Softening

Design of 4th Mega location Oasen

CT 5520

Drinkingwater Treatment 2

Floor van den Berg
Udo Ouwerkerk

June 1, 2007

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TU Delft
Delft University of Technology

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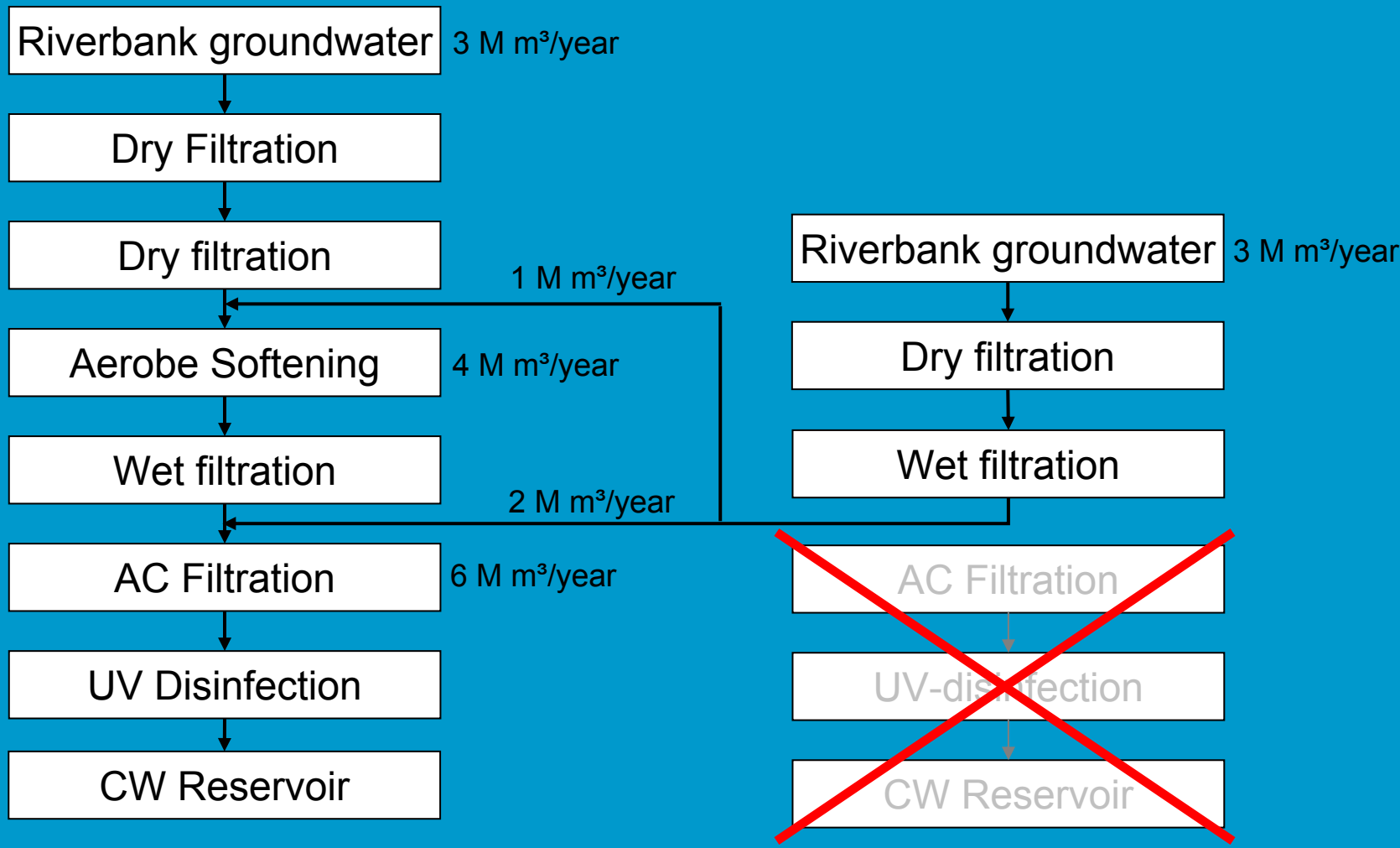
2nd Phase, softening



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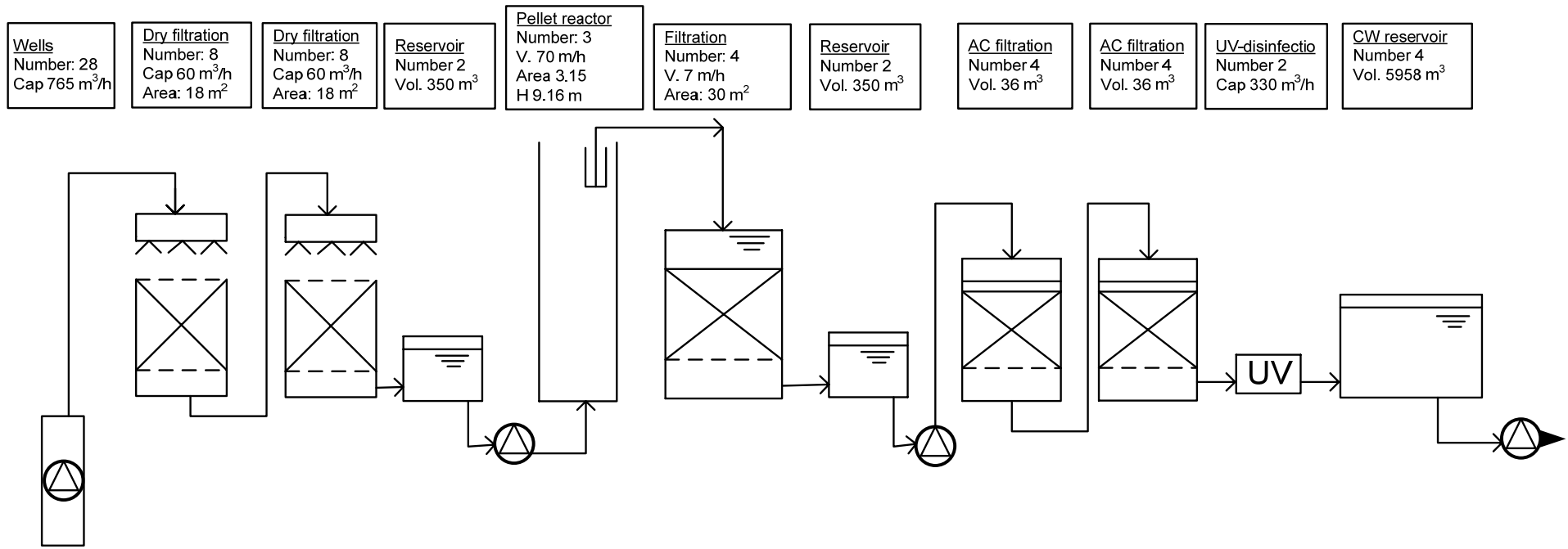
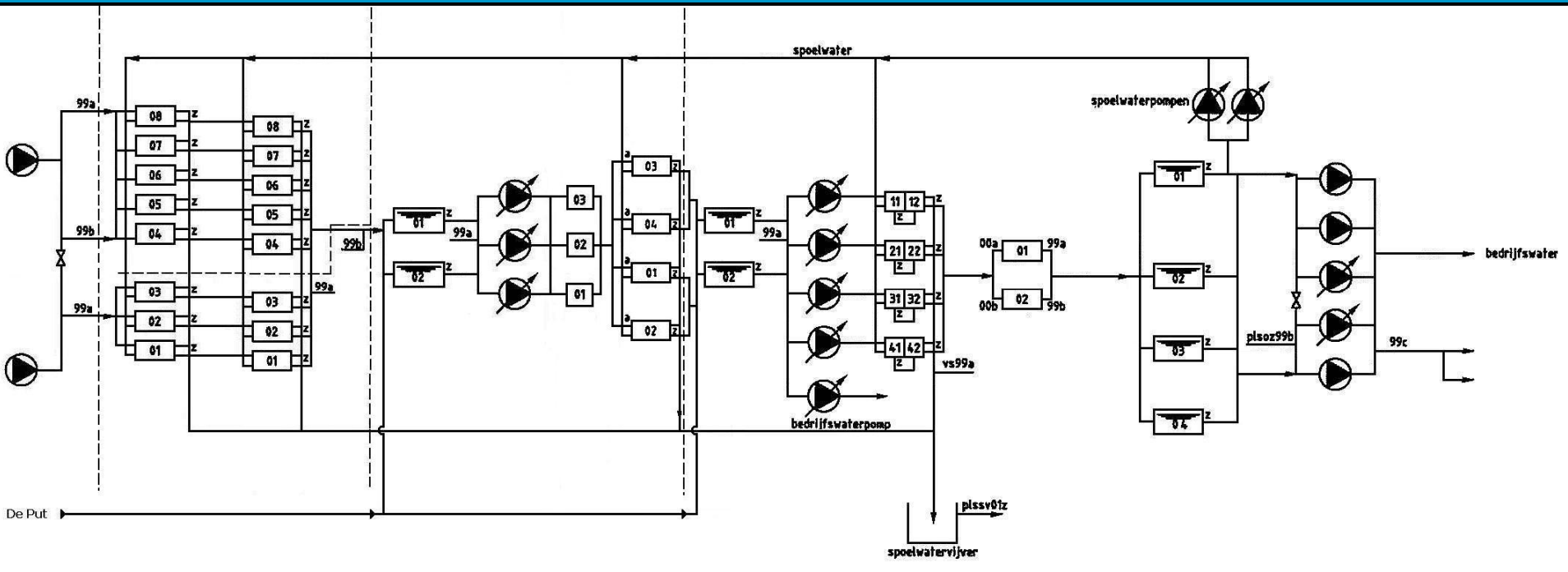
PID, 2nd Phase



Process scheme 2nd Phase



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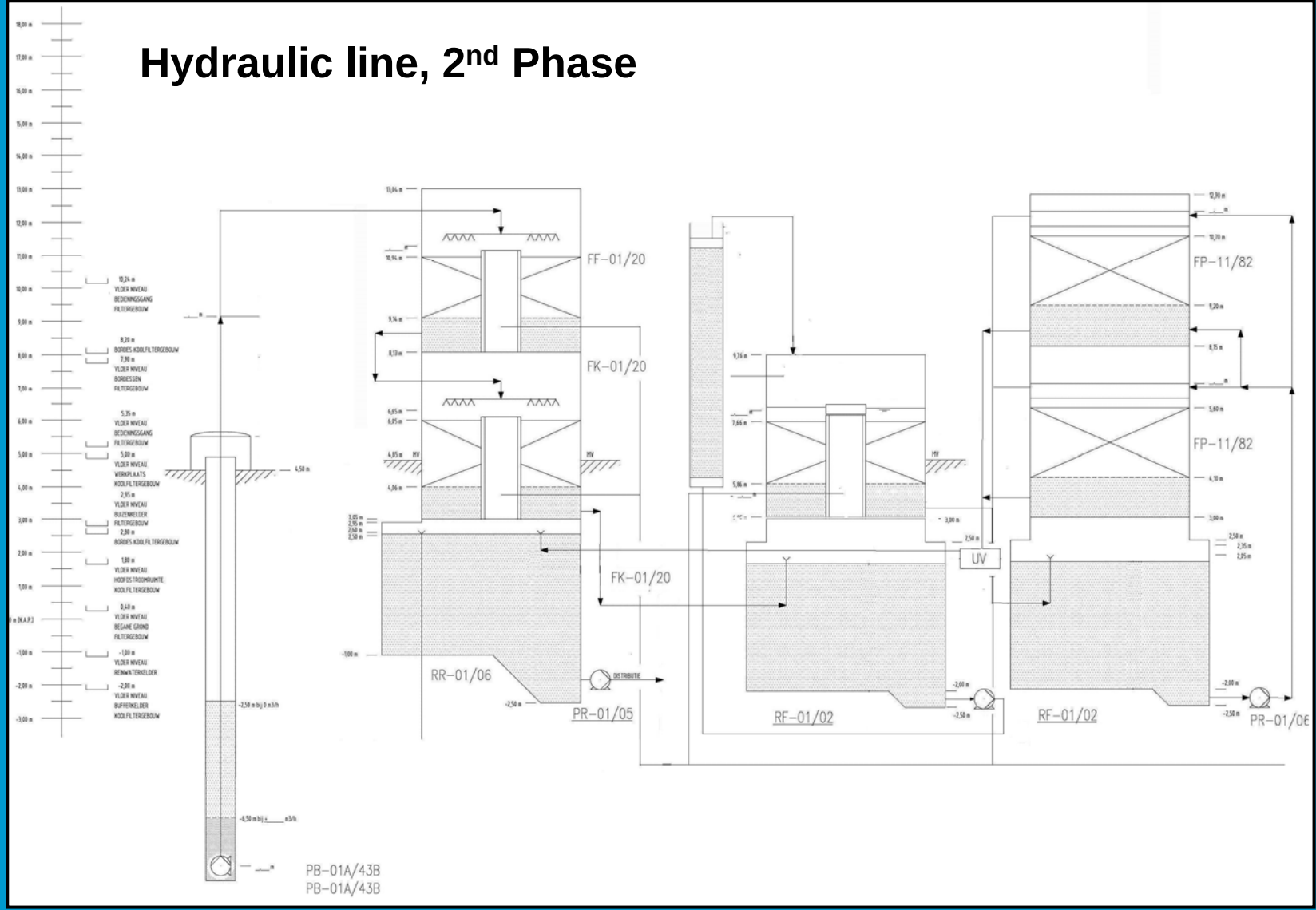
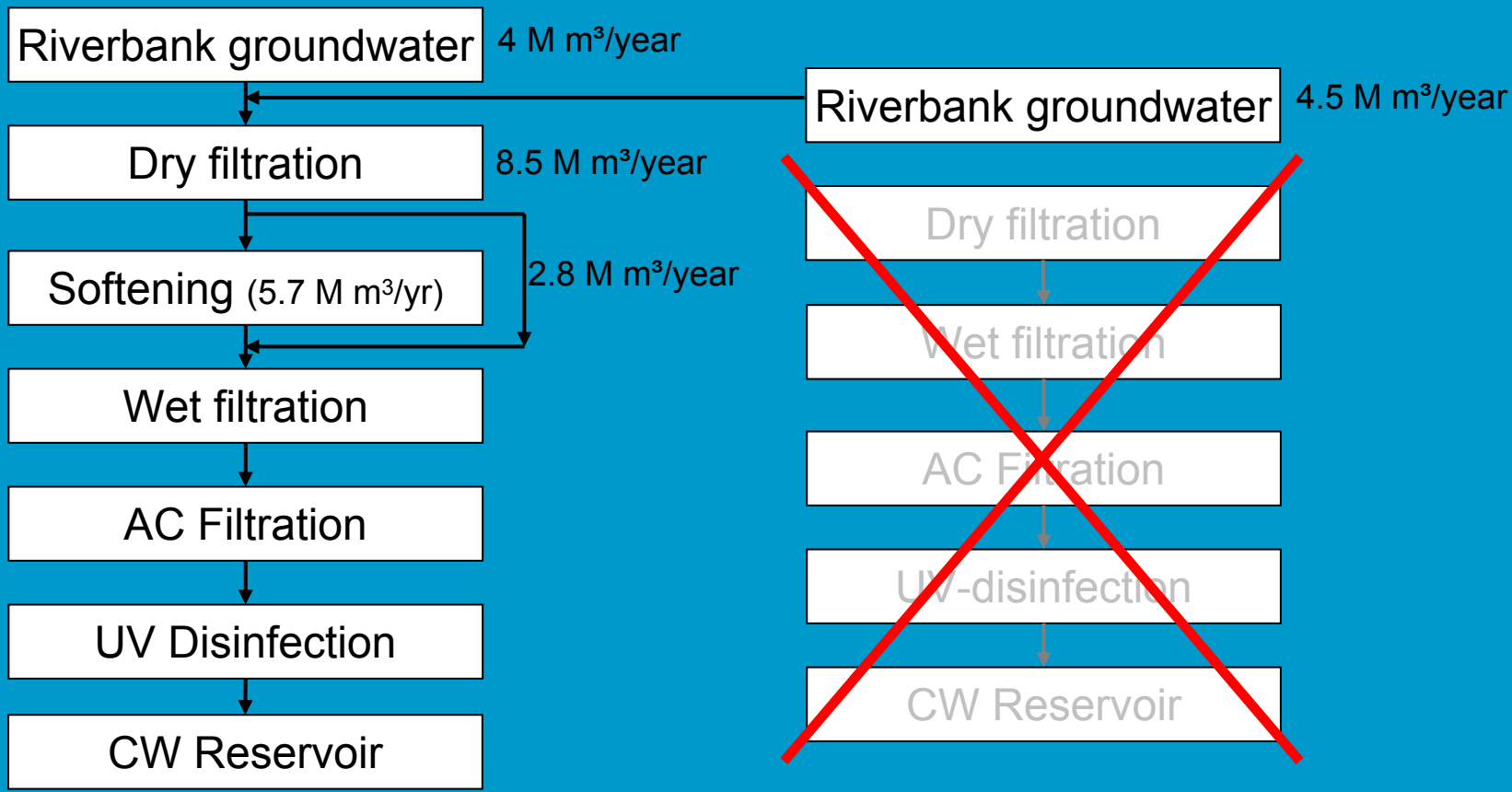
Hydraulic line, 2nd Phase



3th Phase, Scaling up



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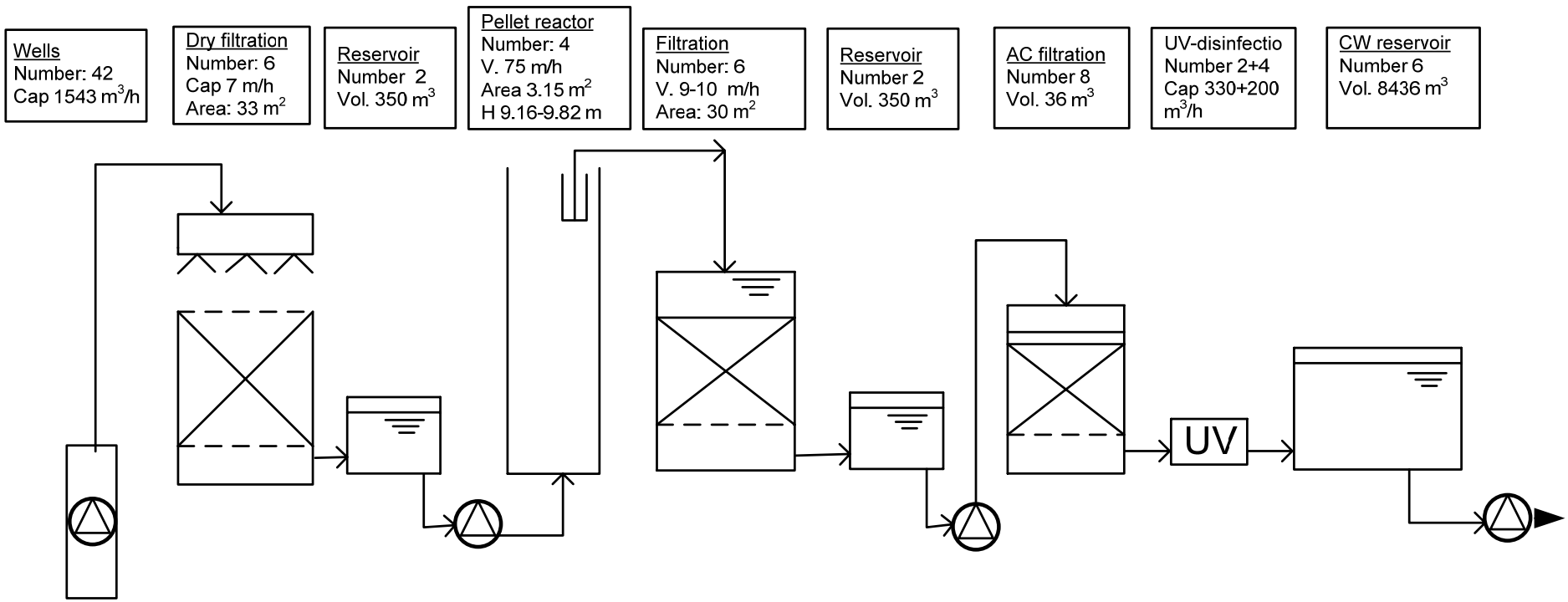
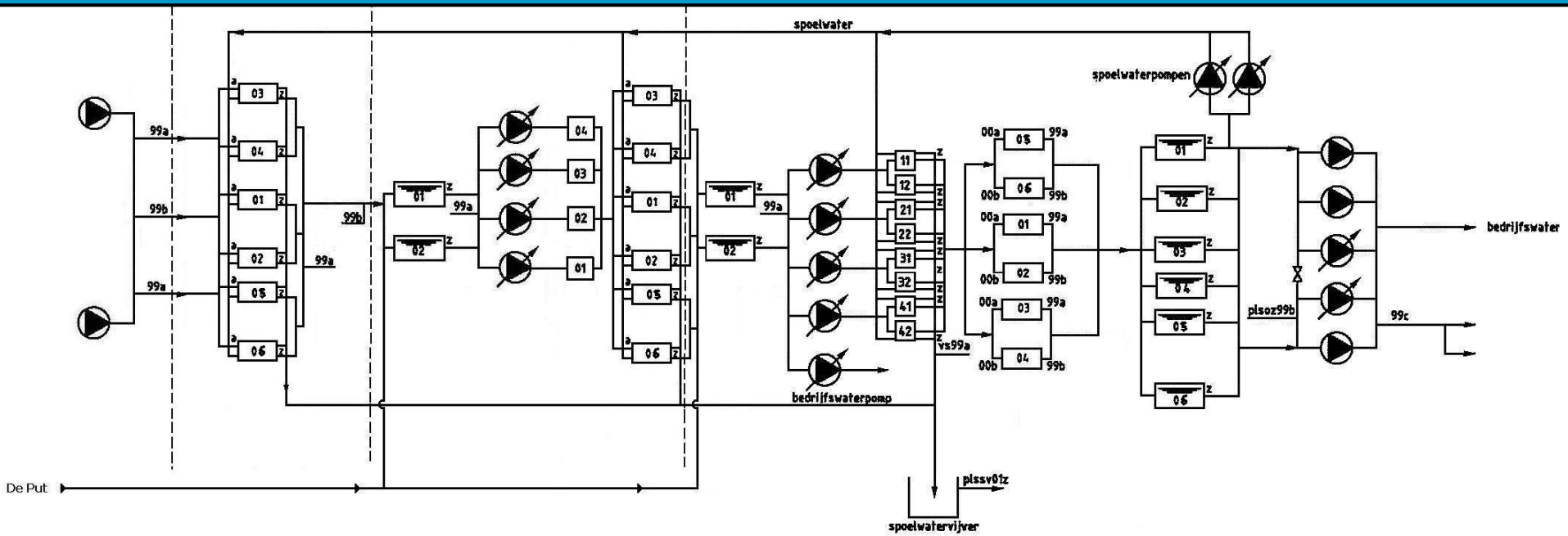
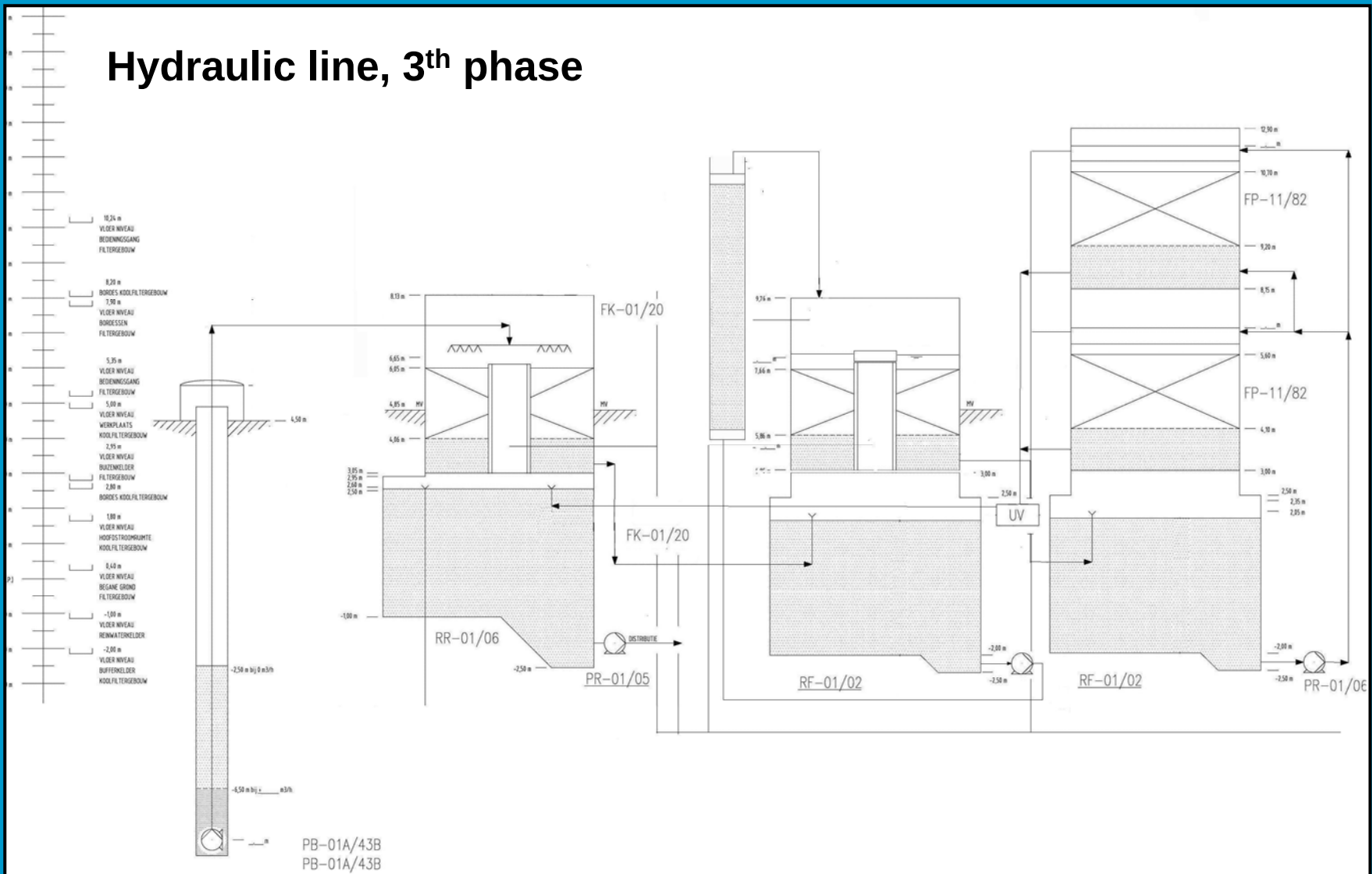
PID, 3th Phase



Process scheme , 3th Phase



Hydraulic line, 3th phase



New building
Softening reactors
Carry over filtration
Seeding sand storage
Pellet storage
Seeding sand washer
Disinfection storage
Chemical storage

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Storage

- Seeding sand washer
  - small particles are washed out
  - caustic soda is added for disinfection
- Disinfection storage
  - no bacteriological contamination
- Chemical storage
  - NaOH is diluted to a 25% solution
- Seeding sand storage

2 tanks of 3m^3 would be sufficient for 8 months in the 2nd fase and for 5.5 months

- Pellet storage:

2nd phase: 102,63 kg/h

3th phase: 145,47 kg/h

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Pellet Reactor

- **Chemicals**
  - Amount of Chemicals 2nd Phase
  - Amount of chemicals 3th Phase
- **Dimensions**
  - Dimensions 2nd Phase
  - Dimensions 3th Phase
- **Construction**

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Chemicals, 2nd / 3th Phase

Ca^{2+} = 2.05 mmol/l, raw water

Mg^{2+} = 0.45 mmol/l, raw water

1.55 mmol/l Ca^{2+} needs to be removed

$$Na(OH) + CO_2 \rightarrow HCO_3^- + Na^+$$

$$Na(OH) + Ca^{2+} + HCO_3^- \rightarrow CaCO3\ (s) + Na^+ + H_2O$$

1.55 mmol/l caustic soda is needed → 2nd Phase max 41.05 kg/h NaOH

3th Phase max 58,19 kg/h NaOH

- Na(OH), gives a fine water quality
- Easy to dose

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Dimension Softening, 2nd Phase

- Min flow-max flow : 60 m/h - 100 m/h
- Enough capacity needed when one reactor breaks down
- Partial flow for softening at Lekkerkerk: 4.0 M m³/year → 456.62 m^3/h

  Min: 0.85 * 456.62 m3/h = 388.13 m^3/h
  Max: 1.45 * 456.62 m3/h = 662.1 m^3/h

A_{total}=(662.1 m^3/h) / (70 m/h) = 9.46 m^2 → 3 reactors, $A_{reactor}$ =3.15 m^2

- When Q_{min}= 388.13 m^3/h → 2 reactors with a velocity: 61.5 m/h
- When Q_{gem}= 456.62 m^3/h → 2 reactors with a velocity: 72.3 m/h
- When 1 reactor breaks down → 2 reactors with a velocity: 105 m/h

  L_e= 7.26 m

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Dimension Softening, 3th Phase

- Min flow-max flow : 60 m/h - 100 m/h
- Enough capacity needed when one reactor breaks down
- Partial flow for softening at Lekkerkerk: 5.7 M m³/year → 647.3 m3/h
  Min: 0.85 * 647.3 m3/h = 550.2 m3/h
  Max: 1.45 * 647.3 m3/h = 938.5 m3/h →

1 extra pellet reactor of equal dimensions

A_{total}=(938.8 m^3/h) / (75 m/h) = 12.60 m^2 → 4 reactors, $A_{reactor}$ =3.15 m^2

- When Q_{min}= 550.2 m^3/h → 2 reactors with a velocity: 87.3 m/h
- When Q_{gem}= 647.3 m^3/h → 3 reactors with a velocity: 68.5 m/h
- When 1 reactor breaks down → 2 reactors with a velocity: 99.3 m/h
  L_e= 6.86 m

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Construction, 2nd Phase

- $E_{total}=1/3*E_{1.0}+2/3*E_{0.3}$

  $E_{1.0}=1.0$

  $E_{0.3}=3.3$

  → $E_{total}=2.53$

- $L_{total}=L_{in}+L_e+L_{uit}$

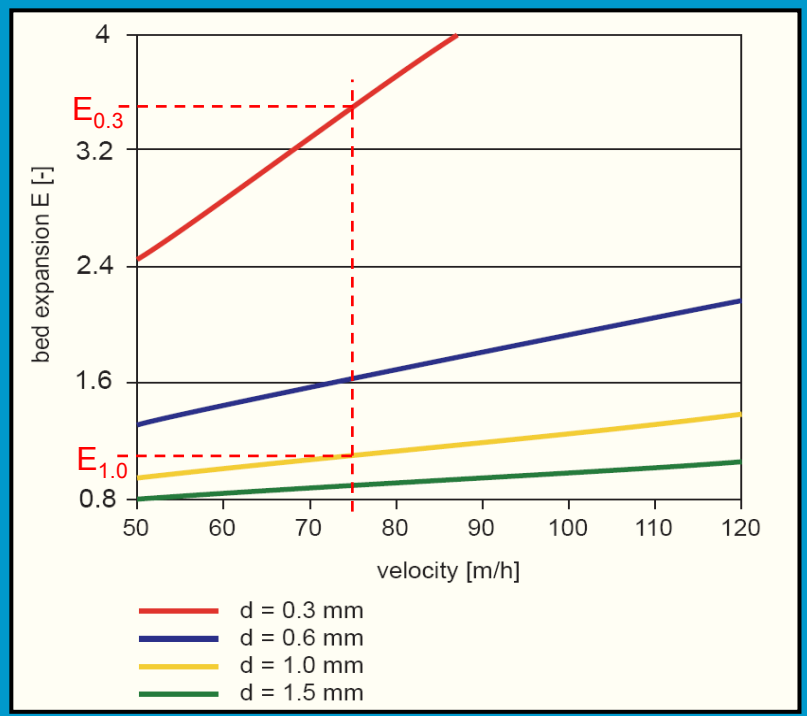
  $L_e = L_0 * E_{total}$

  $L_e =(2\ m)*2.53= 5.06\ m$

  $L_{in}=1.5\ m$

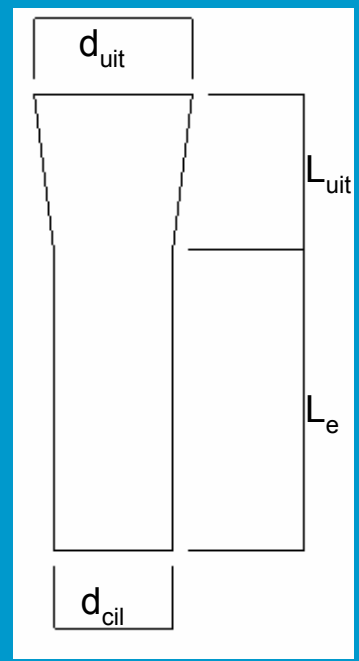
  $L_{uit}=2.60\ m$

  → $L_{total}=9.16\ m$



$d_{uit} = 2.65\ m$

$d_{cil} = 2.00\ m$



Construction, 3th Phase

- $E_{total}=1/3*E_{1.0}+2/3*E_{0.3}$

  $E_{1.0}=1.1$

  $E_{0.3}=3.5$

  → $E_{total}=2.7$

- $L_{total}=L_{in}+L_e+L_{uit}$

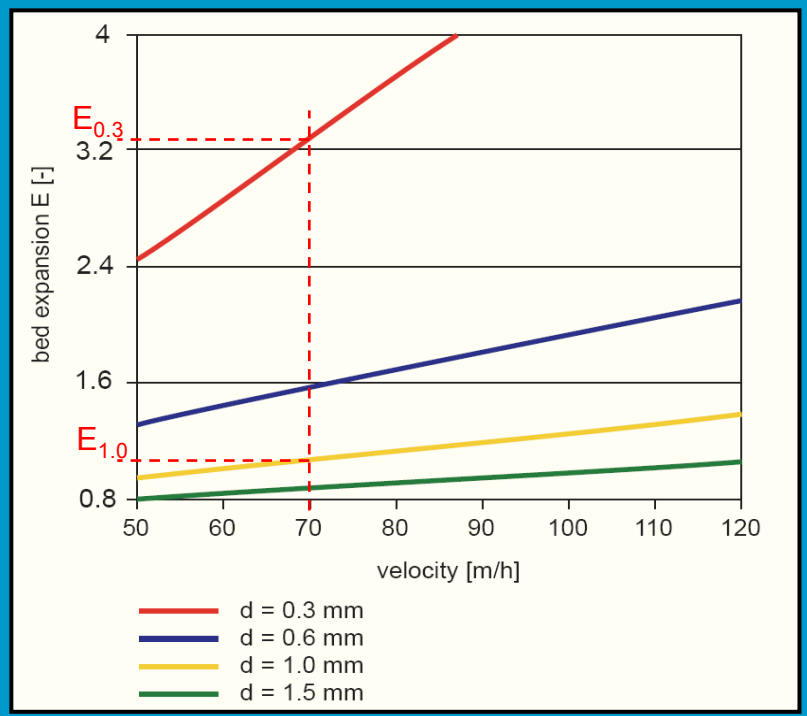
  $L_e = L_0 * E_{total}$

  $L_e =(2\ m)*2.7= 5.40\ m$

  $L_{in}=1.5\ m$

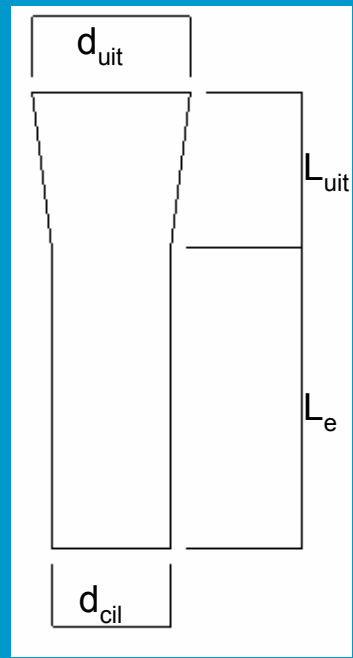
  $L_{uit}=2.92\ m$

  → $L_{total}=9.82\ m$



d_{uit} = 2.73 m

d_{cil} = 2.00 m



Questions?

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