Heat Exchange Technology Explained

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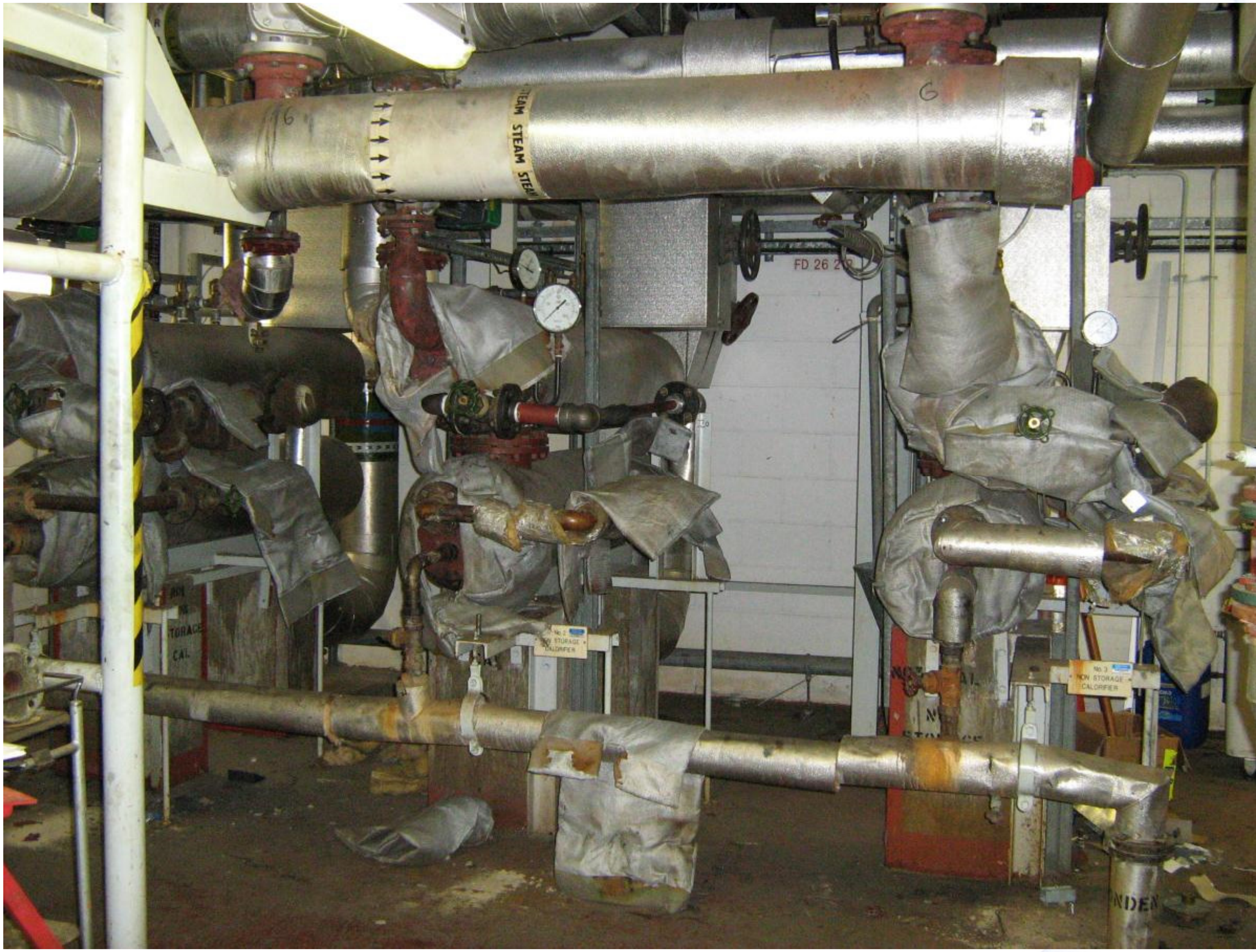

STEAM STEAM STEAM
FD 26 2
No.2 NON STORAGE CALORIFIER
No.3 NON STORAGE CALORIFIER

Steam Heaters – The New Generation – But what are they?, how do they work?

Plate Heat Exchanger components

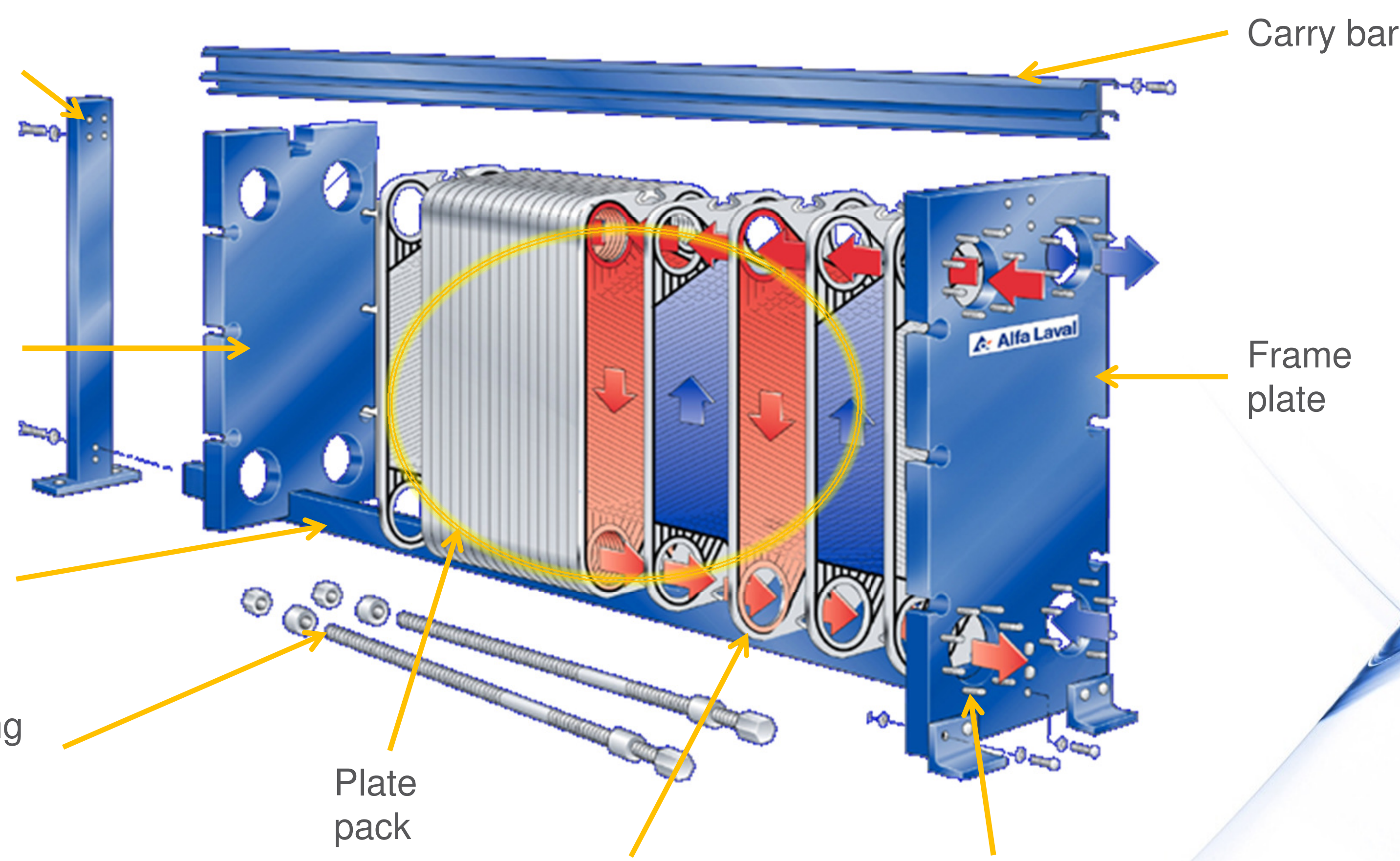


Plate Heat Exchange flow path video

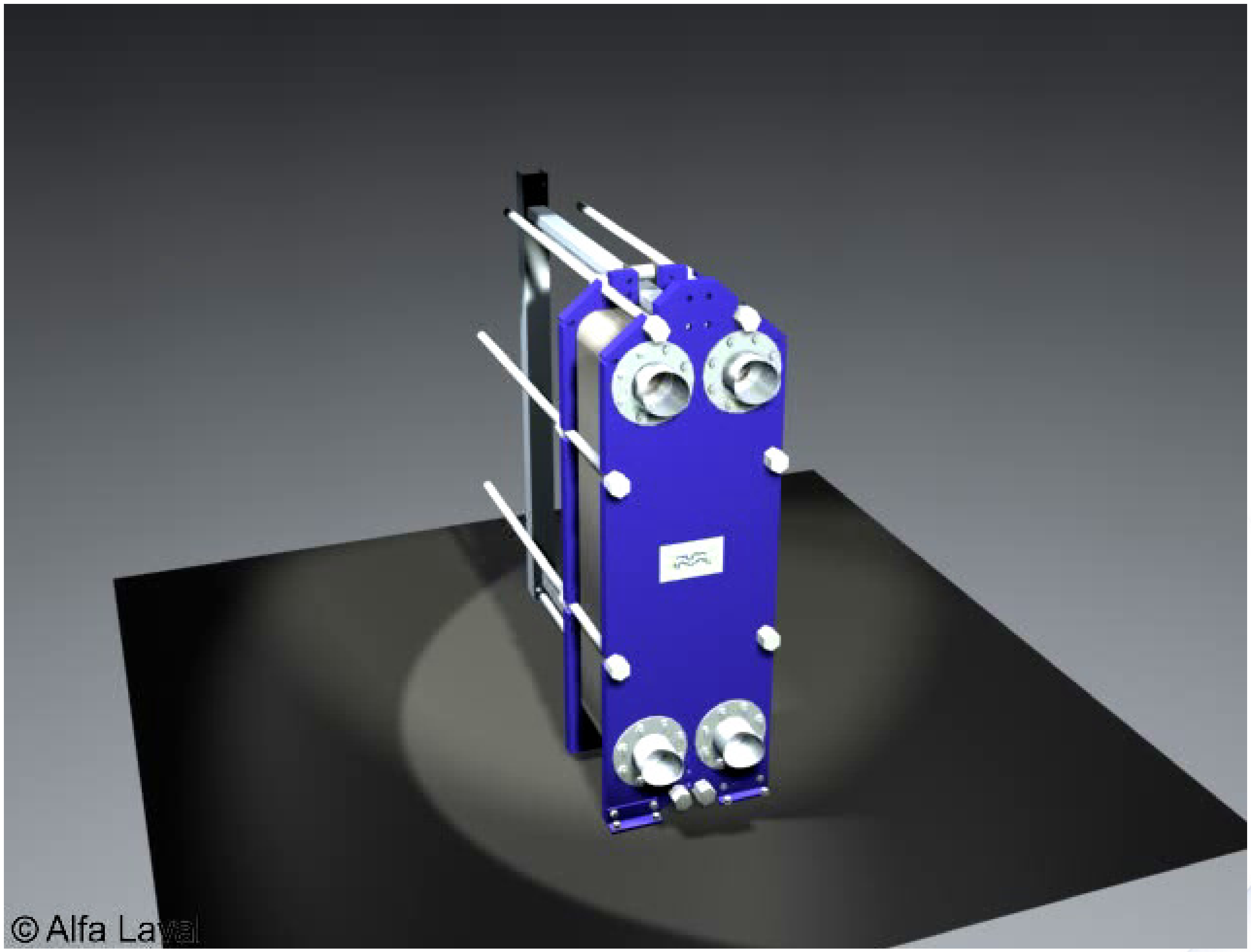


Plate flow pattern

Flow pattern – alternate plates

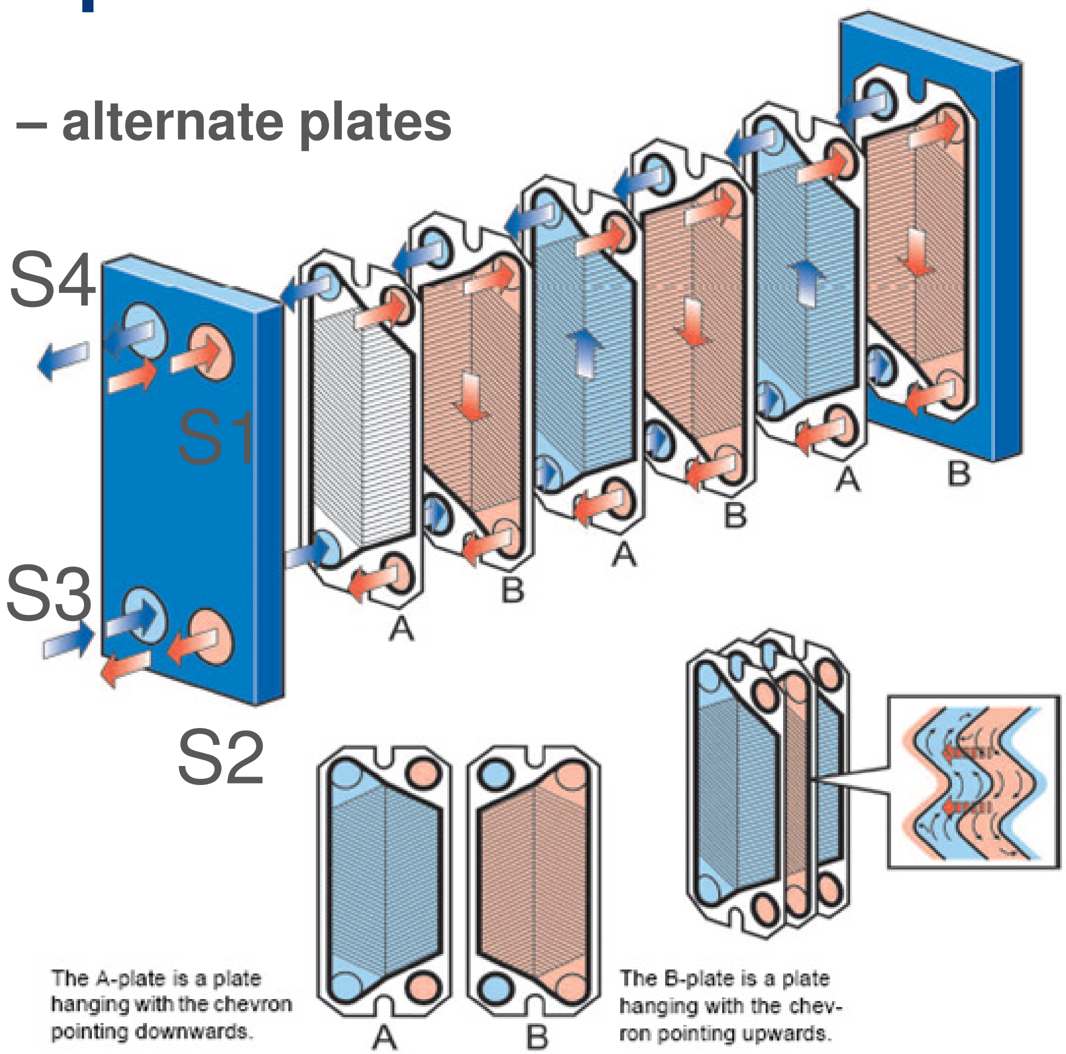


Plate – main components

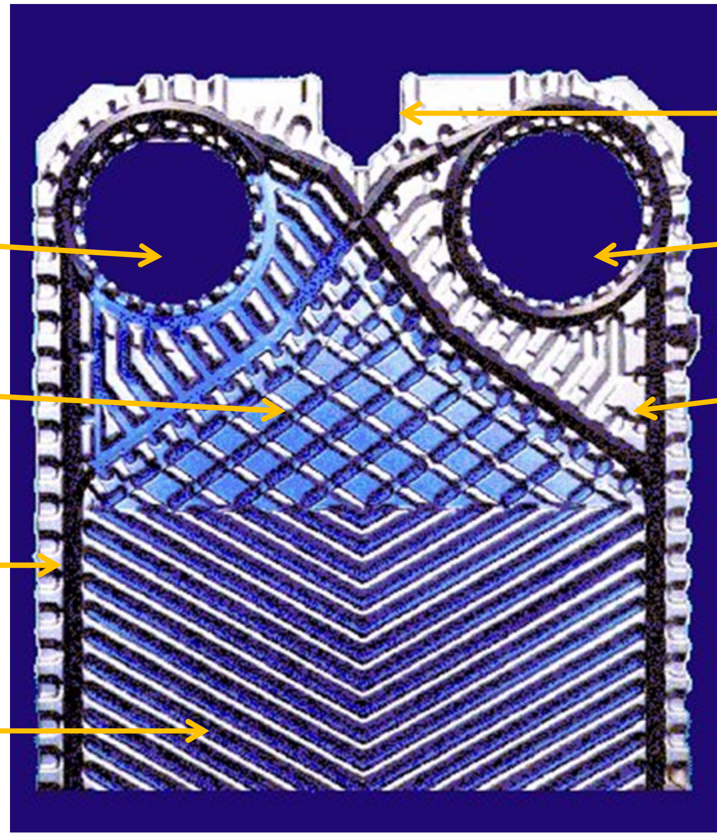
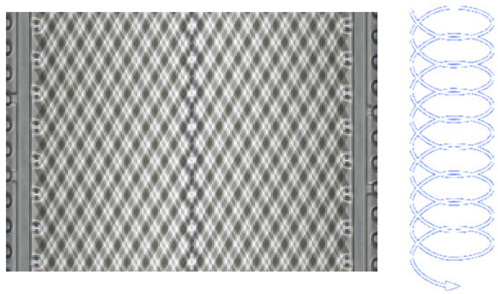


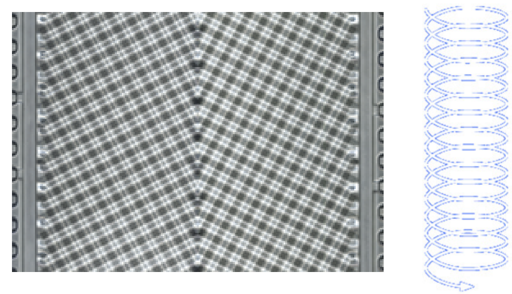
Plate – corrugation and channels

Low turbulence and pressure drop



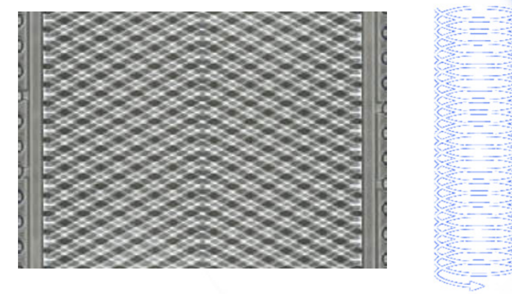
L + L = L channels

Medium turbulence and pressure drop



L + H = M channels

High turbulence and pressure drop



H + H = H channels

Advantages

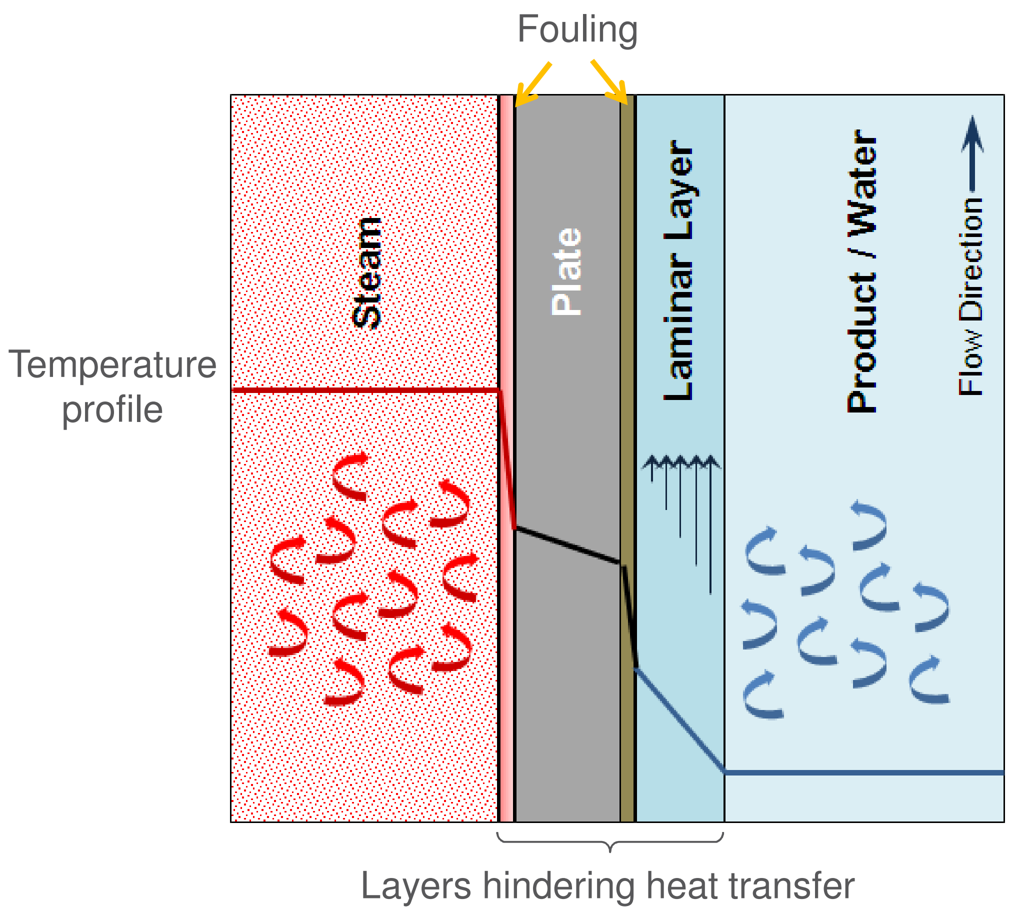
- Efficient heat transfer
- Strong construction

Benefits

- Low fouling
- Optimal design
- Unaffected by vibration

Heat Transfer rate

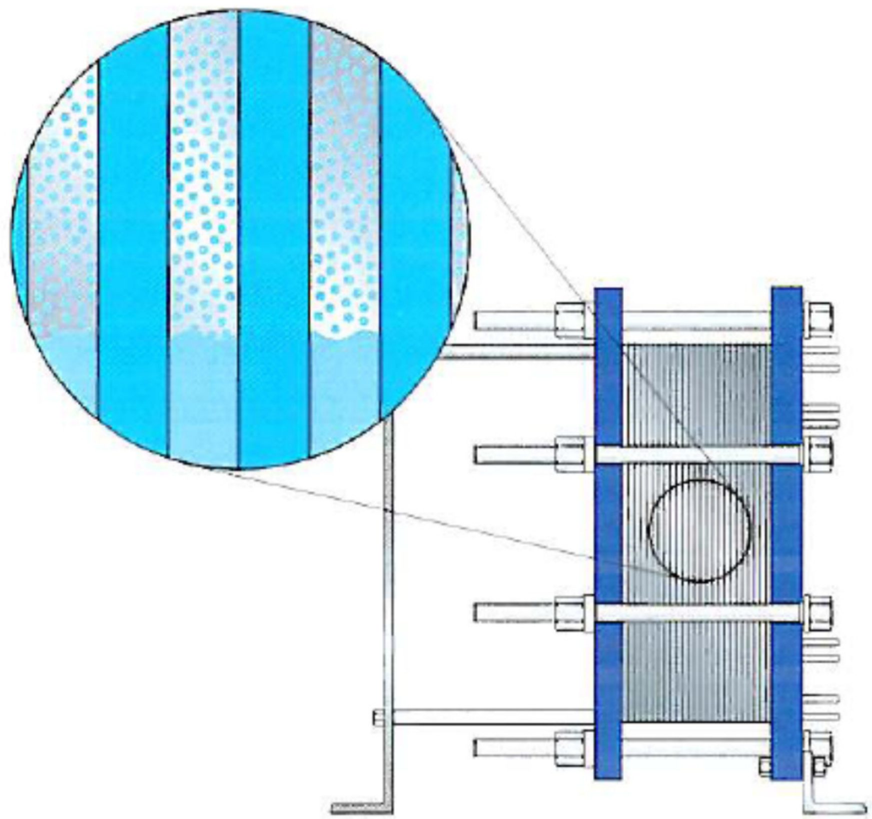
Increased turbulence aiding heat transfer

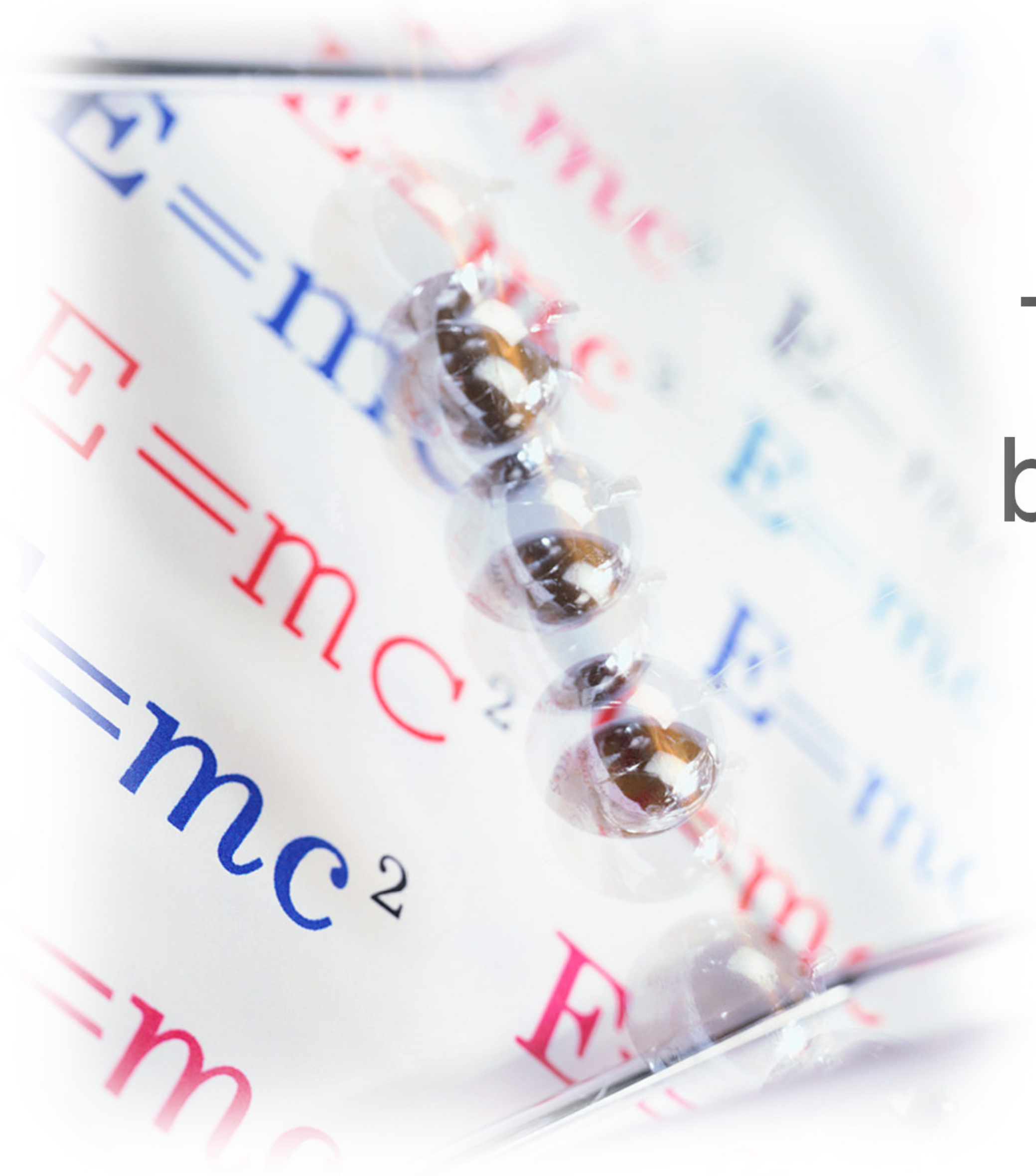


Increased turbulence helps limit the poor heat transfer layers:

- Laminar flow – heat transfer through conduction
- Fouling
  - Scaling
  - Major debris
  - Biological growth
  - Sedimentation
  - Burn-on

Low volume and PV ratio aids sub cool in one single pass





Heat Transfer -a bit of theory

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What should the Heat Exchange control achieve?

- Provide the required degree of accuracy
- Be reactive to the secondary load requirement
- Be safe
- Make full use of the energy available in the steam
- ***Avoid energy wastage***

Heat Transfer equation

This drives the whole process

$$Q = A \times k \times LMTD$$

- Q: energy required
- A: heat exchange area
- k: heat transfer coefficient
- $LMTD$: logarithmic mean temperature difference

Logarithmic mean temperature difference

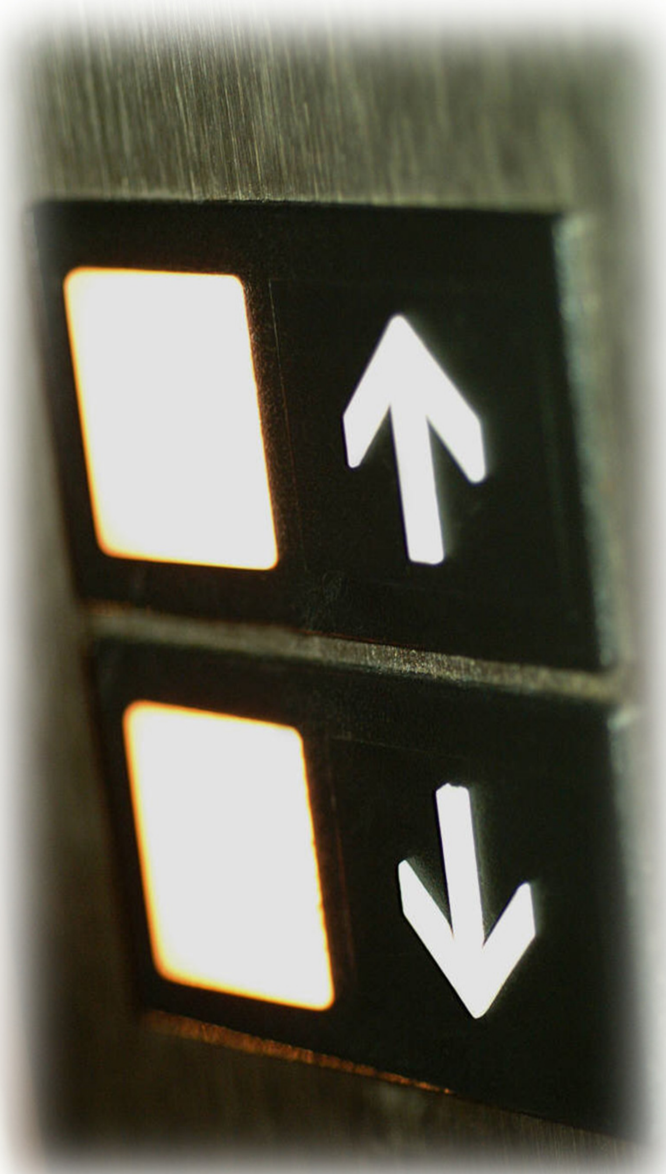
primary side (steam) temperature in

primary side (steam) temperature out

$$LMTD = \frac{(th_1 - tc_2) - (th_2 - tc_1)}{ln\left(\frac{th_1 - tc_2}{th_2 - tc_1}\right)}$$

secondary side temperature out

secondary side temperature in



So how do we control - control actions

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Control actions

$$Q = A \times k \times LMTD$$

the energy requirement decreases

the heating area needs to decrease

Control actions

or

$$Q = A \times k \times LMTD$$

the energy requirement decreases

the logarithmic mean temperature needs to decrease

Control actions

or

$$Q = A \times k \times LMTD$$

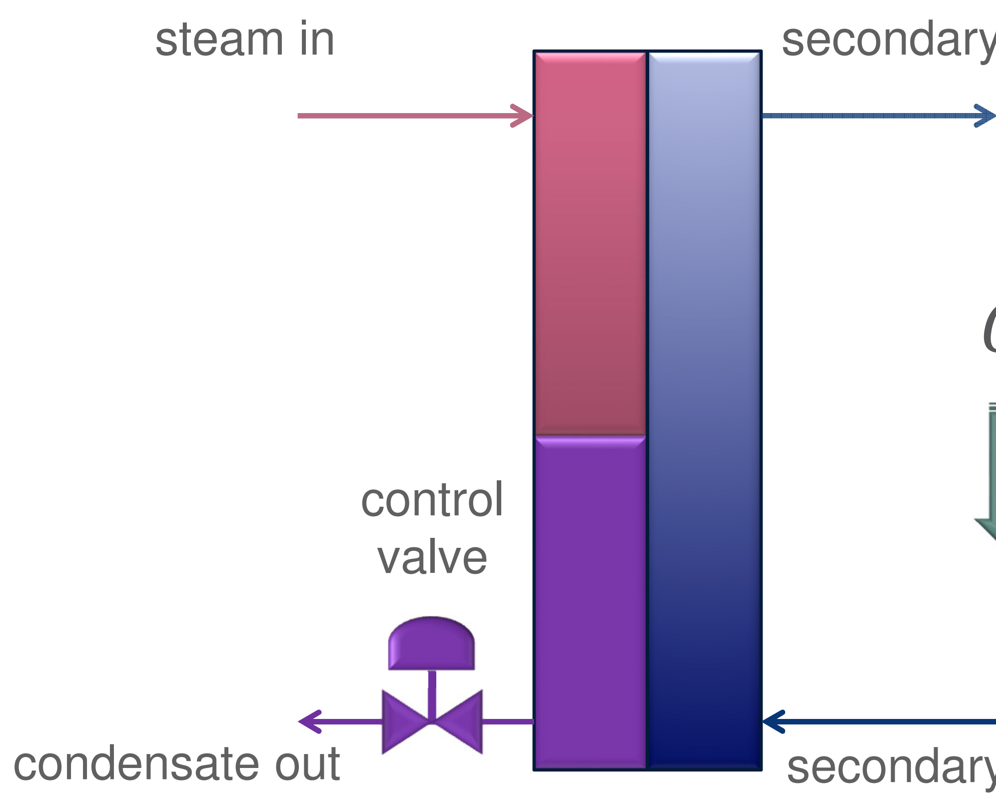
the energy requirement decreases

a combination of the logarithmic mean temperature and the heating area needs to decrease

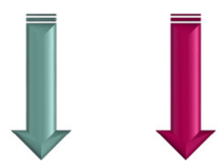
Lets review one control method: condensate control

Basic control methods

Control valve on the condensate outlet

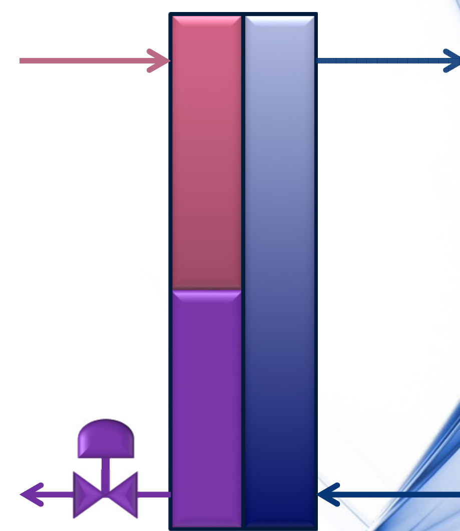


$$Q = A \times k \times LMTD$$



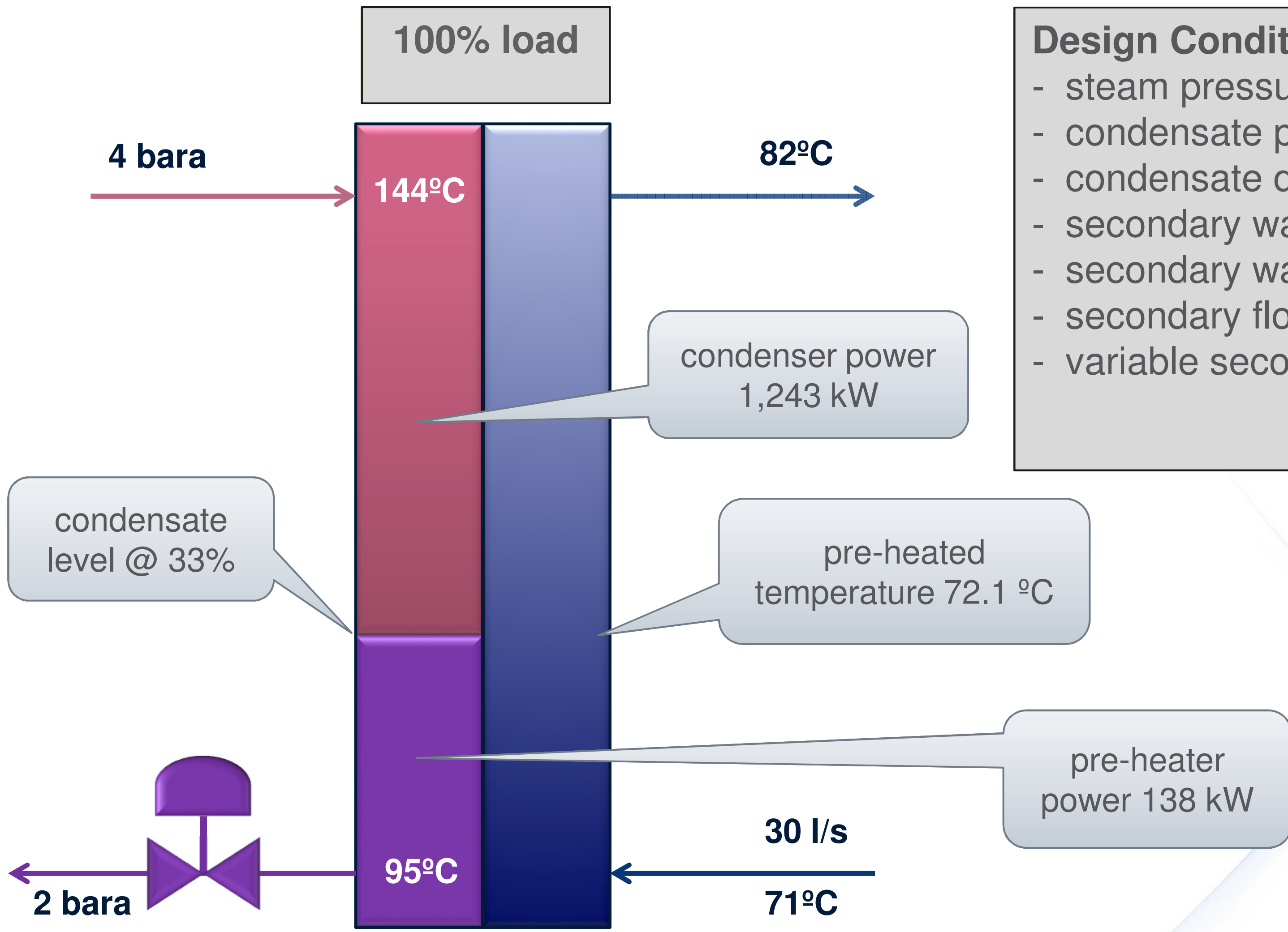
Control valve on the condensate outlet

- Control by condensate varies the heat exchange area
- Reacts quite quickly to an increasing load
- React more slowly to a decreasing load
- Varying heat exchanger area varies sub cooling
- When the condensate is sub-cooled, sensible heat pre-heats the secondary side. This in turn:
  - lowers the amount of steam required by the heating process
  - Ensures no flash steam is formed, avoiding a possible source of wasted energy



So, how does it work, what does it achieve?

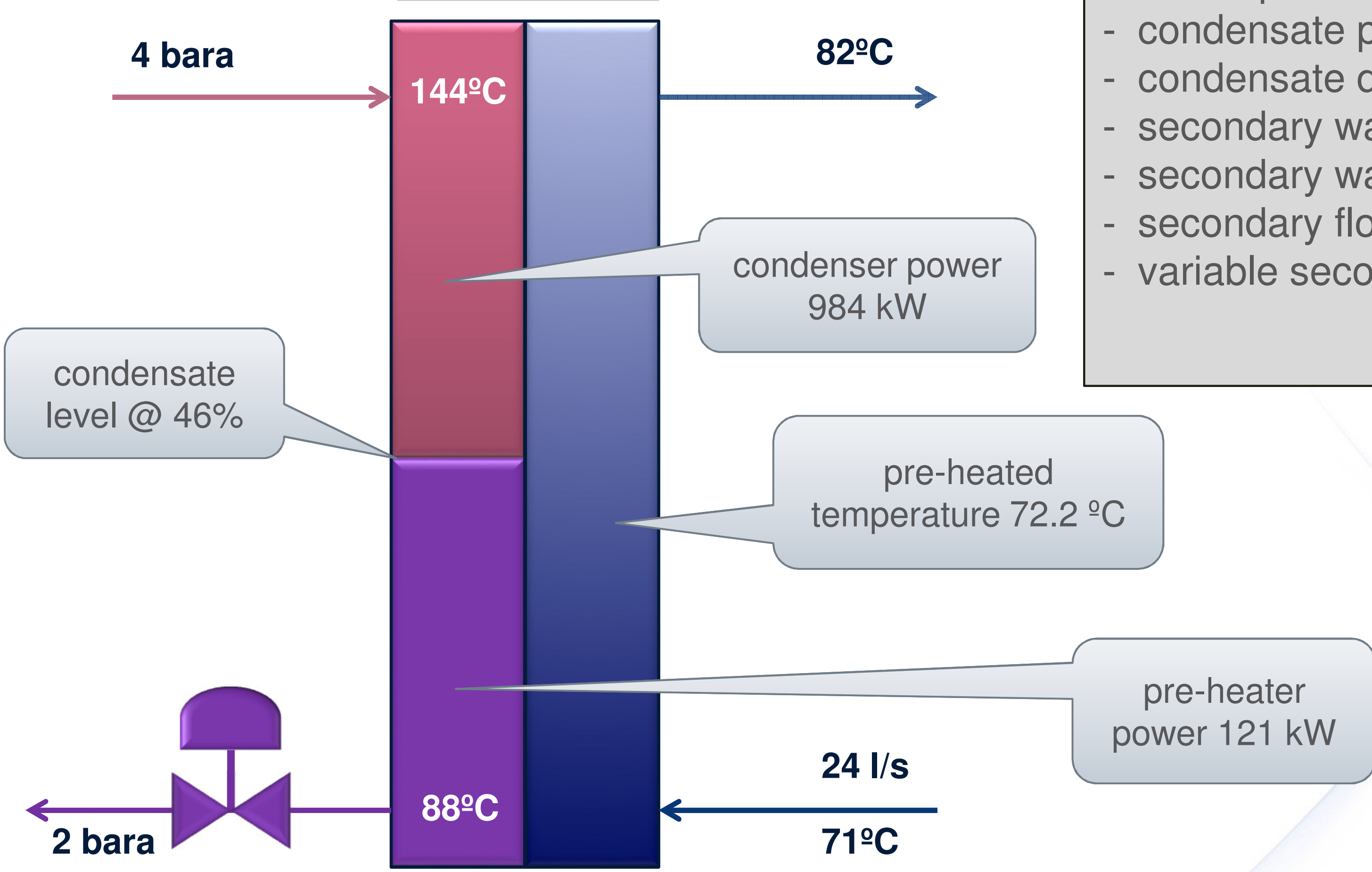
Control valve on the condensate outlet



Design Condition
- steam pressure 4 bara
- condensate pressure 2 bara
- condensate discharge 95ºC
- secondary water in 71ºC
- secondary water out 82ºC
- secondary flow 30 l/s
- variable secondary flow

Control valve on the condensate outlet

80% Load



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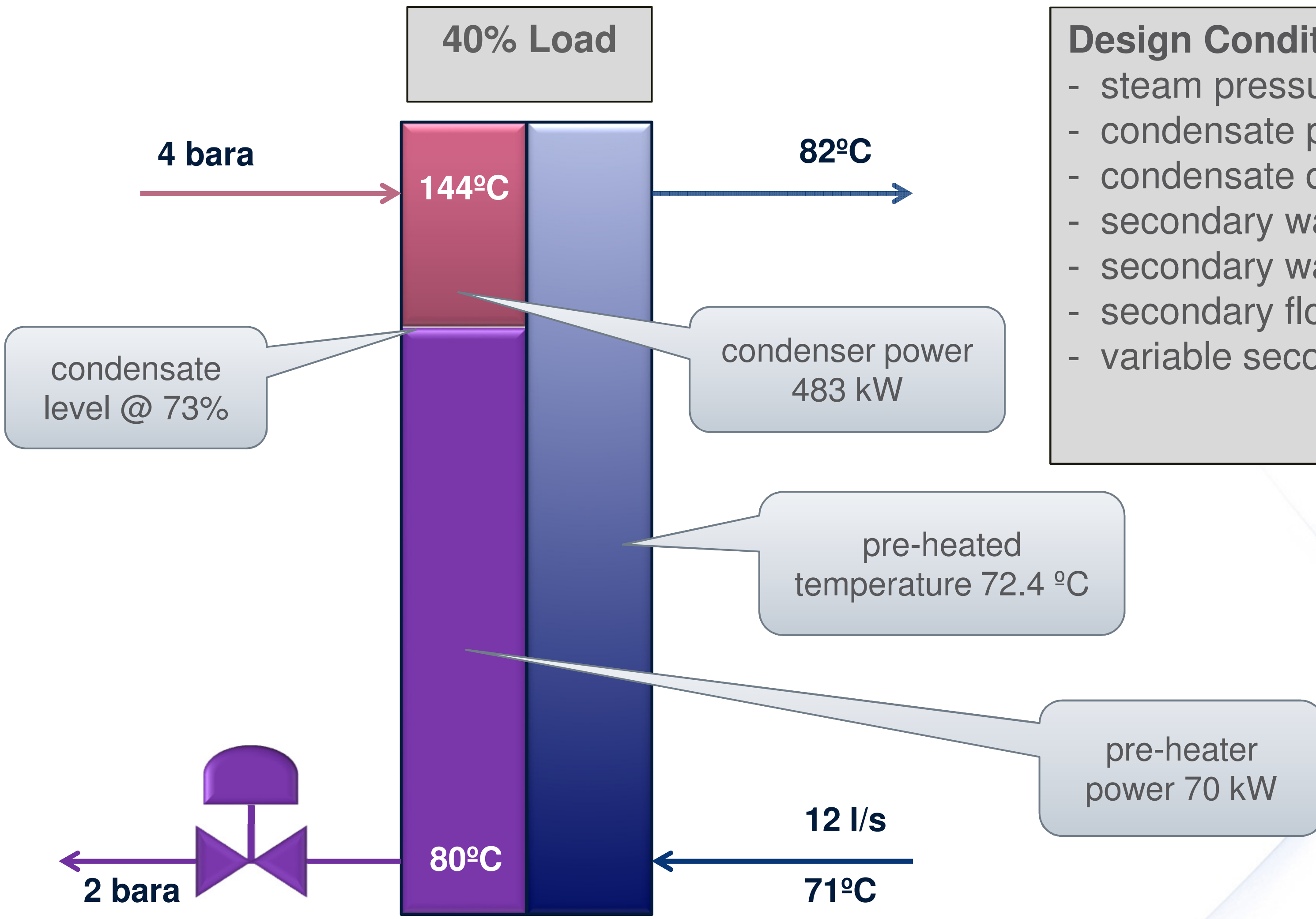

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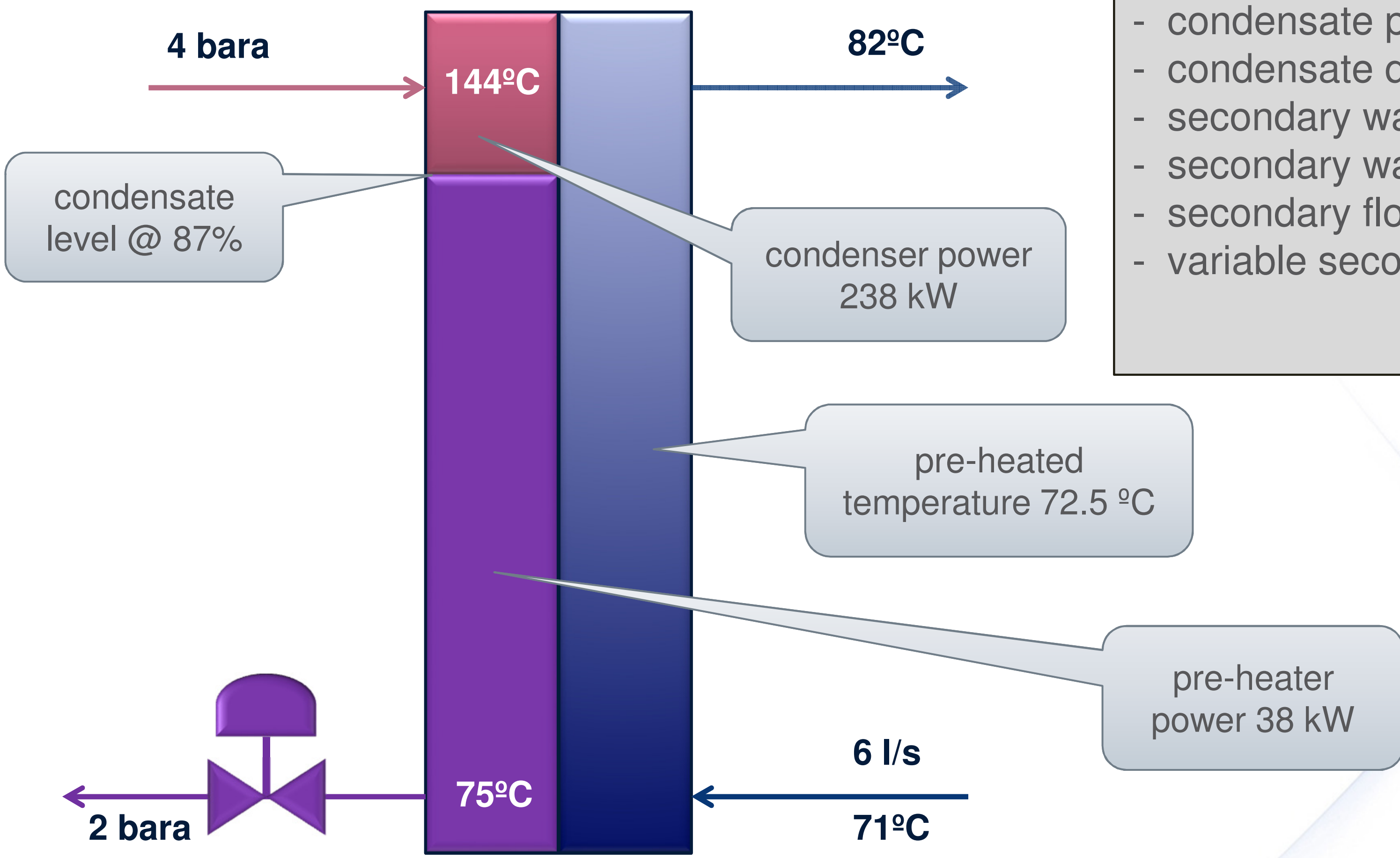

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Energy savings

- Existing heat exchanger with steam control (LTHW)
- 5 bar g steam supply
- Heat exchanger sized to condense at 2.5 bar g steam
- On substantial load, i.e. 50% year, design KW rating 400KW

- **Heat exchanger sub cools condensate to at least 95°C (full load), but general this will be within 2 degrees of the return temperature**

Saving = (139-95) x 4.186 x (400/2153) = 34KW = 8.5%

Or simply 2.5 bar g to zero is 7.5% and 100 to 95°C is 1%

Other Benefits…

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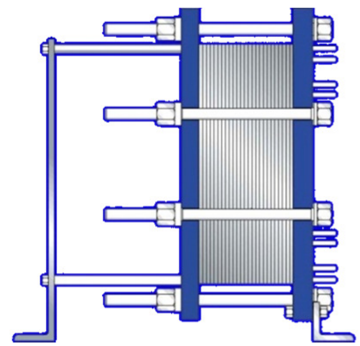
PHE benefits compared to shell and tube

- Excellent temperature control characteristics
- Small P x V product => no need for inspection from pressure vessel authorities (splash guards must be fitted)

Small hold-up volume



- Slow response to load changes
- Large P x V product => inspection required from pressure vessel authorities

Large hold-up volume

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Add Power Generation to get even more efficiency and carbon reduction…

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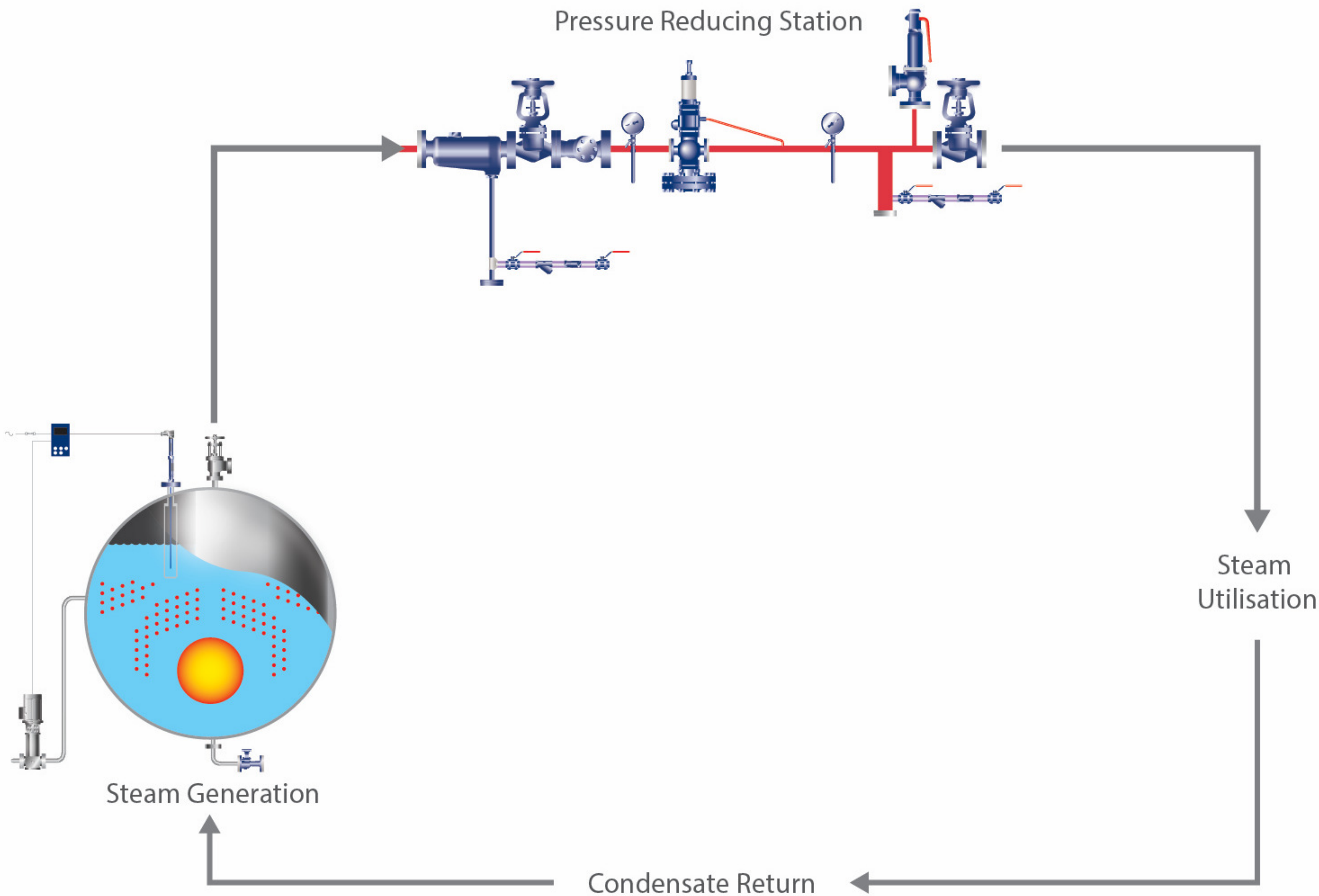

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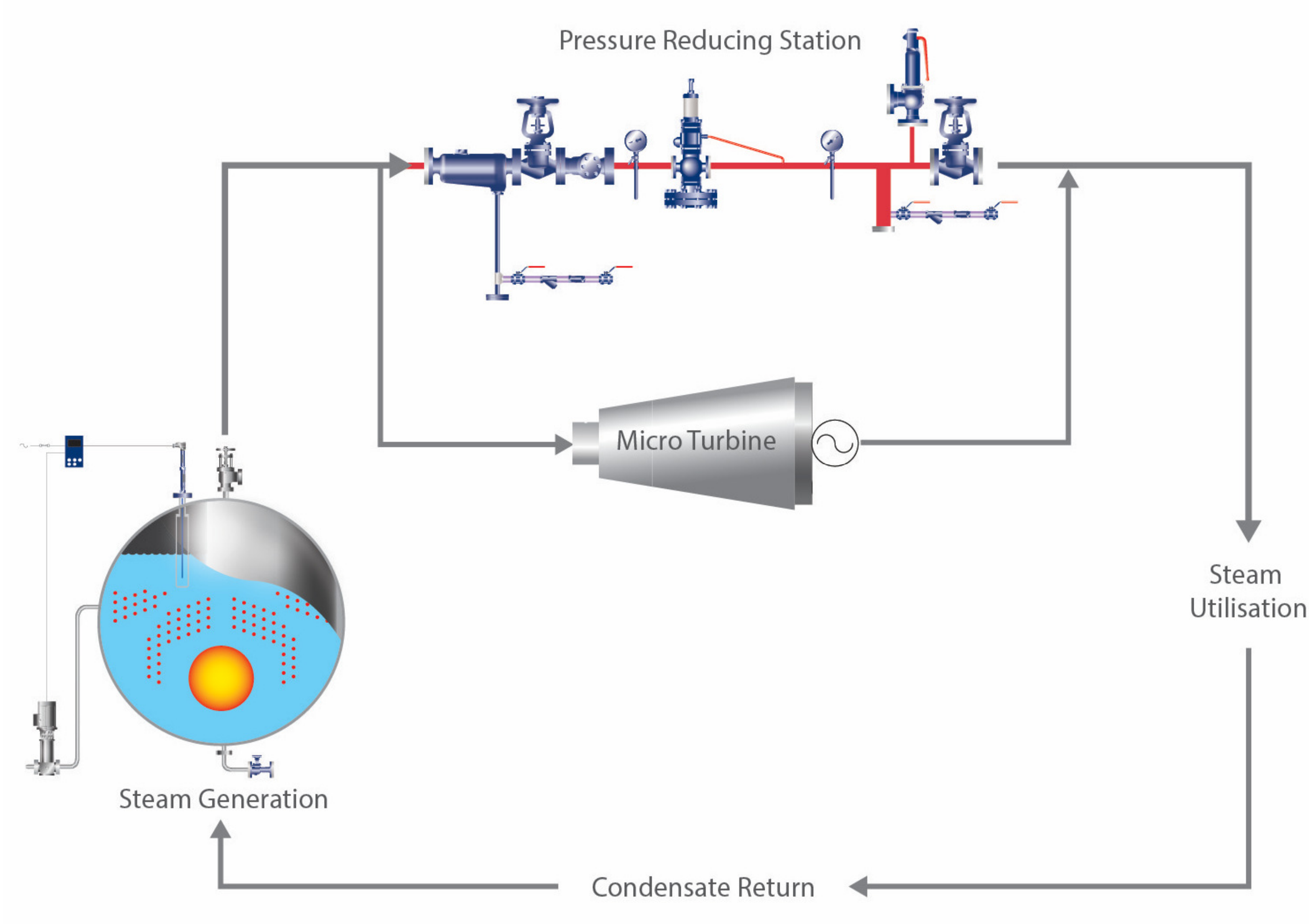

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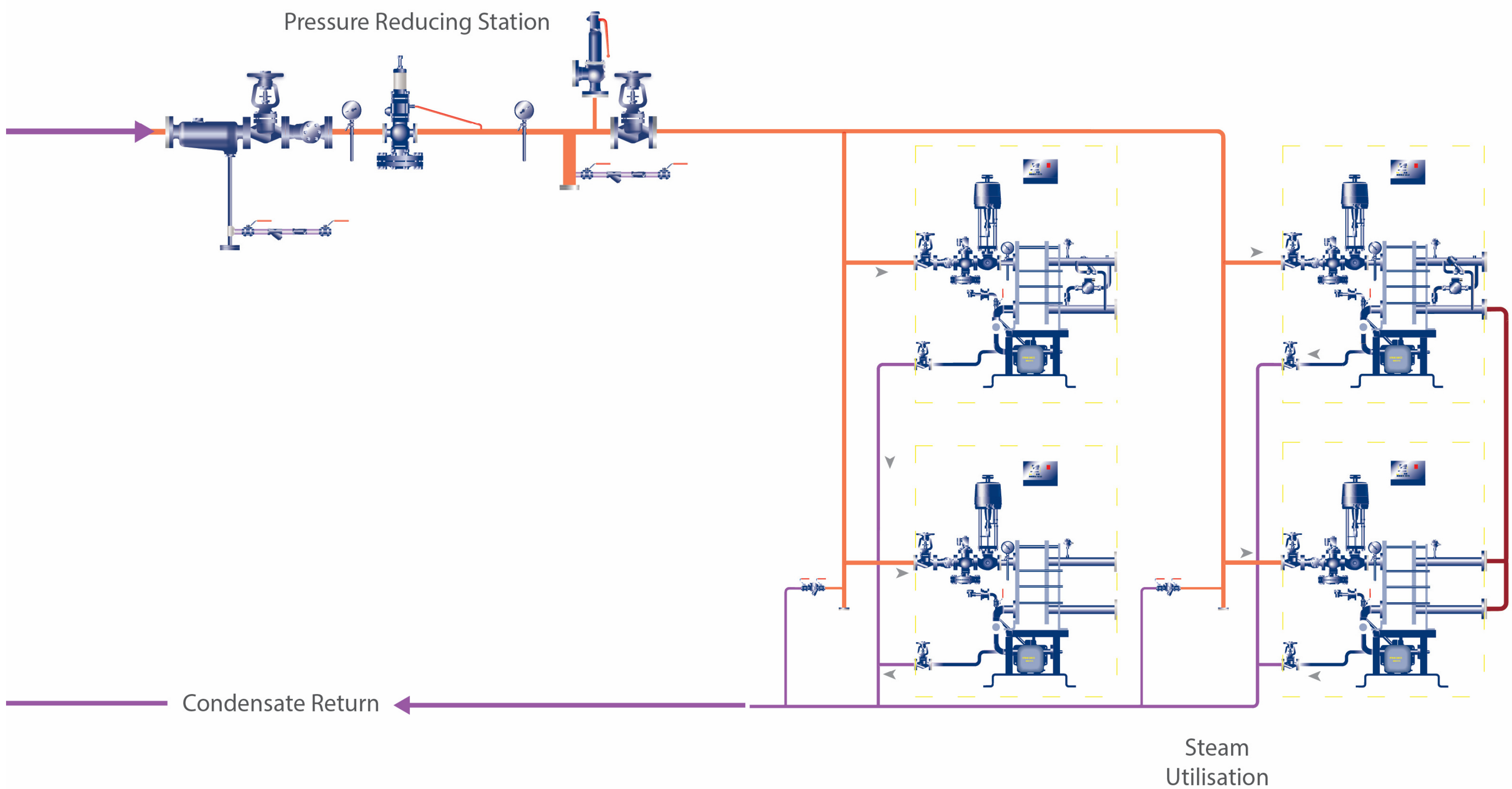
The low carbon plantroom



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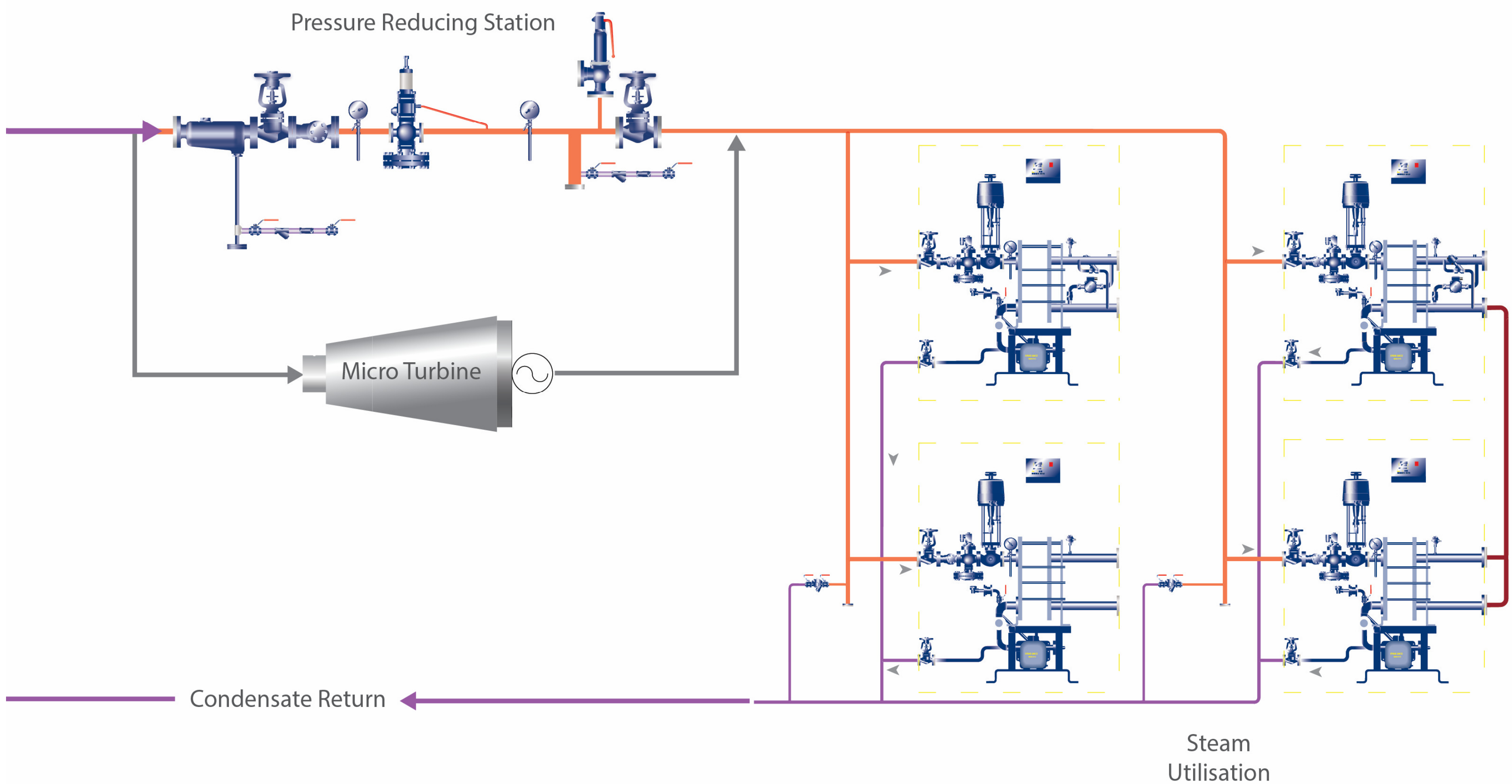
The low carbon steam plantroom
with power generation



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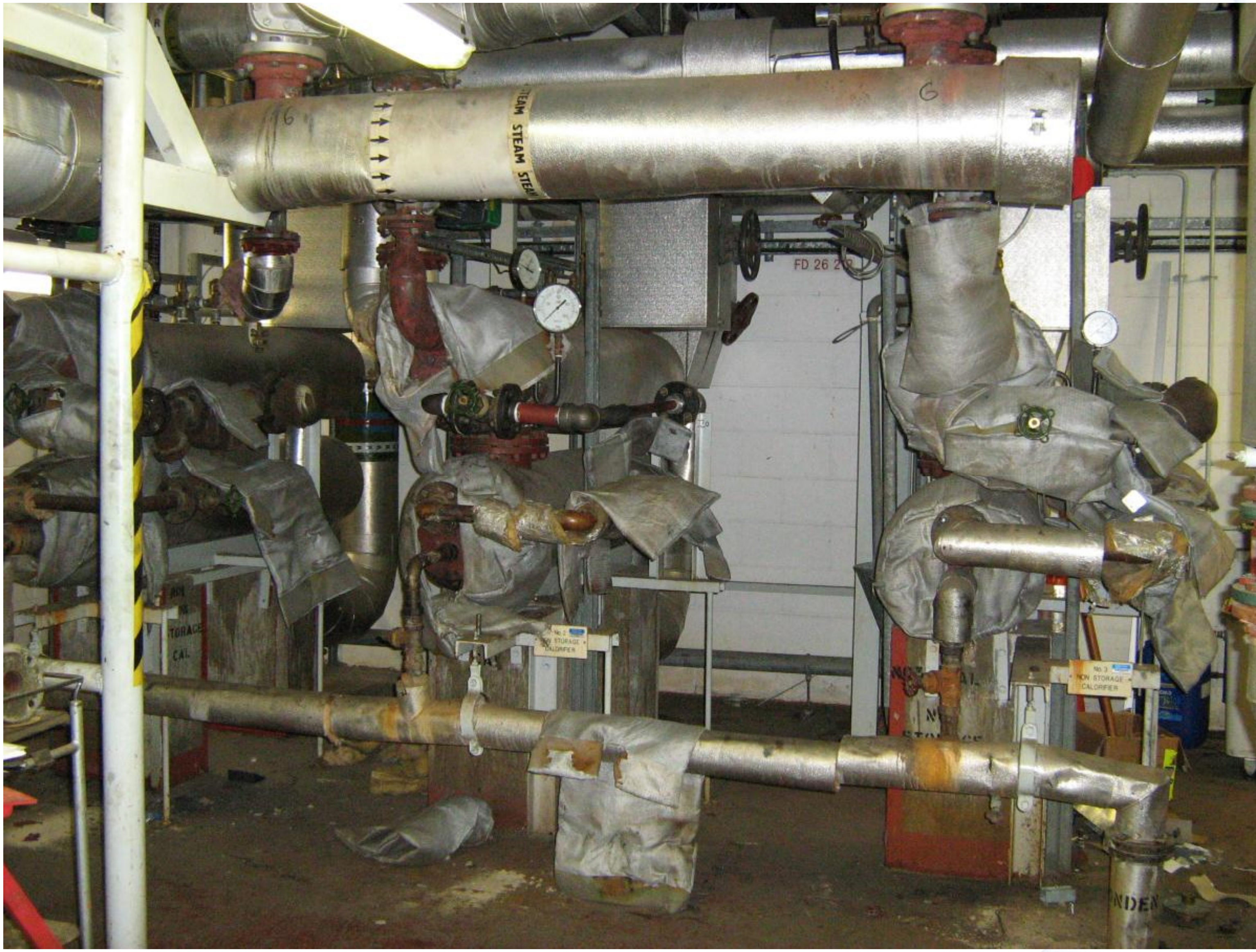
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Thank you for listening

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