4th International Conference on Smart Energy Systems and 4th Generation District Heating
Aalborg, 13-14 November 2018

Requirements for a prosumer facility (feed-in plant)

AALBORG UNIVERSITY
DENMARK

4th International Conference on Smart Energy Systems and 4th Generation District Heating 2018
#SES4DH2018

4DH
4th Generation District Heating Technologies and Systems

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

Feed-in plants need more rules

4DH
4th Generation District Heating Technologies and Systems

Energianalys AB

Gunnar Lennermo

Solar Thermal consultant

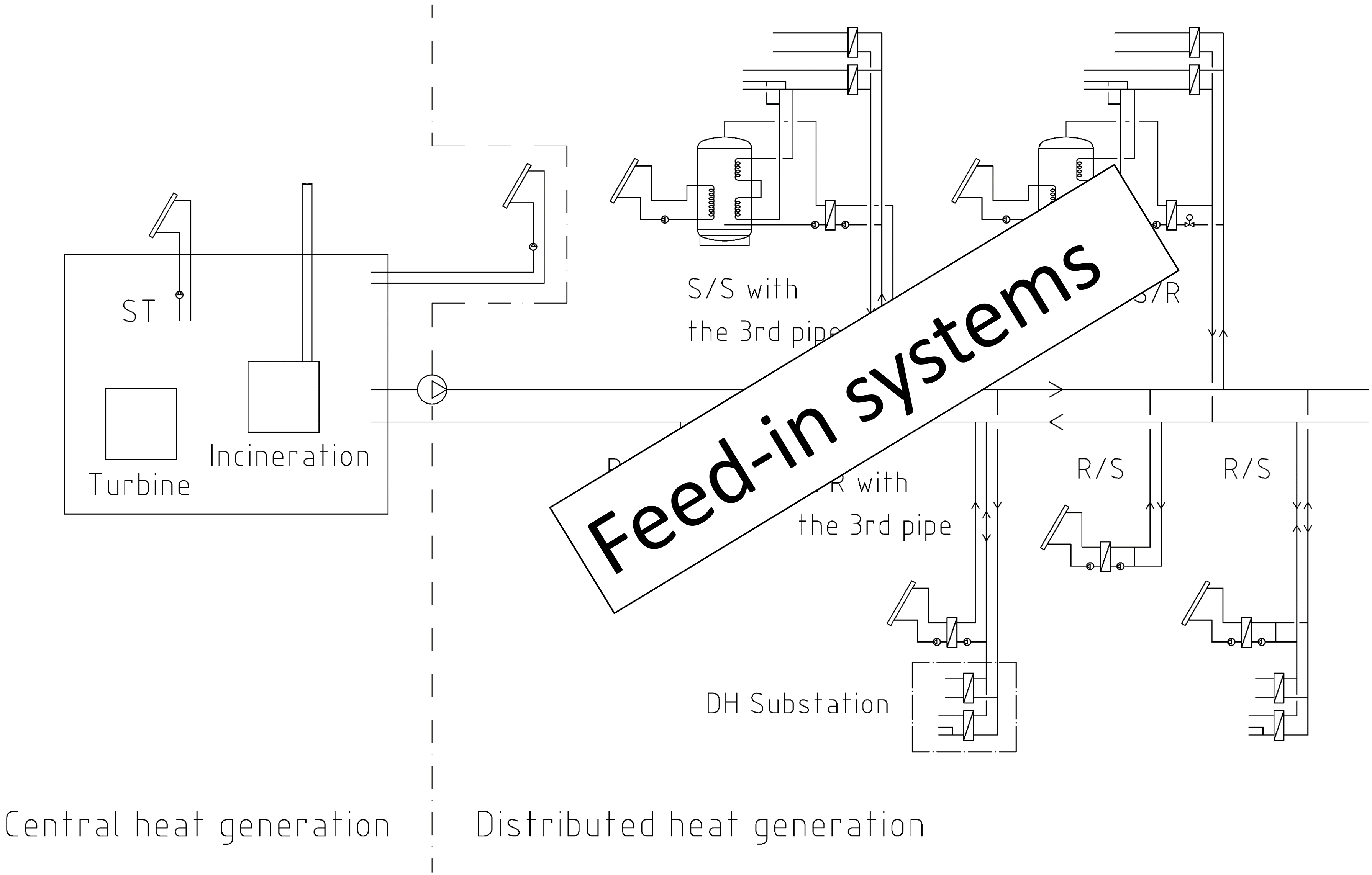
(expert in feed-in systems)

+46 322 61 17 54

gunnarl@energianalys.net

AALBORG UNIVERSITY DENMARK

Feed-in systems

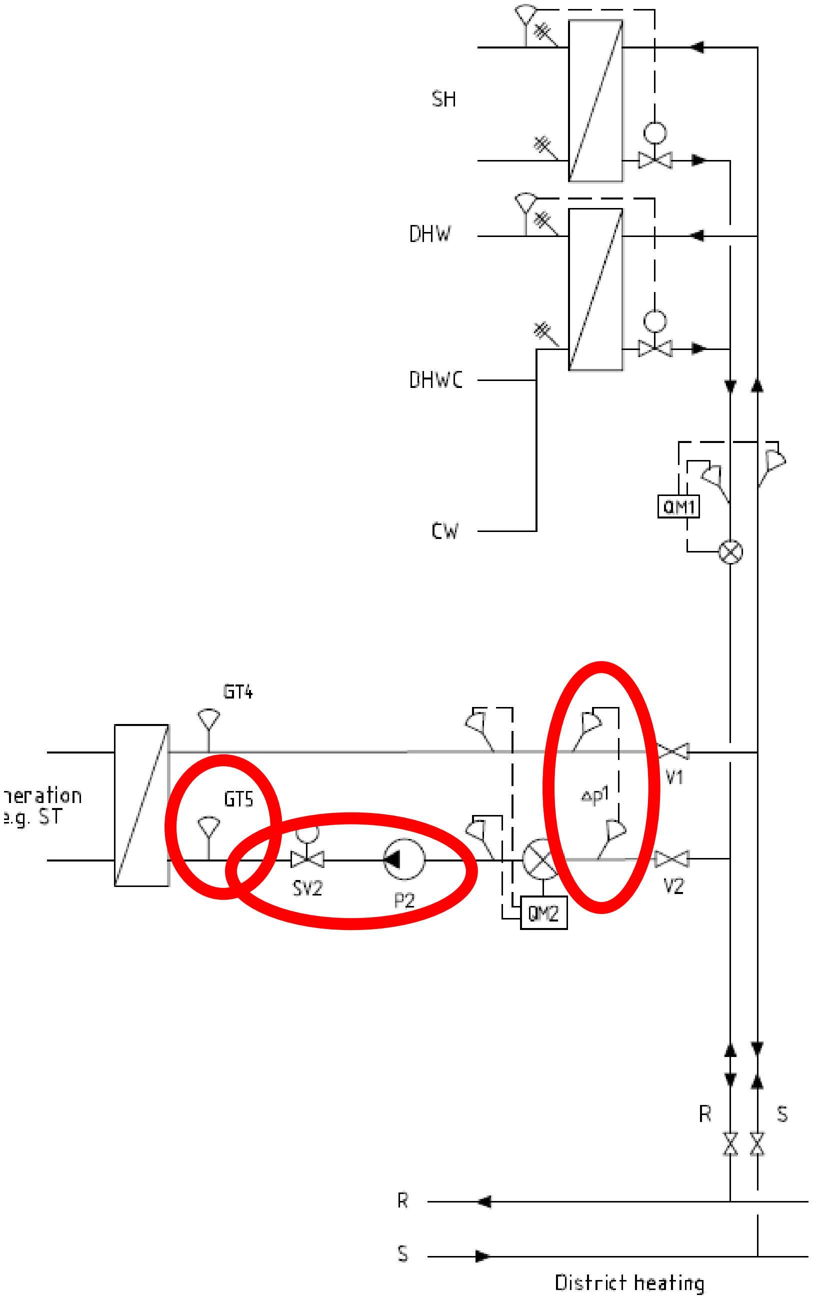


Distributed heat generation	R/R	R/S	S/R	S/S
Most common	X	X		
Can create a flow in the DH network		X	X	
Need a feed-in pump (in brackets, can function without a pump)	(X)	X		(X)
Increase DH return temperature	X		X	
Simple control strategy	X		X	X
Must produce a temperature at a certain level		X		
Can be used as an over-heat protection system at a consumer DH substation without an extra pipe (the 3rd pipe)		X	X	
Lowest risk for DH pipe fatigue		X		
An extra pipe is needed when connected to a consumer DH substation (the 3rd pipe)	X			X
Useful in most applications		**X**		

Two different kinds of feed in system (in R/S mode)

Flow controlled (FC)

- No short circuit – the temperature at GT5 is the DH return temperature
- The feed-in flow is controlled by the feed-in pump, P2, and a 2-way-valve SV2. At low flow has P2 a speed given by a differential pressure setpoint, Δp1, and SV2 is used as a break.
- Flow range at 1 to 10.
- If the feed-in pump will work with a to low flow for a too long time, it will give warrantee problems.
- A high differential pressure and a low flow can cause control and pump problems.



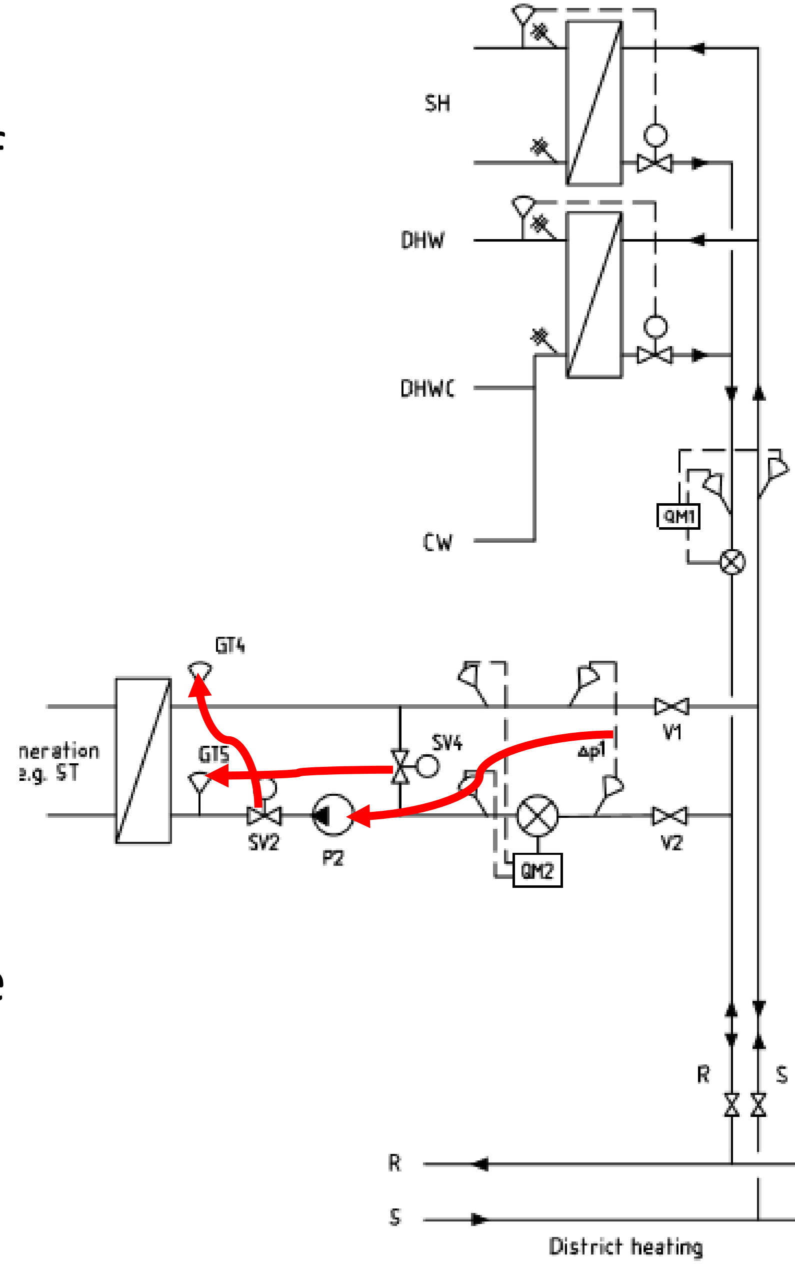
Two different kinds of feed in system (in R/S mode)

Temperature controlled (TC) **not primarily for thermal solar**

- The cold temperature on the cold side of the HX, GT5, is controlled by the valve in the short circuit, SV4. It is always higher than the DH return temperature.

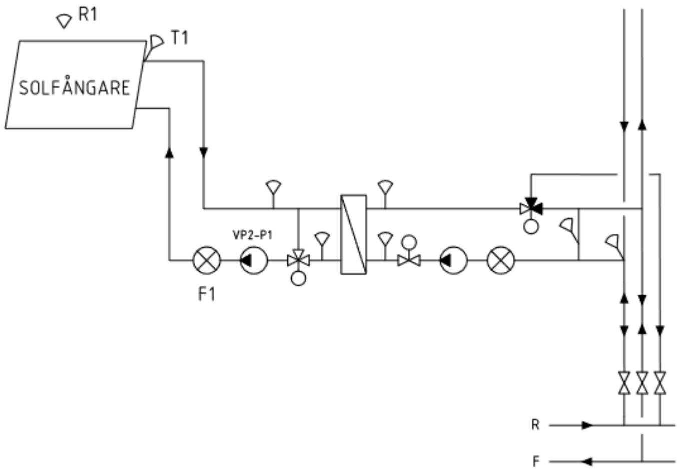
- The feed-in pump, P2, shall give enough pressure head to exceed the differential pressure, set point curve Δp1 – pump-speed. SV2 is used as a break to have a correct temperature on GT4.

- There must always be a flow through the short circuit – SV4 may never close completely.

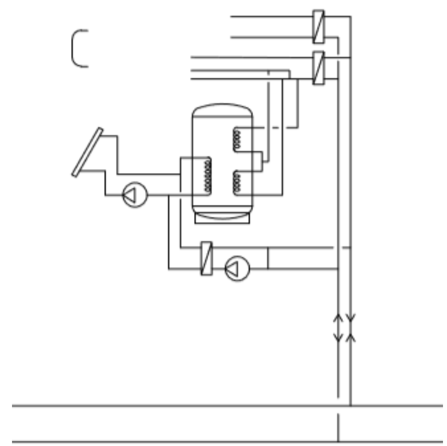


There are two combination systems that are relatively common

R/R+R/S



secondary+R/S



Both systems can change the flow in the supply line quite fast, is this OK?

Can a fast change in flow cause water hammers?
Can a fast change in feed-in flow from R/R to R/S disturb the central pumps?
Can a fast change in feed-in flow and a high heat-power delivery from secondary to R/S distrurb the central pumps and the central heat generation?

Is there a need for a minimum change time in kW/minute?

Impact on the DH return temperature

R/R and S/R increase the return temperature while R/S and S/S not

- A low DH return temperature raise the efficiency of some heat generation systems.
- A low DH supply and return temperature lower the heat losses from the DH network
- A large temperature reduction over a DH sub-station lower the temperature losses in the DH network, lower the power used in the central pumps or more customers can be supplied at the same flow
- A R/R or S/R does not affect the flow-balance in the DH-network but it lower efficiency of other heat generation systems and raise DH heat losses.
- Is it fair to raise the return temperature if there are other feed-in plants that are connected R/R or R/S? Only the first one will get a low return temperature.

Impact on the DH supply temperature

S/S increase the supply temperature while R/R, S/R and R/S in normal function not.

Is it fair to raise the supply temperature if there are other feed-in plants that are connected S/S. Only the first one will get a low supply temperature.

How much may the feed-in temperature from a R/S plant deviate from the normal supply temperature in the feed-in point?

- Lower than normal – affect other customers.
- Higher than normal – unfair to other prosumers
- Variation – risk for DH pipe fatigue

Some alternatives:

+/- 2 K or +/- 5 K or + 10 K and – 5 K or 15 K-minutes (degree-time)

The cold plug

Refers primarily to R/S feed-in system with solar thermal systems

When R/S feed-in solar thermal system starts in the morning the feed-in supply line is cold. The water in this pipe is “the cold plug”.

Should this cold water be fed into the supply line or into the return line and under how long time?

On supply line – cause temperature problem?

On return line – a risk of short circuit between supply and return line is introduced - appropriate? How should it be checked?

Deep freeze protection

Refers primarily to R/S feed-in system with solar thermal but the problem can exist for all feed-in alternatives.

Although the solar thermal circuit is freeze-protected, there may be parts of the feed-in system that contains pure water that might freeze, refers to both the return and the supply line.

How should the pipes be protected from breaking freezing?

Should the water that keep the pipes in the feed-in circuit, free from deep freezing be fed into the supply line or on the return line?

On supply line – cause temperature problem?

On return line – a risk of short circuit between supply and return line is introduced - appropriate? How should it be checked?

Risk of pipe fatigue in the DH-network

varying temperatures, cycles a day/year

- R/R always provides a temperature rise on the return line (almost every day) – How big temperature rise is appropriate or acceptable - Is it advisable to use R/R at all?

- S/S always provides a temperature rise on the supply line – How big temperature rise is appropriate or acceptable and how often? - Is it advisable to use S/S at overheat protection system?

- S/R always provides a large temperature rise on the return line – How big temperature rise is appropriate or acceptable and how often? - Is it advisable to use S/R at overheat protection system?

- **R/S does not affect the temperatures in the district heating network during normal operation - Is R/S the only acceptable decentralized feed-in concept?**

Other issues that need to be discussed

Heat storage – centralized or decentralized?
Heat power balance
Automatic valve shutdown in case of power failure
Safety-valves
Pressure switch – high pressure shutdown
Temperature switch – high temperature shutdown
Risk of short circuit in the feed-in sub-station
Prosumer feed-in – when does the heat change owner?
And many more

Alarm

- Low temperature feed-in
- High temperature feed-in
- High pressure
- mm

If anyone is interested in a continued discussion on the subject, I am very interested in taking part in this discussion.

I think it is important to create common rules so that development does not have national constraints.