SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF MECHANICAL ENGINEERING

ENGINEERING THERMODYNAMICS

UNIT 4 – STEAM POWER CYCLES

TOPIC –RANKINE WITH REHEAT CYCLE

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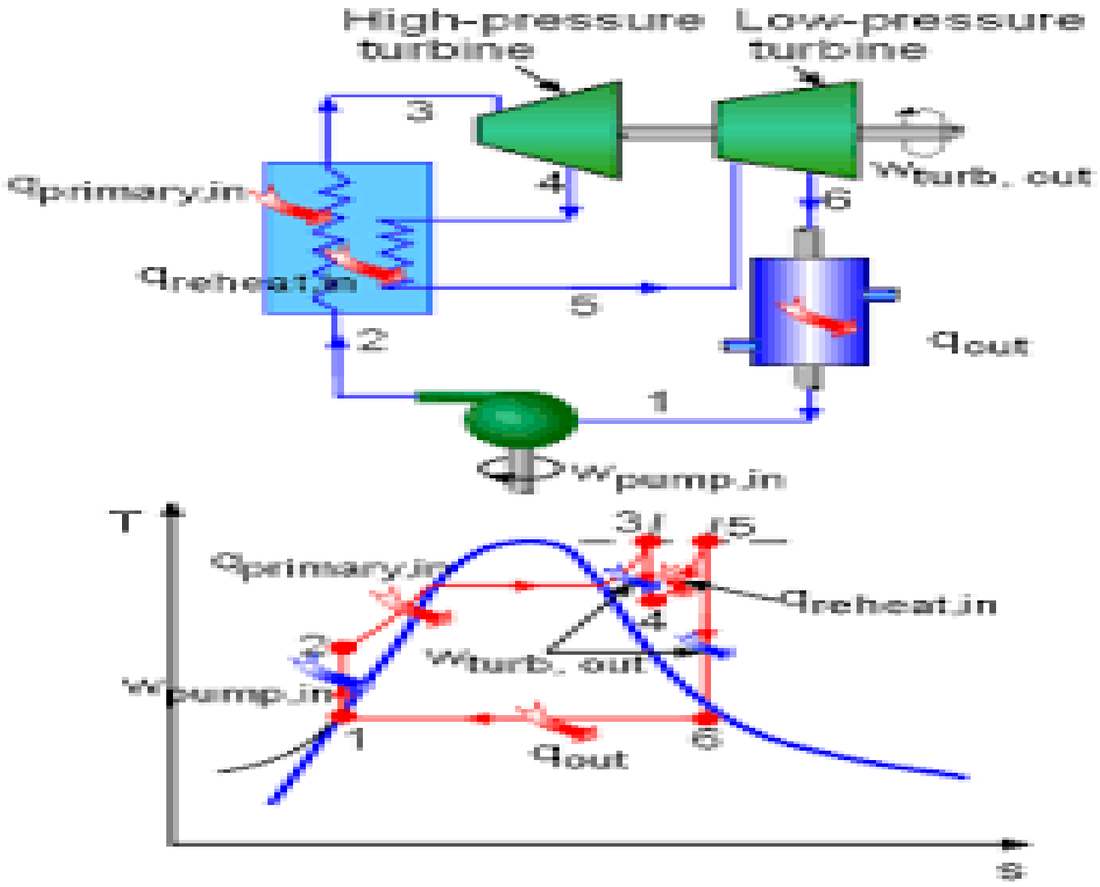
Why Reheat cycle?

- In order to limit the dryness fraction to 0.85
- To avoid corrosion at turbine blades
- To increase the turbine work so as to increase the thermal efficiency

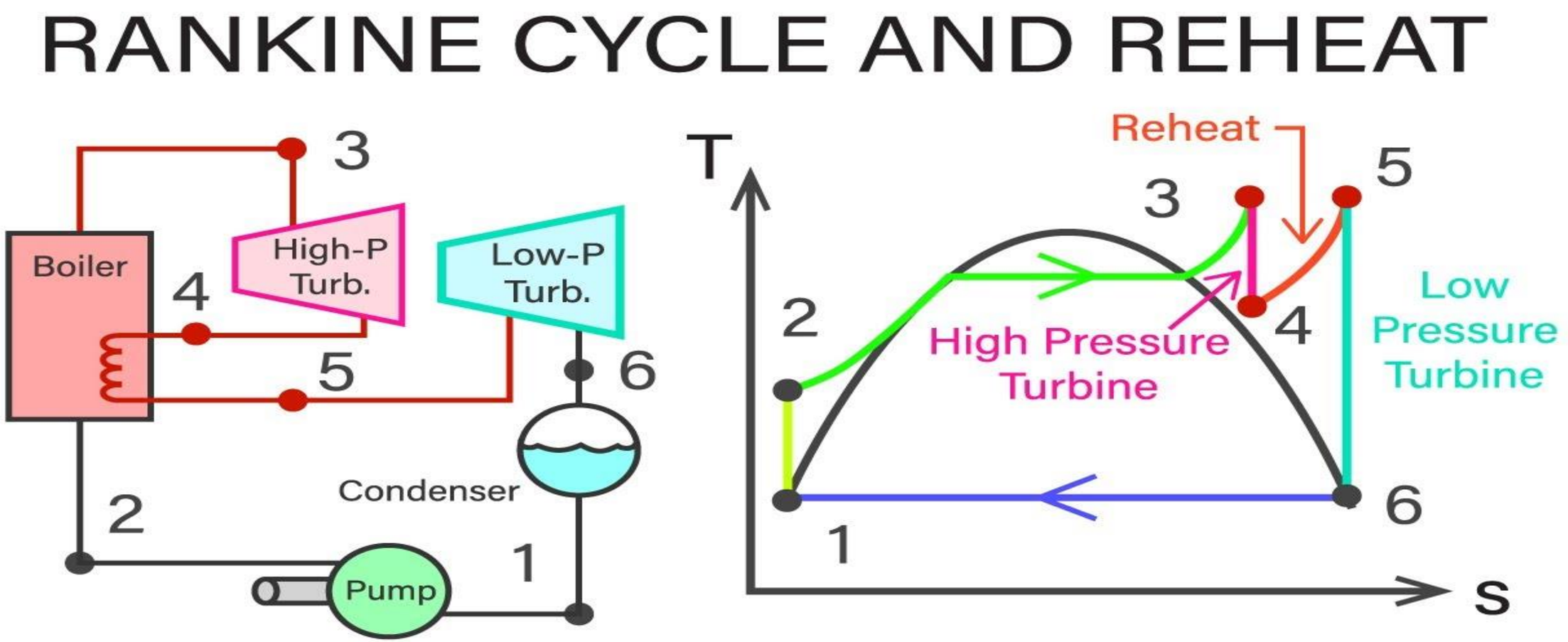
Introduction



Source: ecourses.ou.edu

In order to limit the quality of the steam to 0.85 at turbine exhaust ,Reheat cycle to be adopted

Schematic diagram



Source : https://tinyurl.com/yb7zpom

Processes involved

- Process 1-2 Isentropic compression [Pump]
- Process 2-3 Constant pressure heat addition [Boiler]
- Process 3-4 Isentropic expansion [HP turbine]
- Process 4-5 Constant pressure heat addition Boiler(Reheat)
- Process 5-6 Isentropic expansion [LP turbine]

Assessment -1

1. Specify the steam quality to be maintained at turbine exhaust?

a) 20%

b) 40%

c) 65%

d) 85%

2. Identify the process involved in HP and LP turbines

a) Isothermal Process

b) Isentropic expansion process

c) Isentropic compression process

d) Constant pressure heat rejection process

Working principle

- The water being converted (Superheated in Boiler) passes through the Turbine
- Turbine Work $(W_T)_{HP}$ is obtained in (HP turbine)
- The steam from HP turbine is fed back to Boiler(Reheater)
- Steam from Reheater is sent to LP turbine where Turbine Work $(W_T)_{LP}$ is obtained

Working principle (Contd..)

- The turbine work can be obtained both LP and HP Turbine
- Dryness fraction [Turbine exhaust] is improved when reheat is applied
- It increases thermal efficiency

Estimation of Thermal Efficiency

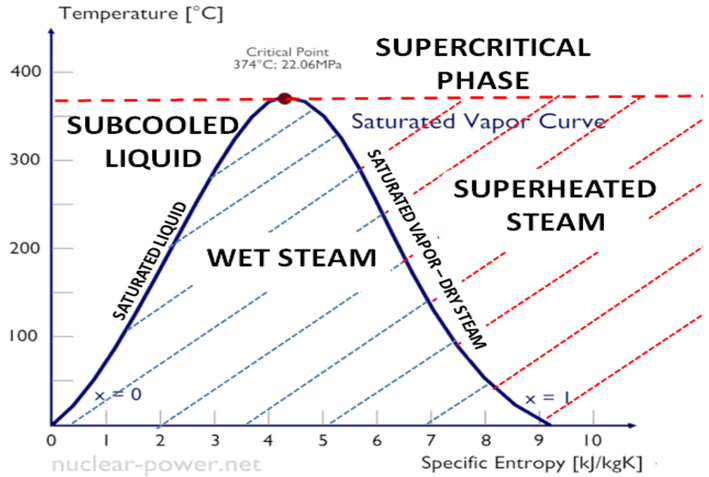
Turbine work can be calculated as $W_T = (h_3-h_4) + (h_5-h_6)$

Compressor work can be calculated as $W_p = (h_2-h_1)$

Heat input can be estimated as $Q_{in} = (h_3-h_2) + (h_5-h_4)$

Thermal Efficiency $\eta = (W_T - W_p) / Q_{in}$

Advantages



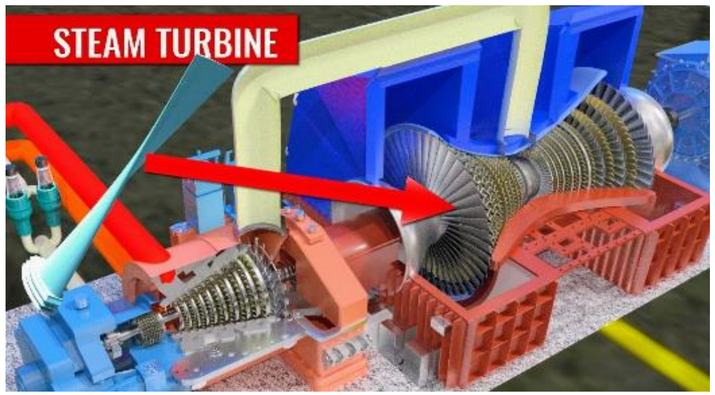
Source : https://www.thermal-engineering.org/

- Improves the dryness fraction at the turbine exit

Source : https://tinyurl.com/y7ef2sl9

- Avoids the corrosion problem at the turbine blades

Advantages(Contd..)



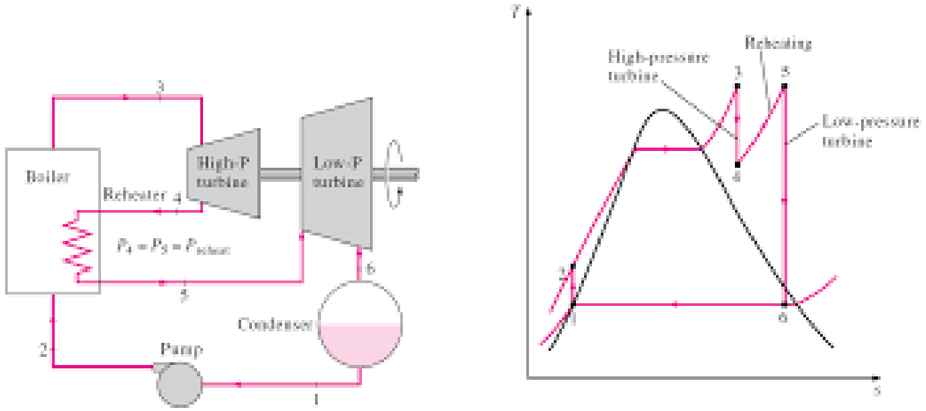
_Source : https://tinyurl.com/y9sqlssk

- Improves turbine work

_Source : https://learnthermo.com

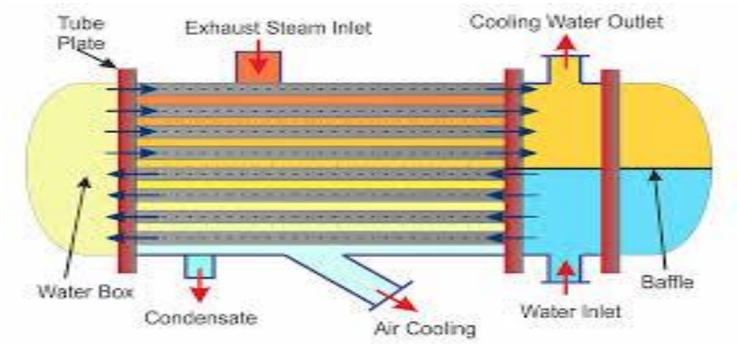
- Increases thermal efficiency

Disadvantages



_Source : https://staff.emu.edu.tr

- High Initial cost due to inclusion of reheater



_Source :watco-group.co

- Increases size of the plant (condenser)

Assessment -2(Problem)

1. A reheat cycle operating between 30 bar and 0.04 bar has a superheat and reheat temperature of 450°C. The first expansion takes place till the steam is dry saturated and then reheat is given. Neglecting feed pump work and Estimate

   i) Turbine Work

   ii) Ideal Rankine with Reheat cycle efficiency.

Assessment -2

2. If the quality of the steam lies below 85%, _____ kind of problem occurs on turbine blades

a) Corrosion

b) Erosion

c) Creep

d) Elongation

3. Identify the process involved in pump

a) Isothermal process

b) Isentropic expansion process

c) Isentropic compression process

d) Constant pressure heat rejection process

References

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