Heat Roadmap Europe 2050
A low-carbon heating and cooling strategy

4DH
4th Generation District Heating Technologies and Systems

reINVEST

3RD INTERNATIONAL CONFERENCE ON

SMART ENERGY SYSTEMS AND 4TH GENERATION DISTRICT HEATING

COPENHAGEN, 12–13 SEPTEMBER 2017

AALBORG UNIVERSITY
DENMARK

R/R or R/S feed-in plants

What is most important for a feed-in plant, solar thermal or any other heat source?

- **Generate as much heat as possible?**
- **Produce useful heat, at a correct temperature?**
- **Disturb the central heat production as little as possible?**
- **Generate heat as economically as possible?**

A Feed-in Solar Thermal plant in Ystad

Owner – Ystad Fjärrvärme (public owned company)

Area – 36 collectors, 534 m² aperture area

Collector brand – SavoSolar

Contractors – 3 parts,

- **SavoSolar – all parts and all work on roof**
- **Absolicon – deliver of feed-in sub-station, with control unit**
- **Ystad fjärrvärme (DH) – all the rest with sub-contractors and own staff**

Responsible for tender documents and system design

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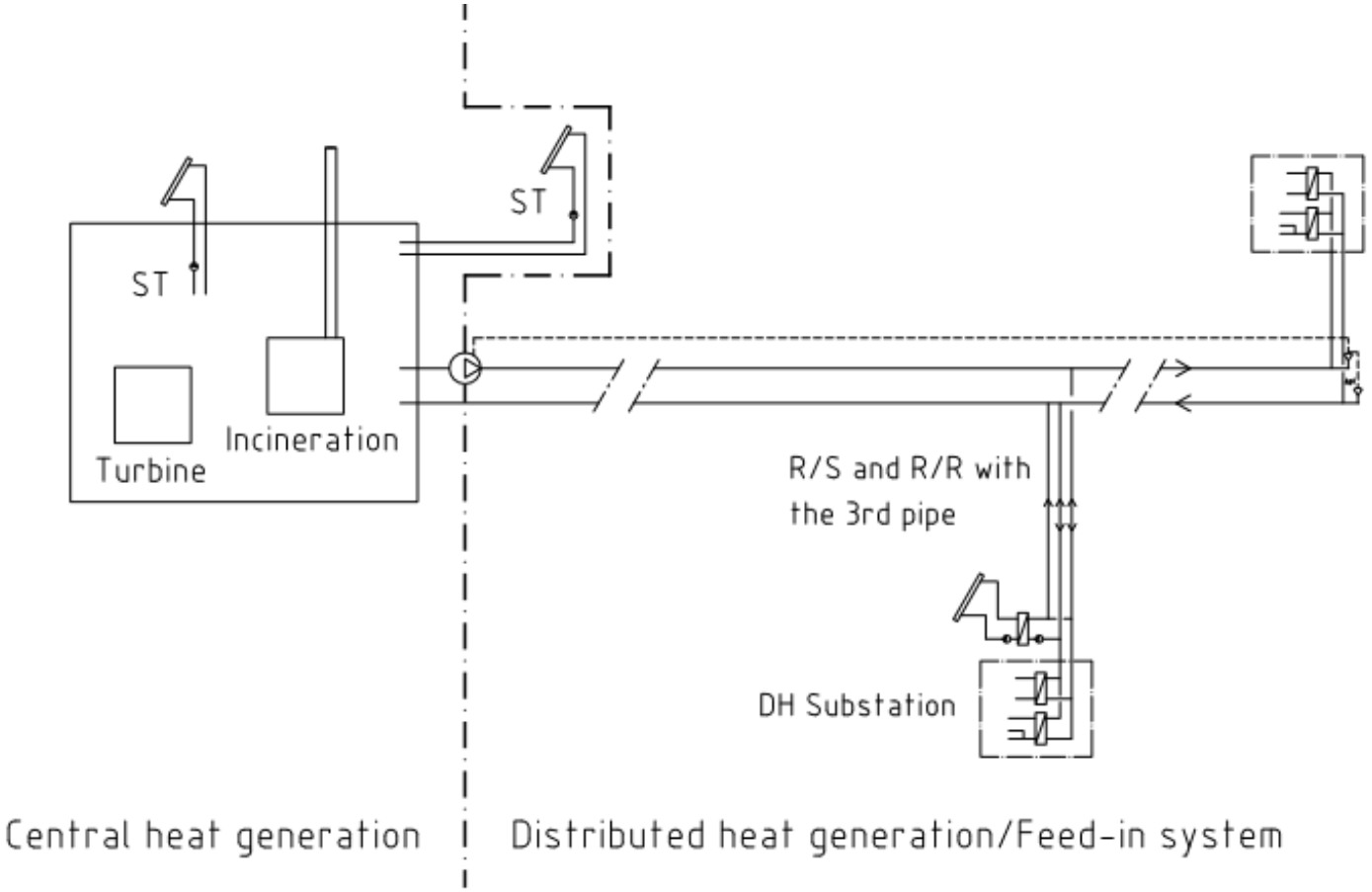
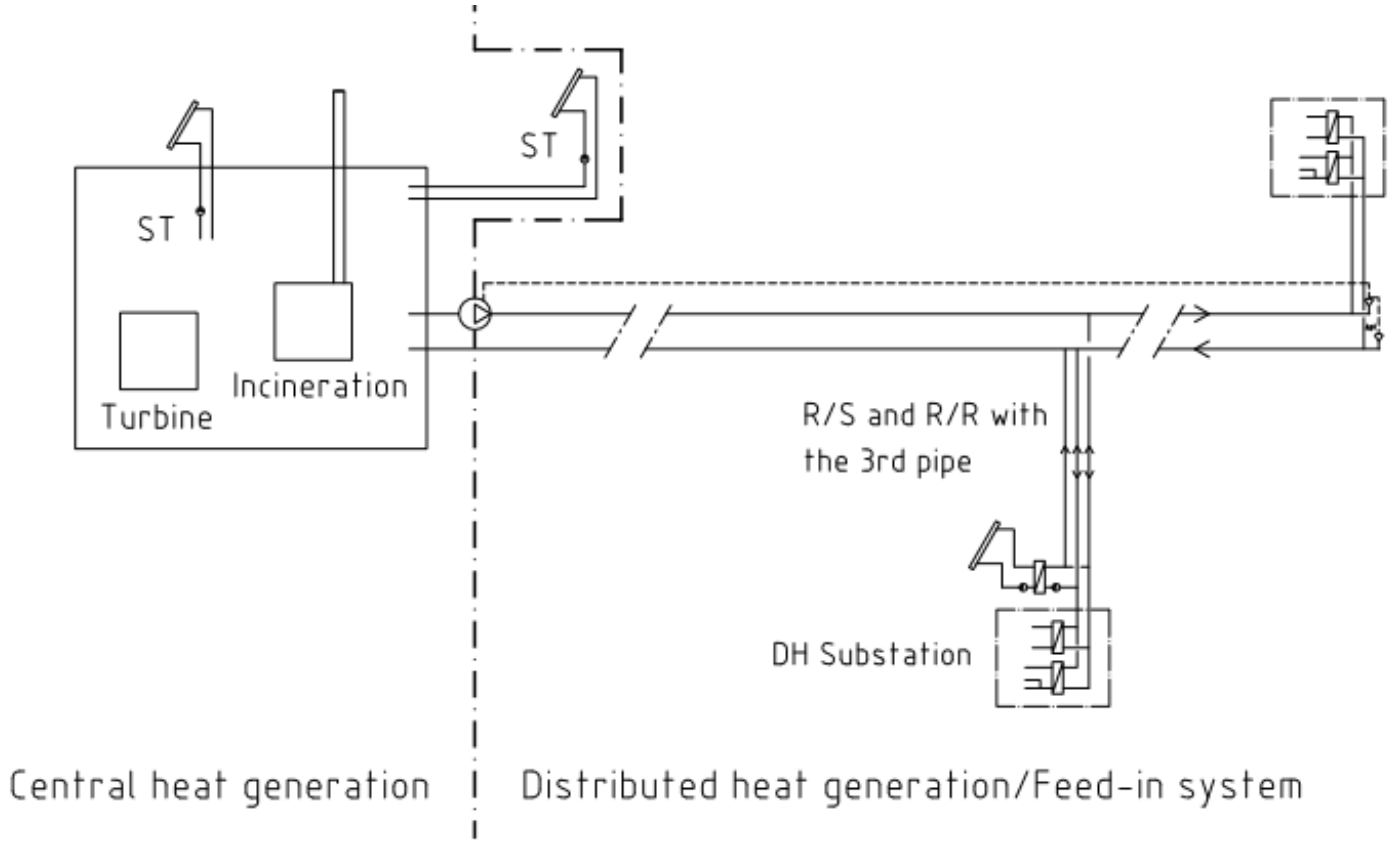
- **A feed-in plant – connected to the DH network outside the main pumps in the system**


ST
ST
Turbine
Incineration
R/S and R/R with
the 3rd pipe
DH Substation
Central heat generation
Distributed heat generation/Feed-in system

- **A feed-in plant – connected to the DH network outside the main pumps in the system**
- **A combination between Return/Return and Return/Supply feed-in**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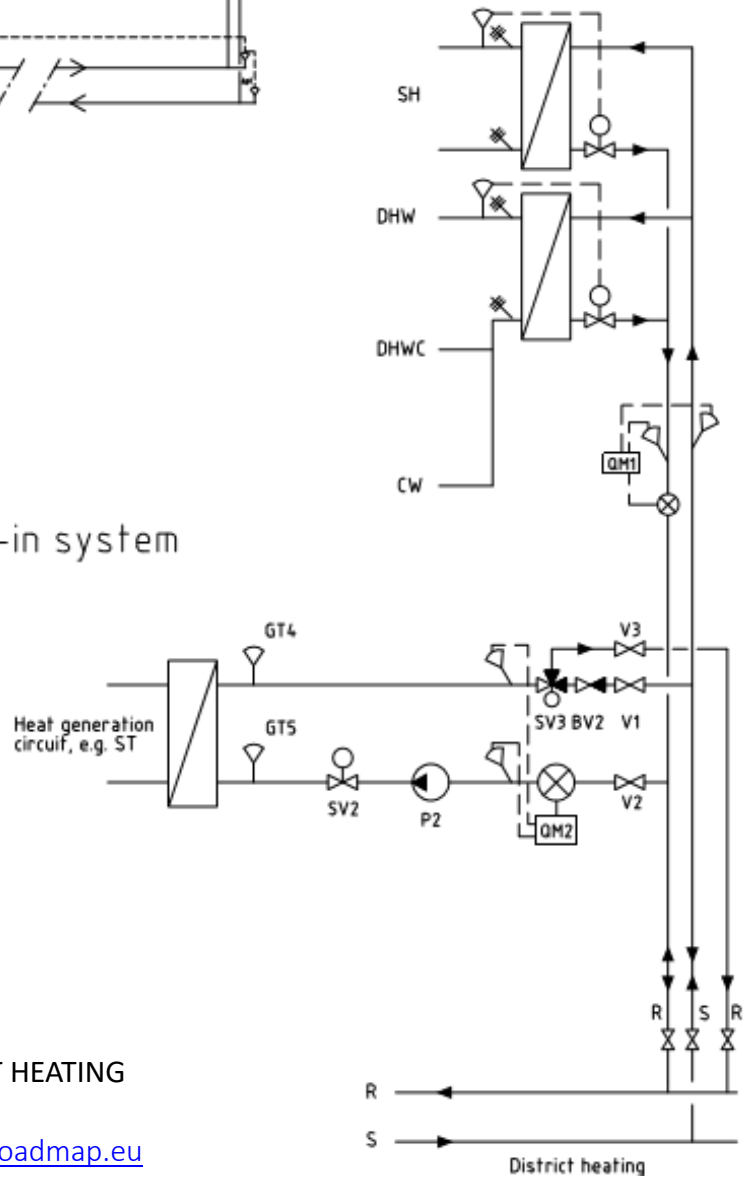
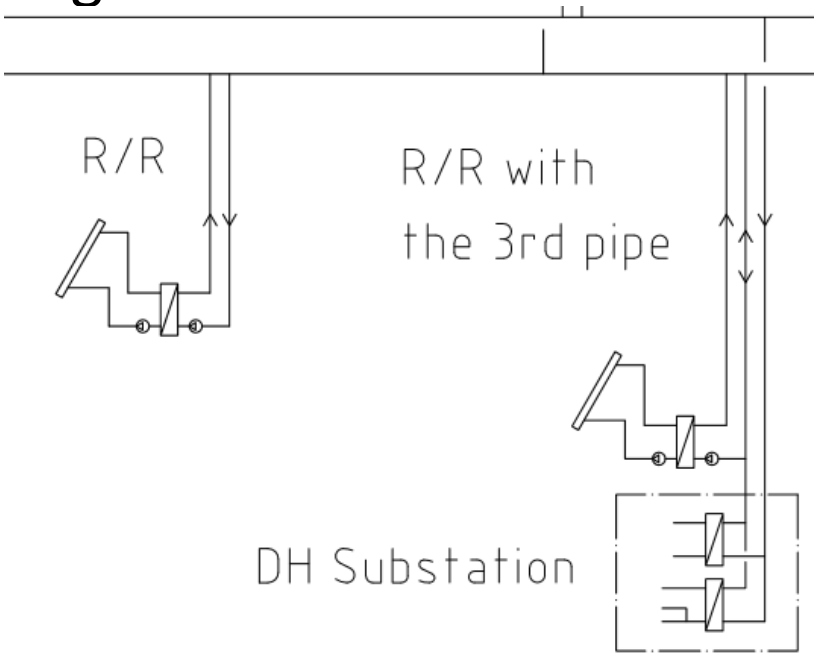

SH
DHW
DHWC
CW
QM1
GT4
V3
Heat generation
circuit, e.g. ST
GT5
SV3 BV2
V1
SV2
P2
QM2
V2
R
S
R
R
S
District heating

- **A feed-in plant – connected to the DH network outside the main pumps in the system**
- **A combination between Return/Return and Return/Supply feed-in**
- **Use a Flow controlled R/S-feed in system**
- **Have main control options regarding**
  - **Flow control in the solar circuit**
  - **Feed-in flow control, temperature or flow**
  - **Feed-in pump and control valve for flow adjustment**

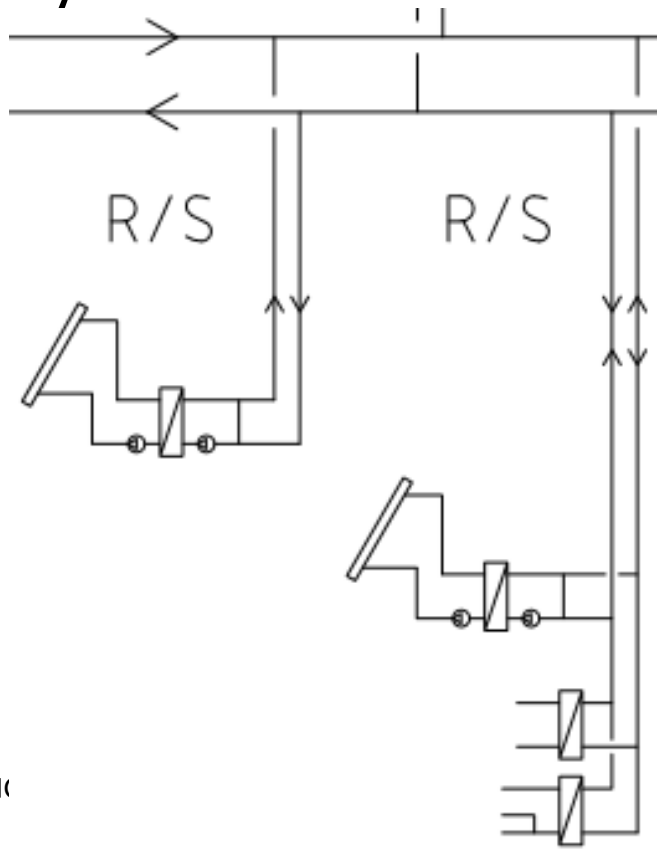
R/R – water is withdrawn from the return pipe and feed back to the return pipe

- Need a third pipe when installed together with a sub-station
- Do not need to feed-in at given lowest temperature
- Increase the return temperature in DH network
- Need very little pump pressure heed to give correct flow
- A very simple control function
- Can not create a flow in the main DH-network



R/S – water is withdrawn from the return pipe and feed back to the supply pipe

- Can be installed separate and together with a sub-station without any extra piping
- Do not affect the temperature in the DH system
- Need much more feed-in pressure head to overcome the differential pressure than a R/R system
- Must feed in a given temperature or at least higher than a given temperature
- More advanced control system
- Can create its own flow in the DH network



Two basic R/S control systems

- Temperature controlled – with a short circuit

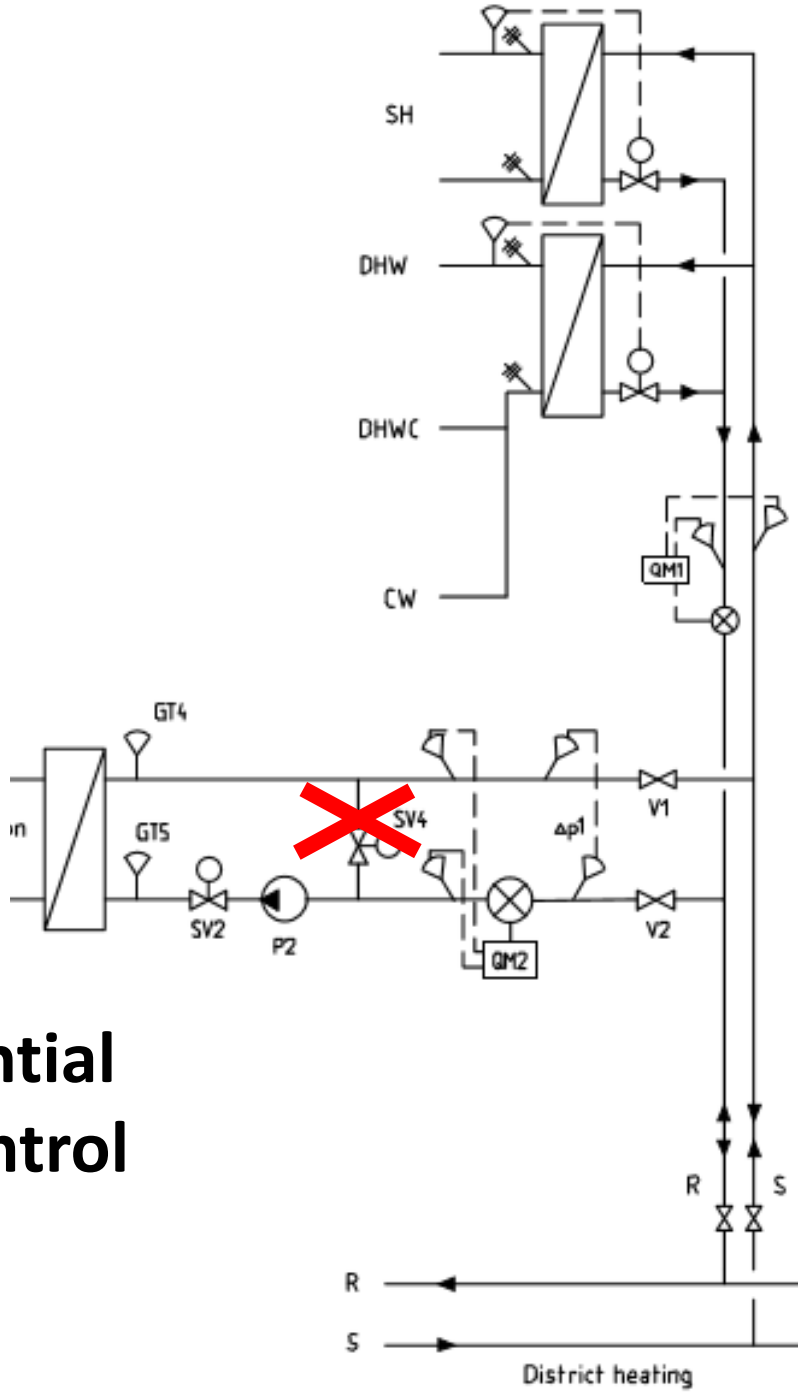
SV4 is never allowed to close to 100 %.

P2 guarantees a feed-in flow but SV4 control it.

- Flow controlled – without short circuit

SV4 do not exist

The feed-in flow is controlled by P2 and/or SV2



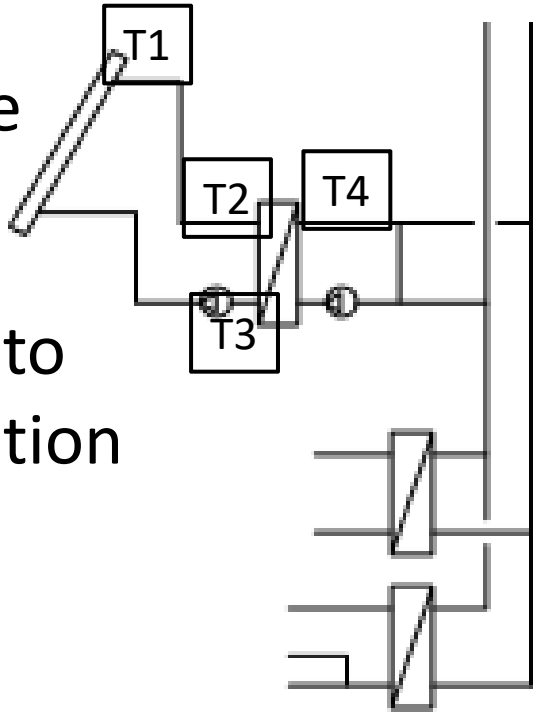
A small plant and a high differential pressure gives a more severe control

Solar circuit control at R/S mode

The desire is to have a stable temperature at T2 independent of the radiation, 2 to 3 degrees higher than feed-in set-point, T4.

Variable flow can provide a very long response time.

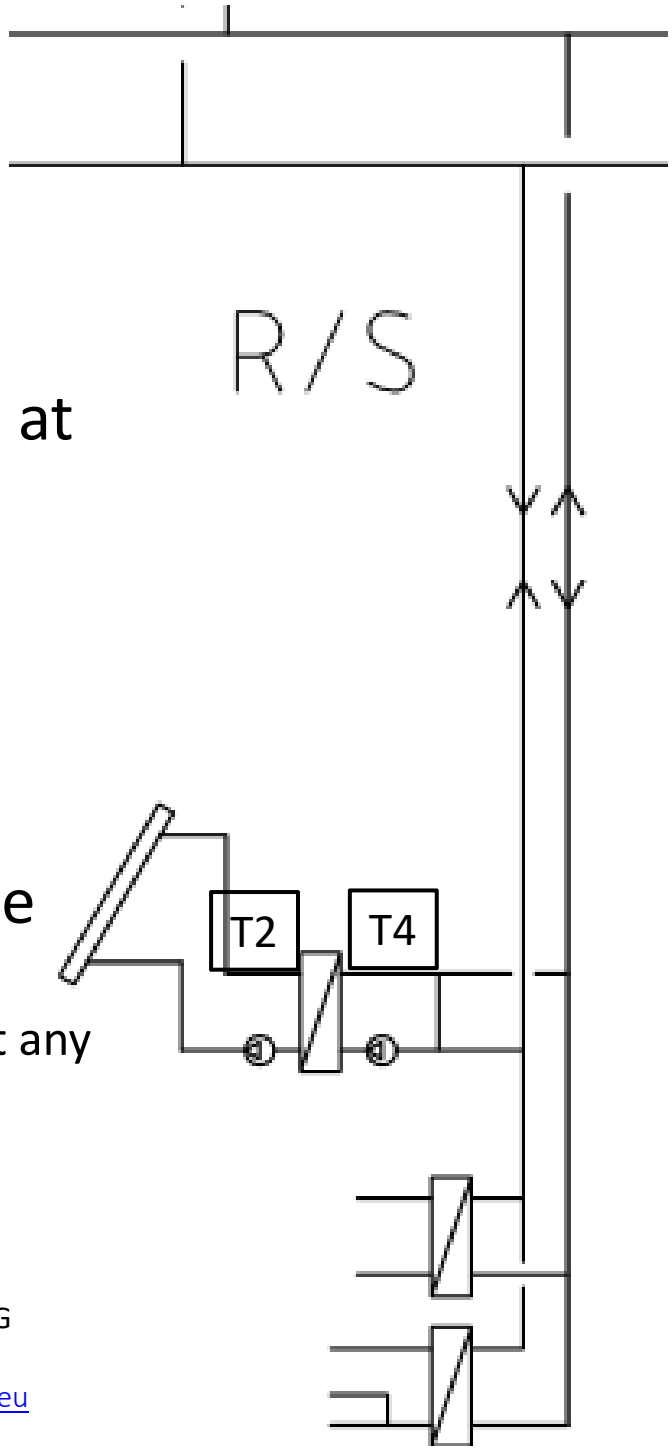
- Adjust the ST-pump speed to have a stable temperature at T1 (= T2 + 2°C)
- Adjust the ST-pump speed relative to the radiation with help of the solar equation
- Fixed ST-pump speed variate T3 relative to the radiation with help of the solar equation



Laminar or turbulent flow in the absorber??

Feed-in circuit control at R/S mode

The desire is to ?????



- Adjust feed-in-pump speed so that the temperature setpoint can be maintained at T4

Need an extra function if T2 is to low, adjusted set-value

"Might" need a shorter response-time than a standard temperature sensor can give

- Adjust feed-in-pump speed relative to the flow in the solar circuit

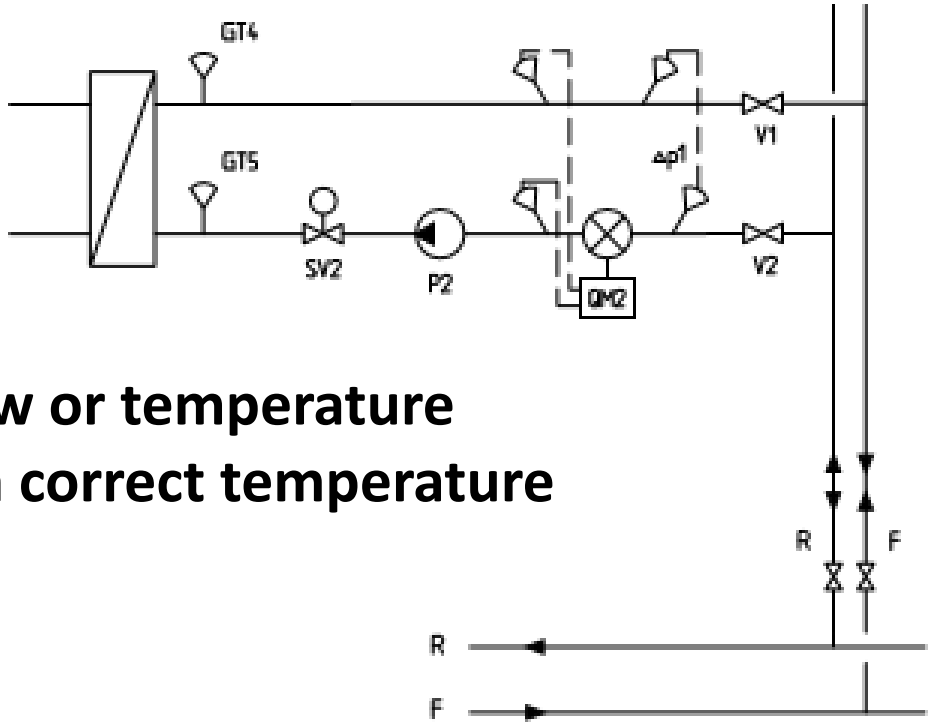
Do not guarantee a correct feed-in temperature at T4 if not any extra control functions is used

Need a "high" flow resolution??

Feed-in circuit control at R/S mode, flow controlled layout

How can a correct feed-in flow be created?

- Only with the feed-in pump, P2
- ~~Only with the control valve SV2~~
- A combination between the feed-in pump, P2, and a control valve, SV2
  - First SV2 then P2 (Δp1)
  - First P2 then SV2

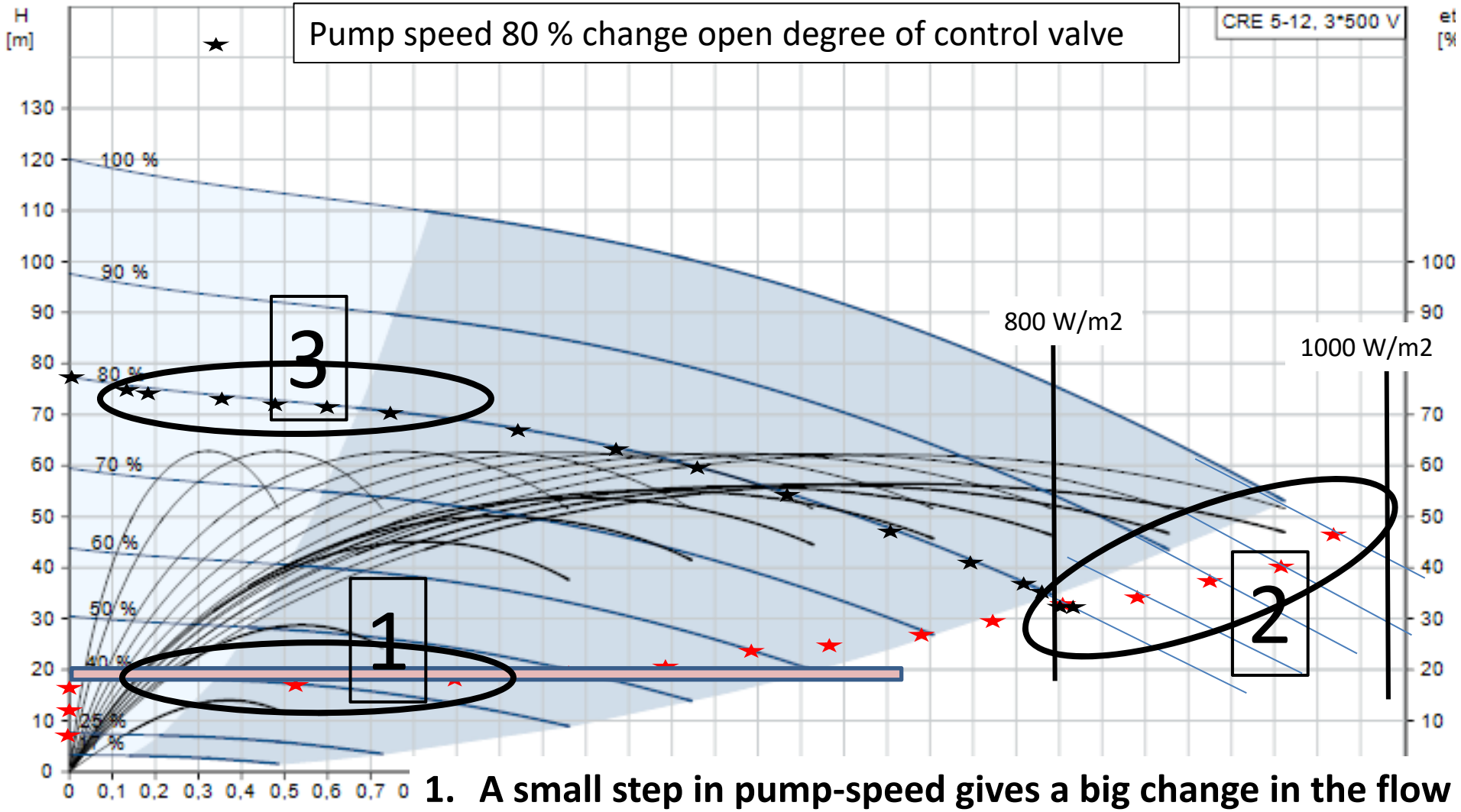


First - kind of control system, flow or temperature
Second - equipment used to gain correct temperature

Differential pressure 1,8 – 2,1 bar

Change of pump speed and control valve open to 100 %

Pump speed 80 % change open degree of control valve



1. **A small step in pump-speed gives a big change in the flow**
2. **Flow below recommended work area, risk for cavitation**
3. **It is easier to create a proper low flow with the SV2**

Experience so far, focus on R/S feed-in

- Vacuum degassing works, perhaps not necessary but strongly recommended
- It is easier to get a proper flow or temperature using a flow sensor, both in the ST circuit and at the feed-in, than using a temperature sensor
- A pump-speed related to differential pressure and flow control with a control valve is best at small flows, and pump-speed flow control at large flows
- The change between R/R and R/S, and revers, requires careful control planning

Return/Supply feed-in – demands from DH

Need a discussion (some requirements are listed below)

- Temperature tolerance, +/- X°C or only + X°C
- The cold plug at start, all at once, towards S or R
- Risk of fatigue, varying temperatures, cycles a day
- Change in feed-in heat-power, kW/minute
- Change in feed-in flow, l/s per minute
- Risk for water hammers, fast change in flow
- Maximum feed-in heat-power in relation to the current DH heat-power requirement

Plants with R/R+R/S need more rules

Thank you

Questions

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