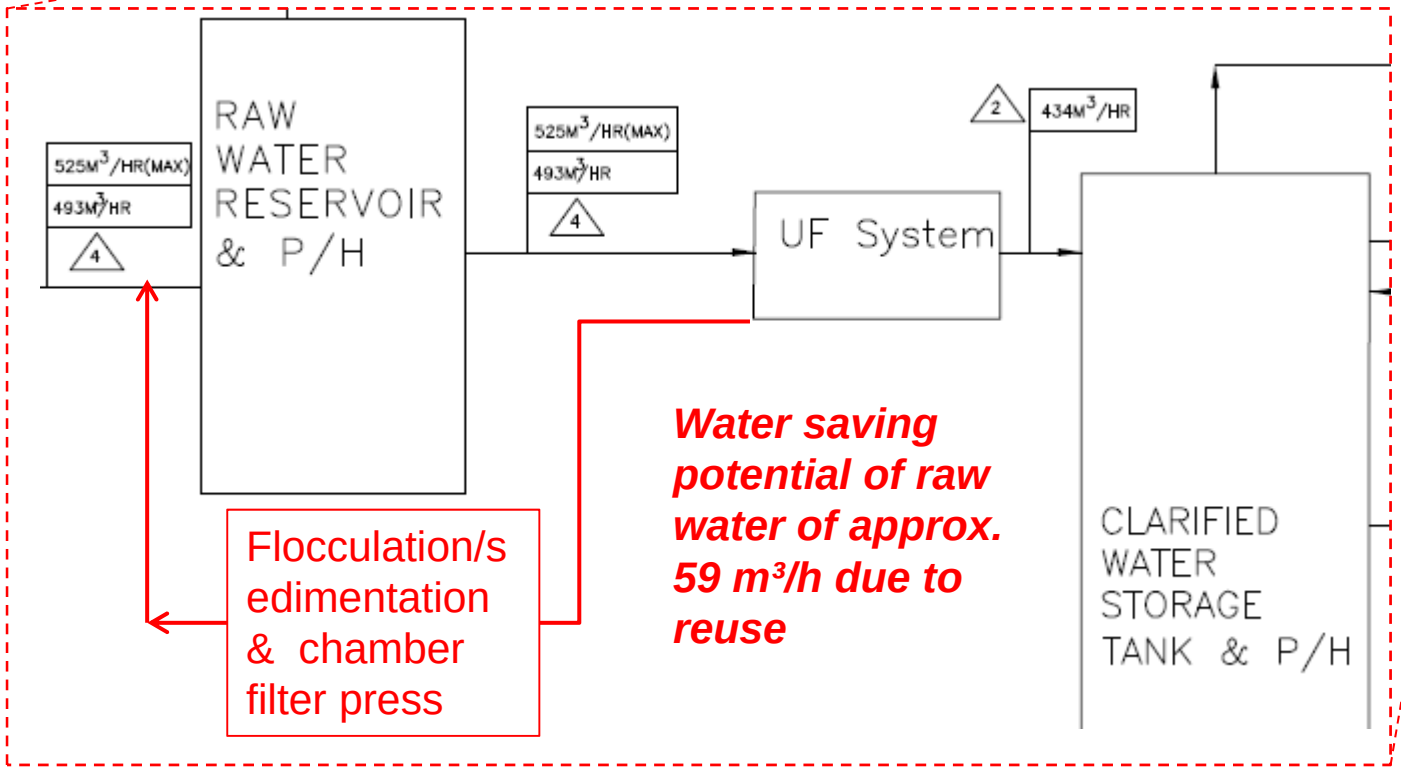
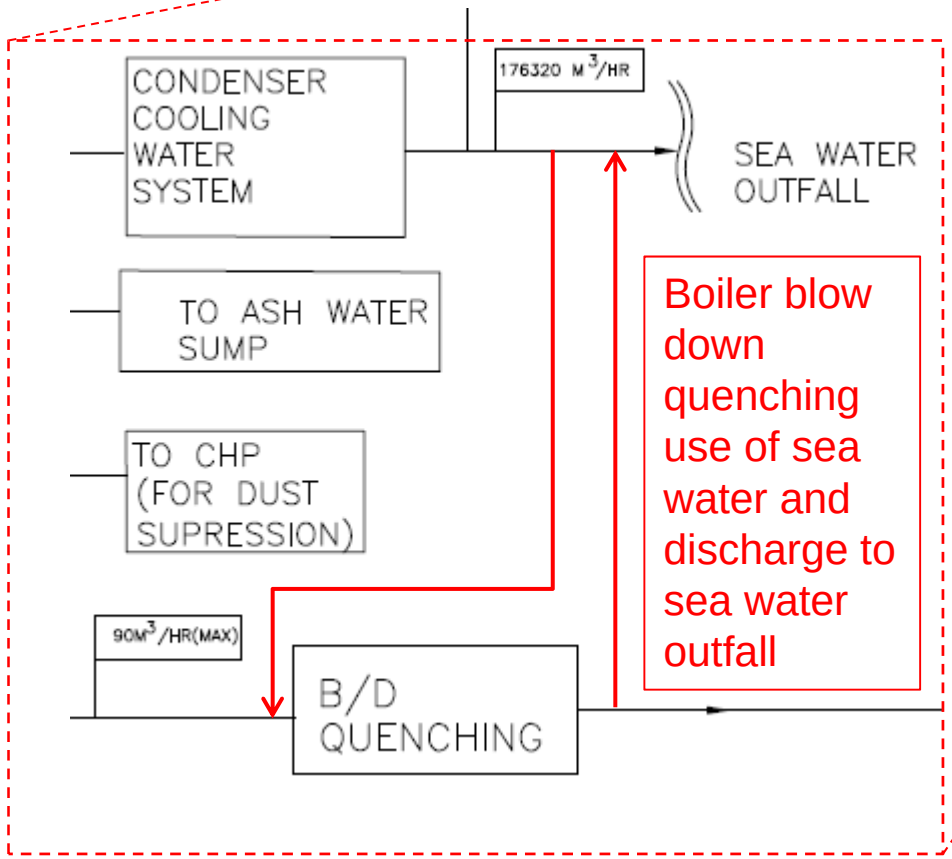
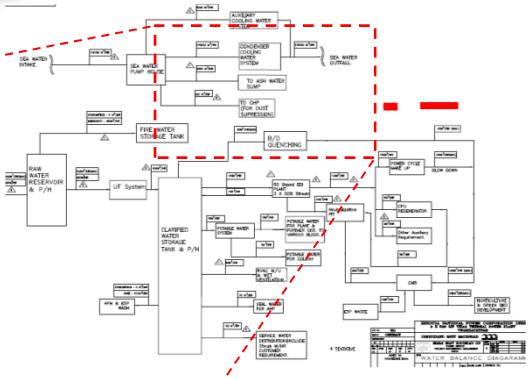




Flocculation & Sedimentation System

Example for possible saving of water
2 x 520 MW Power Station in India





Water saving potential of raw water of approx. 90 m³/h

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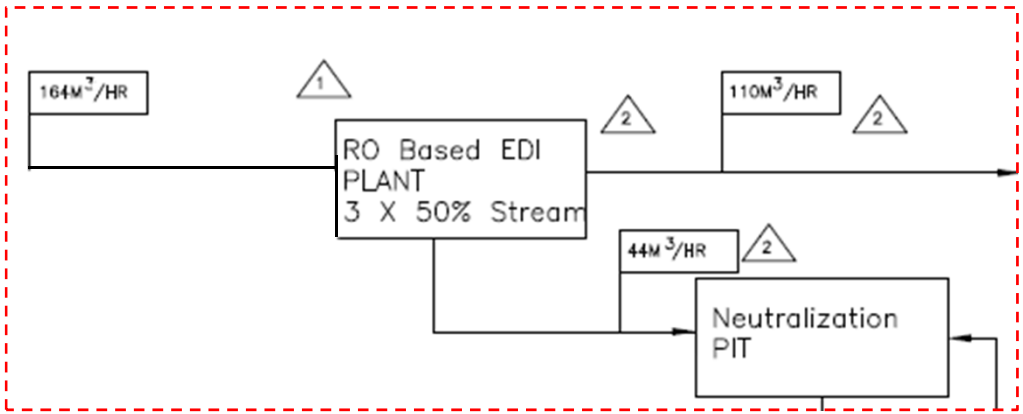
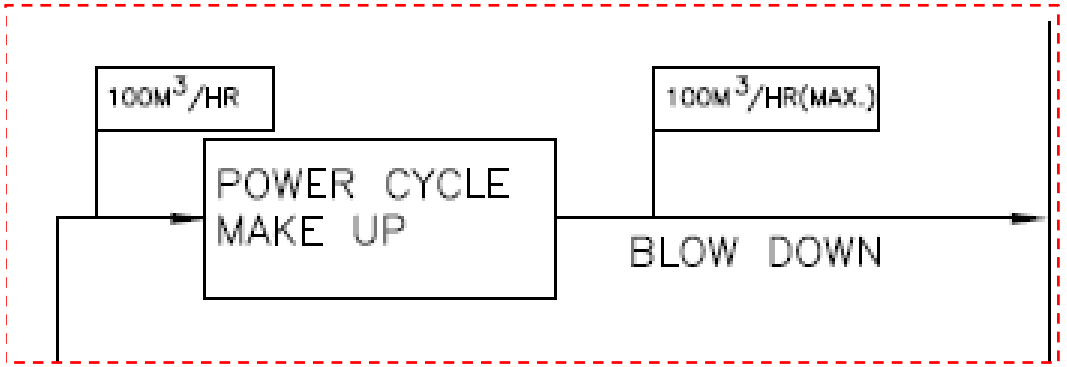
2 x 520 MW Power Station in India



Efficiency of installed Reverse Osmosis Plant is 71 % and approx. 4 % under the standard design value

Normally, boilers in India are designed for 3 % make up (100 tons/hrs for 1000 MW). VGB conformed demi-water usage:

- ***Drum boiler: max. 2 %,***
- ***Benson boiler max. 1.5 %***



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