

Synergies between process energy efficiency and relief loads

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Synergies between process energy efficiency and relief loads

- Introduction
- Similarities in work processes for improving energy efficiency and reducing relief loads
- Case studies of dual benefits:
 - Pump with excess discharge pressure
 - Cooling upstream of product separator
 - Three-product distillation column
- Conclusions

Motivations to improve efficiency and reduce relief loads

- Energy:
 - Reduce the largest variable cost of production
 - Reduce emissions
 - Expand production without additional utilities

Motivations to improve efficiency and reduce relief loads

- Energy:
 - Reduce the largest variable cost of production
 - Reduce emissions
 - Expand production without additional utilities
- Relief Load:
 - Safety system audit in response to Texas City
 - Eliminate relief to atmosphere
 - Expand production without additional flare capacity

Similarities in work processes

The work process to reduce energy/utility consumption is similar to that used to reduce loads to the relief system:

Similarities in work processes

The work process to reduce energy/utility consumption is similar to that used to reduce loads to the relief system:

- Survey the entire system as a system
- Identify major consumers (of energy or flare capacity)
- Eliminate unnecessary consumption
- Reduce demands of largest consumers

Efficiency and Relief Loads: Dual Benefits

Reducing consumption of energy in the process *may* also reduce the required relief load if:

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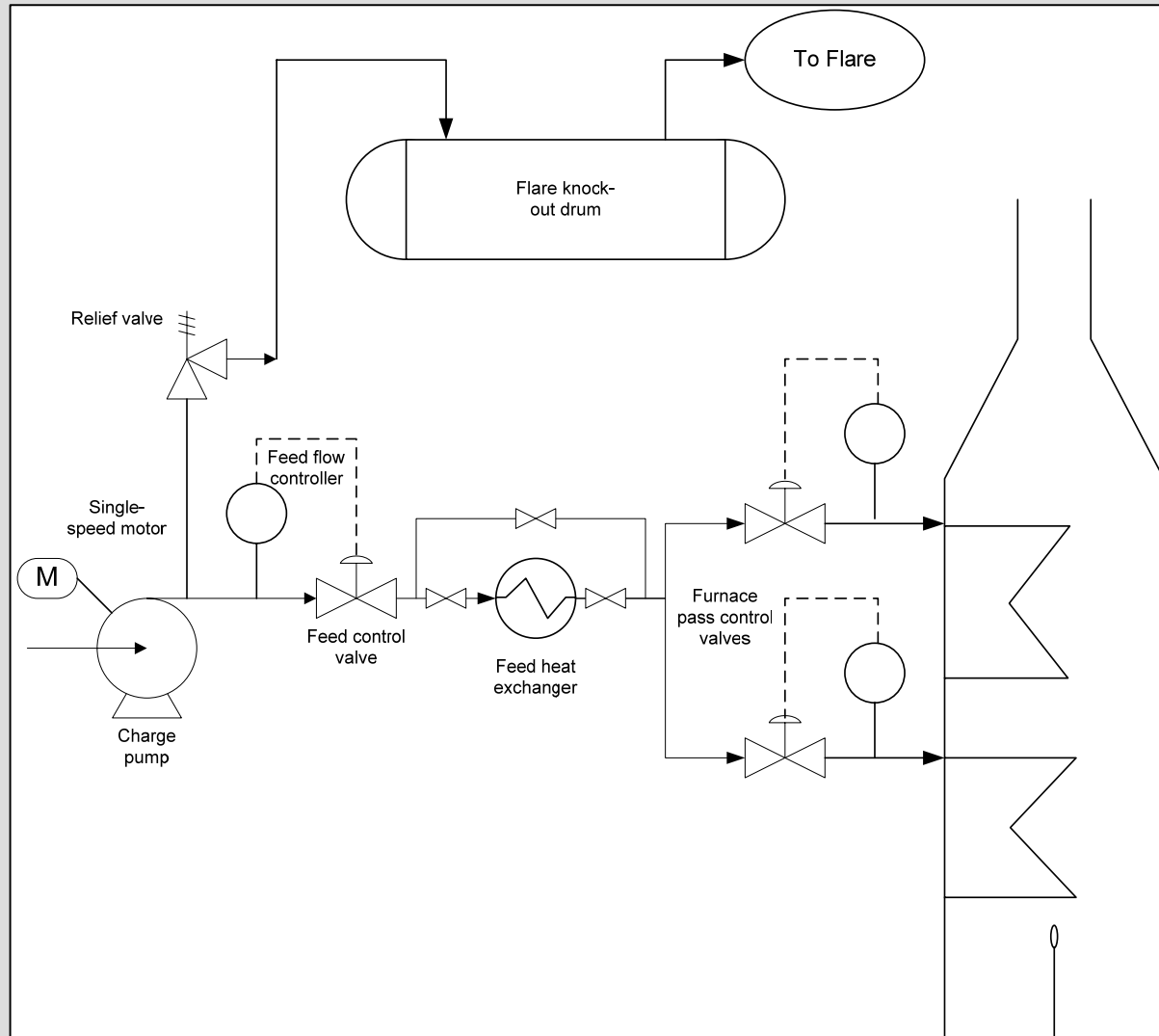
- The normal energy balance is changed
- The energy source responsible for the relief load is the one reduced

Example 1: Pump with excess discharge pressure

ENERGY

Feed control valve and pass valves openings are all less than 50%

Indicates pump power consumption could be reduced



Example 1: Pump with excess discharge pressure

ENERGY

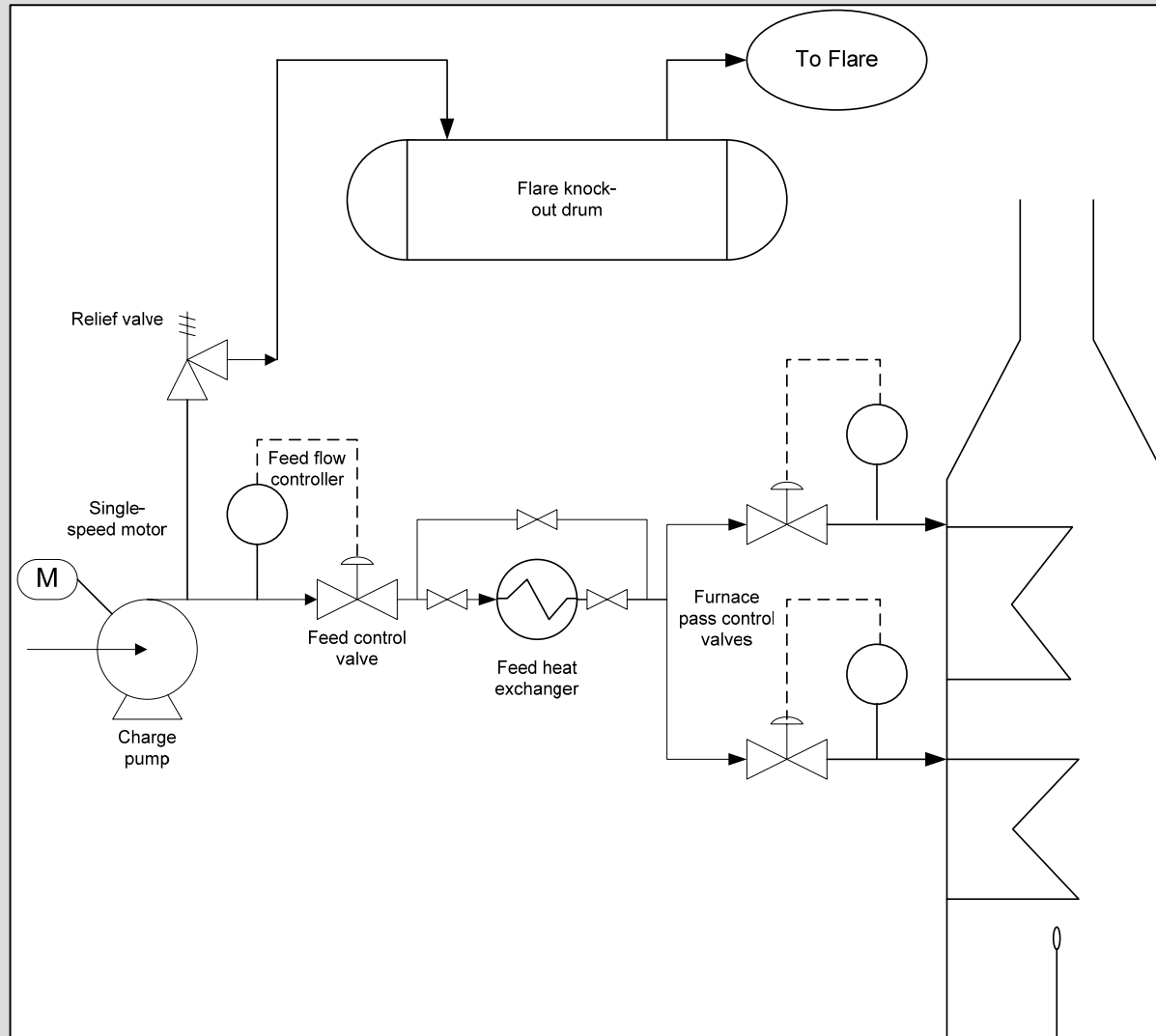
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RELIEF LOAD

Charge pump can develop head larger than exchanger MAWP

Blocked outlet at exchanger results in large liquid release through RV at pump discharge.

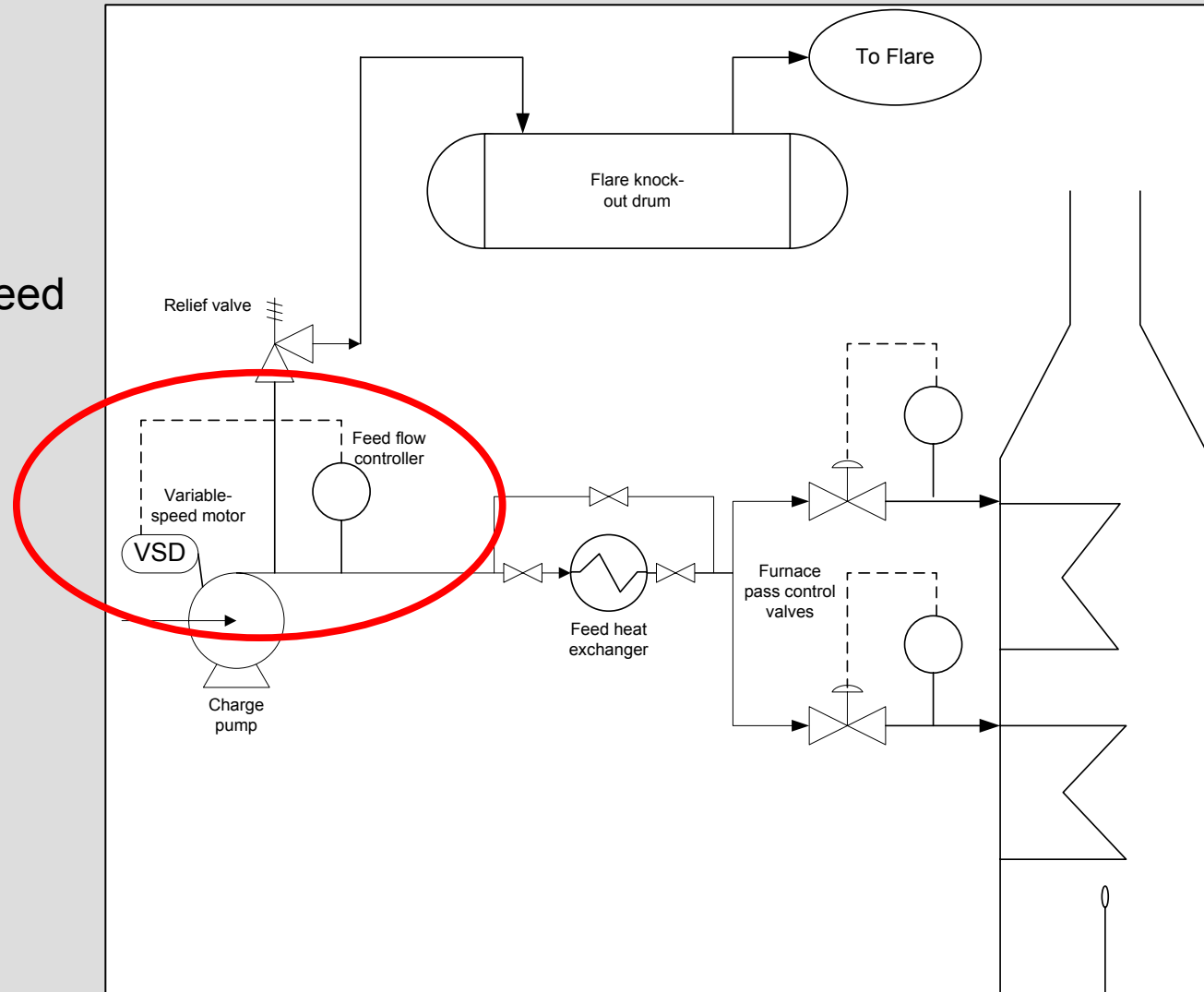


Example 1: Pump with excess discharge pressure

POTENTIAL SOLUTION

Install variable-speed driver on charge pump

Flow controller adjusts pump speed



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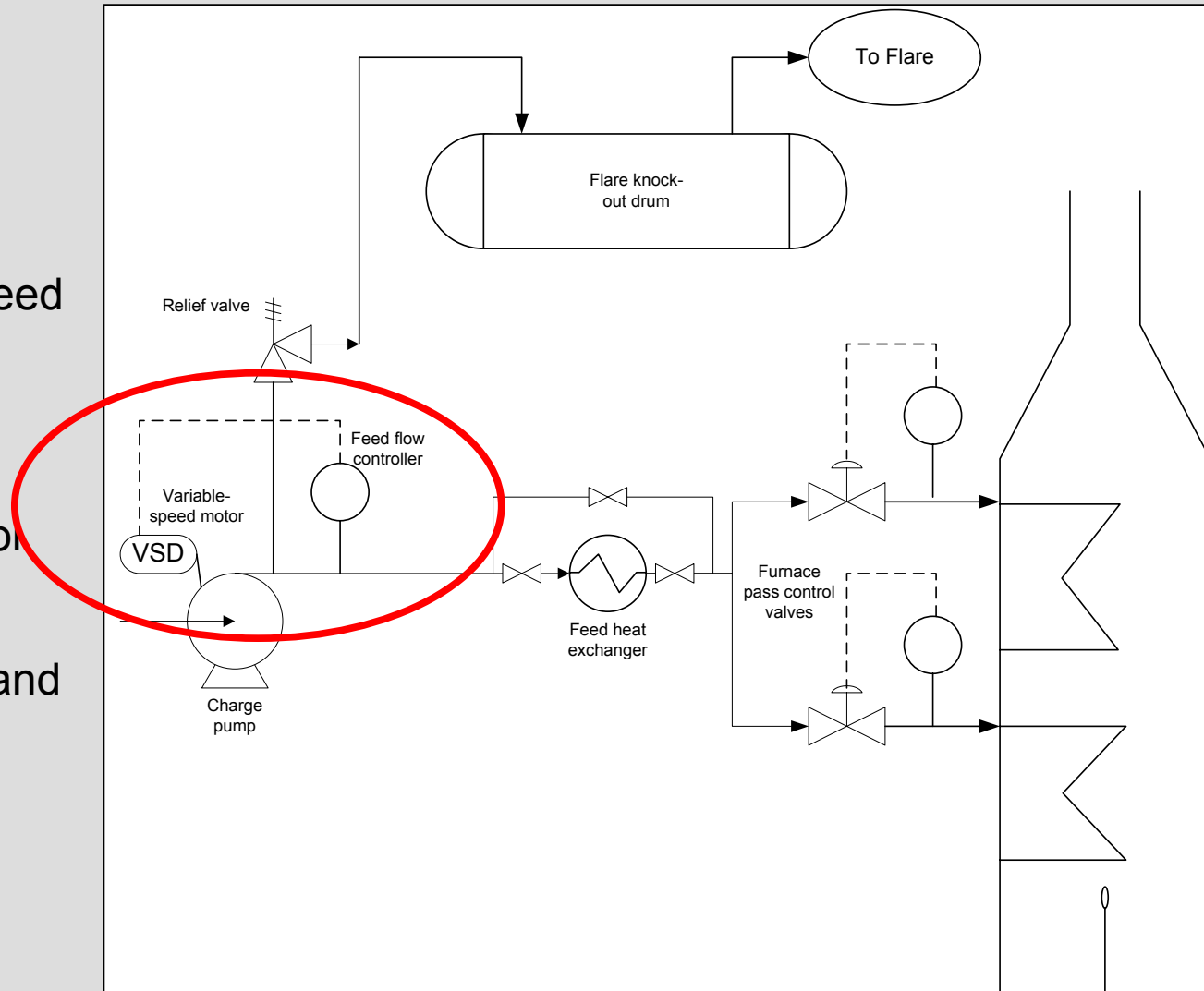
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ENERGY BENEFITS

Pressure loss across feed control valve has been eliminated

Reduced normal electricity demand



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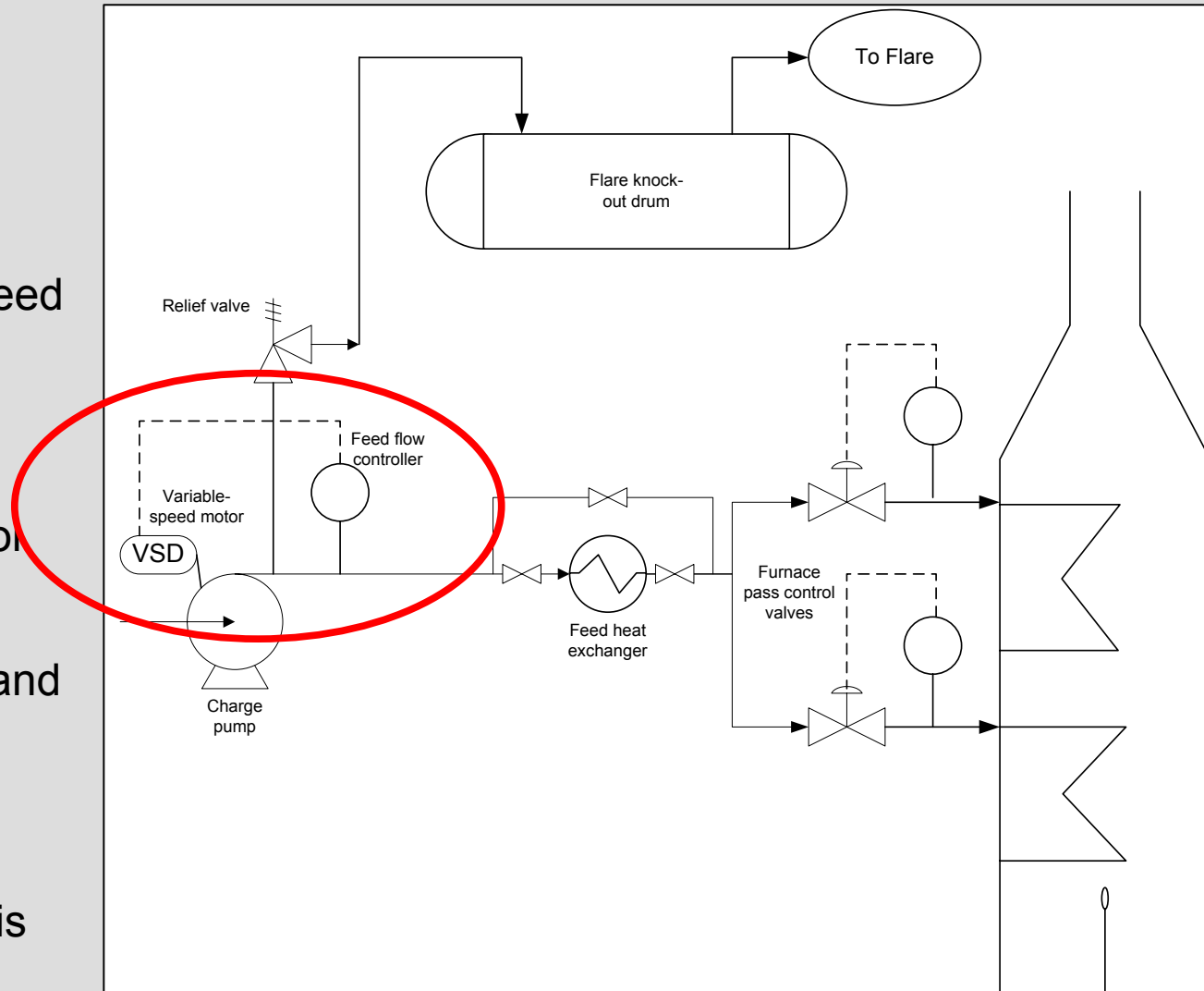
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RELIEF LOAD BENEFITS

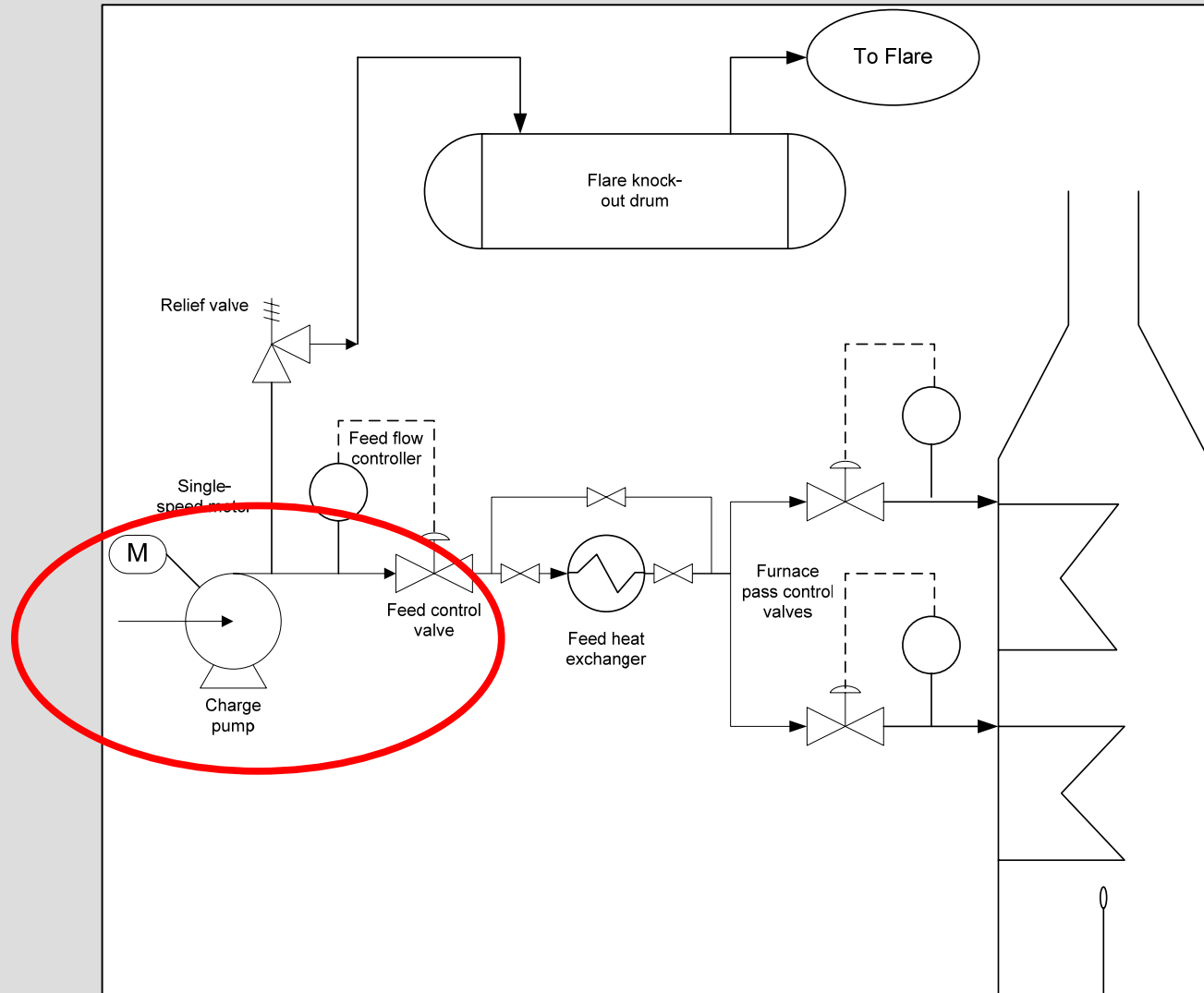
None: Blocked-outlet relief load is unchanged



Example 1: Pump with excess discharge pressure

ALTERNATE SOLUTION

Reduce pump impeller size



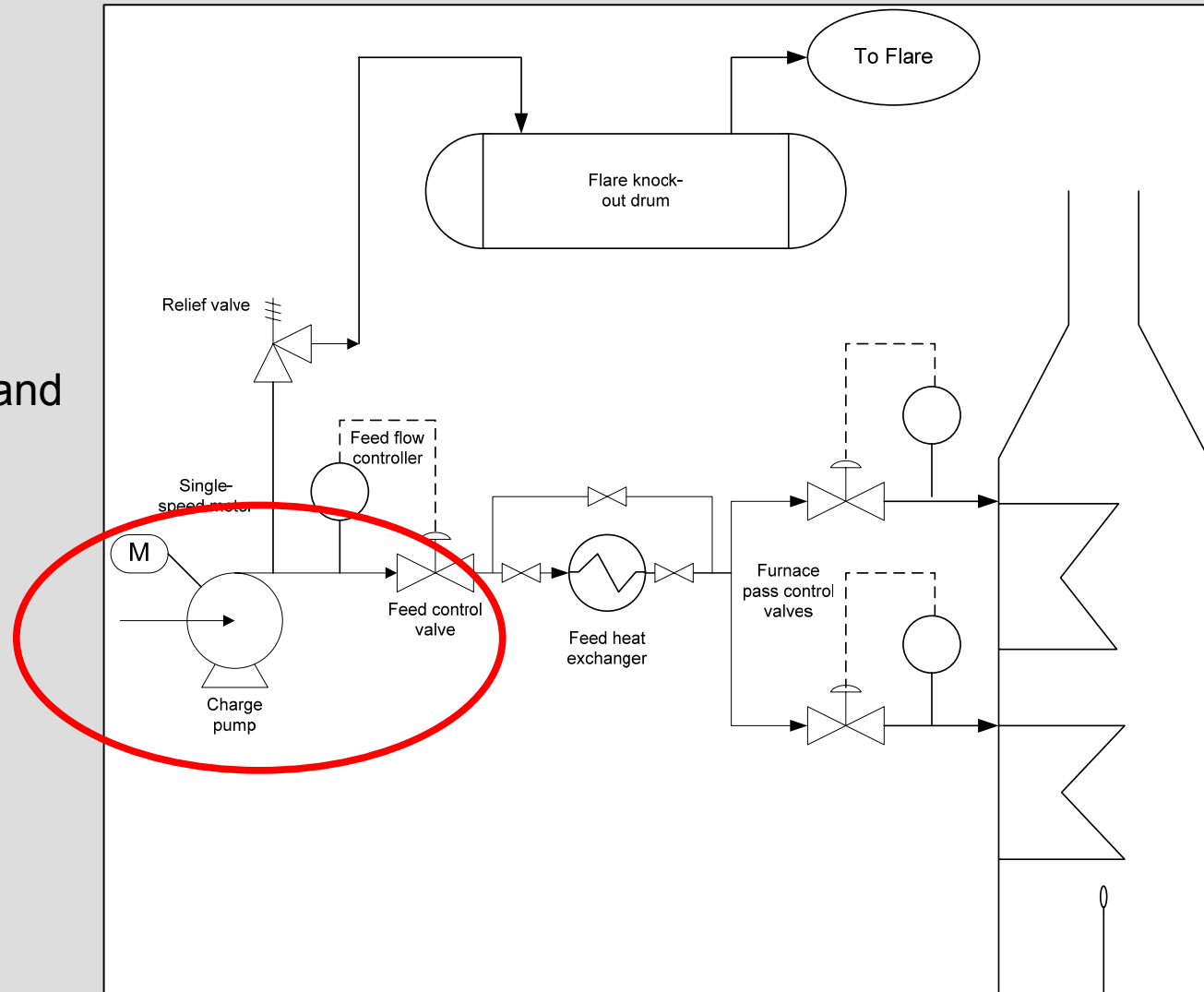
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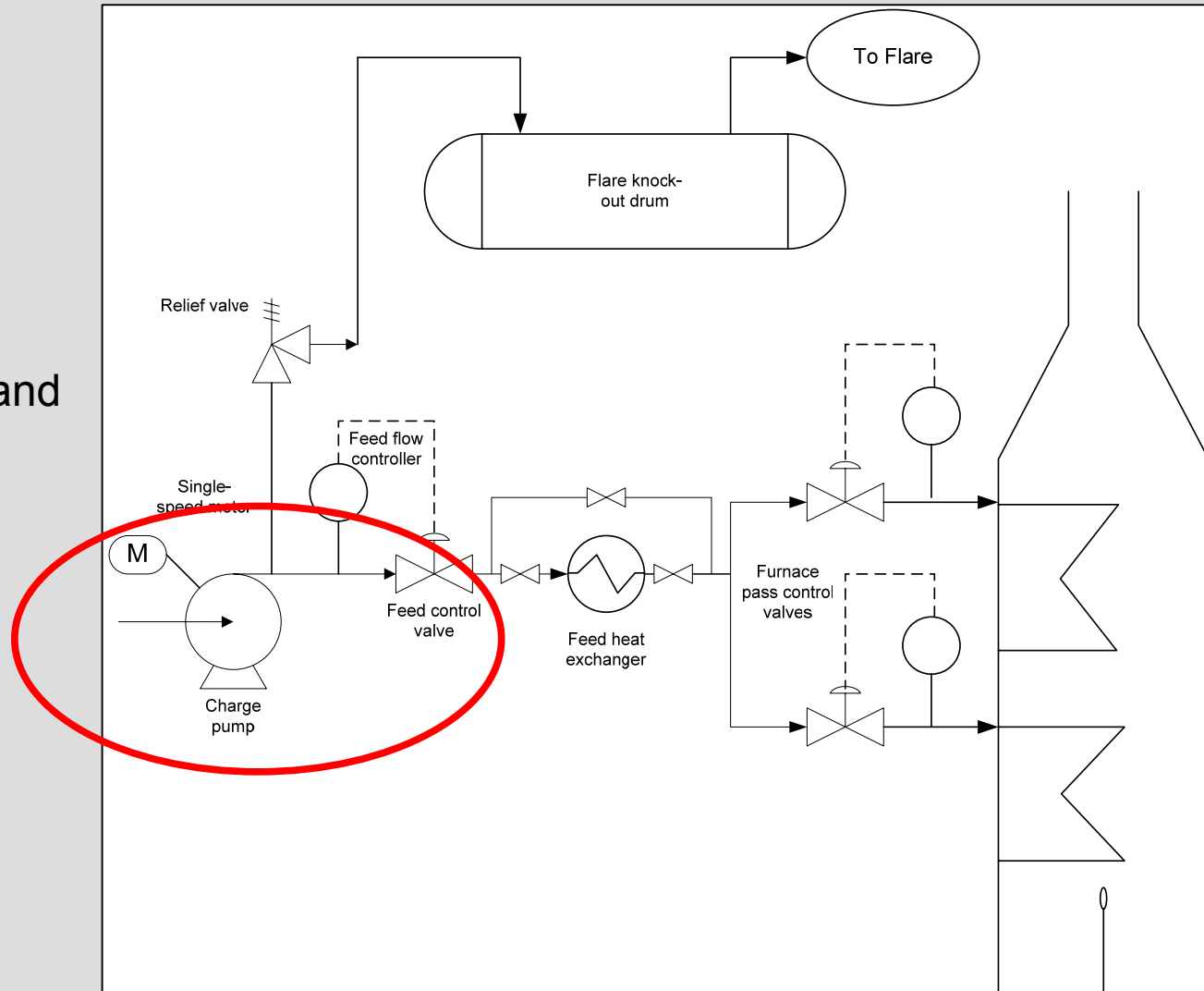
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RELIEF LOAD BENEFITS

Reduced pump head results in smaller relief load for blocked-in exchanger



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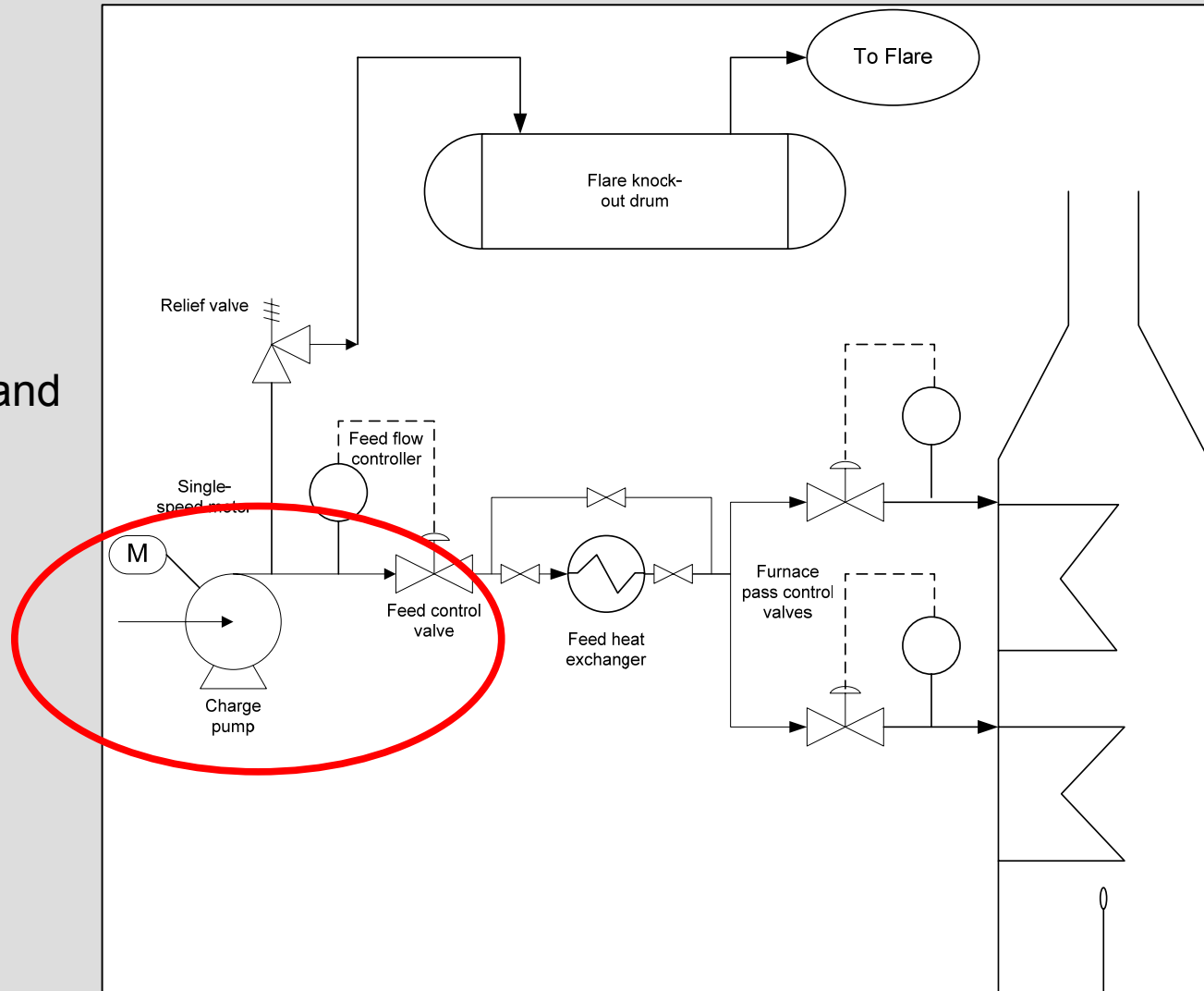
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RELIEF LOAD BENEFITS

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PROCESS FLEXIBILITY LOST

Reduced maximum throughput

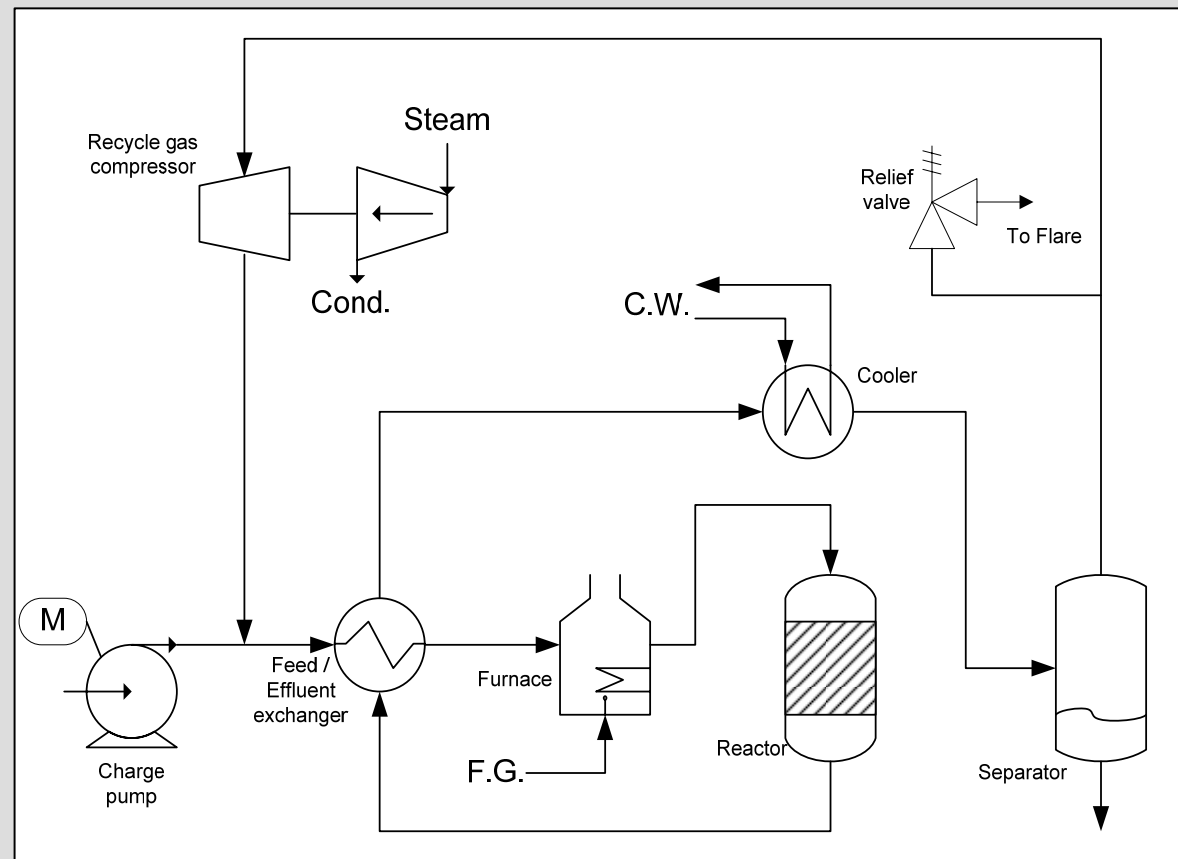


Example 2: Cooling upstream of product separator

ENERGY

Intention is to reduce overall energy consumption in this process

- Cooling water
- Fuel gas



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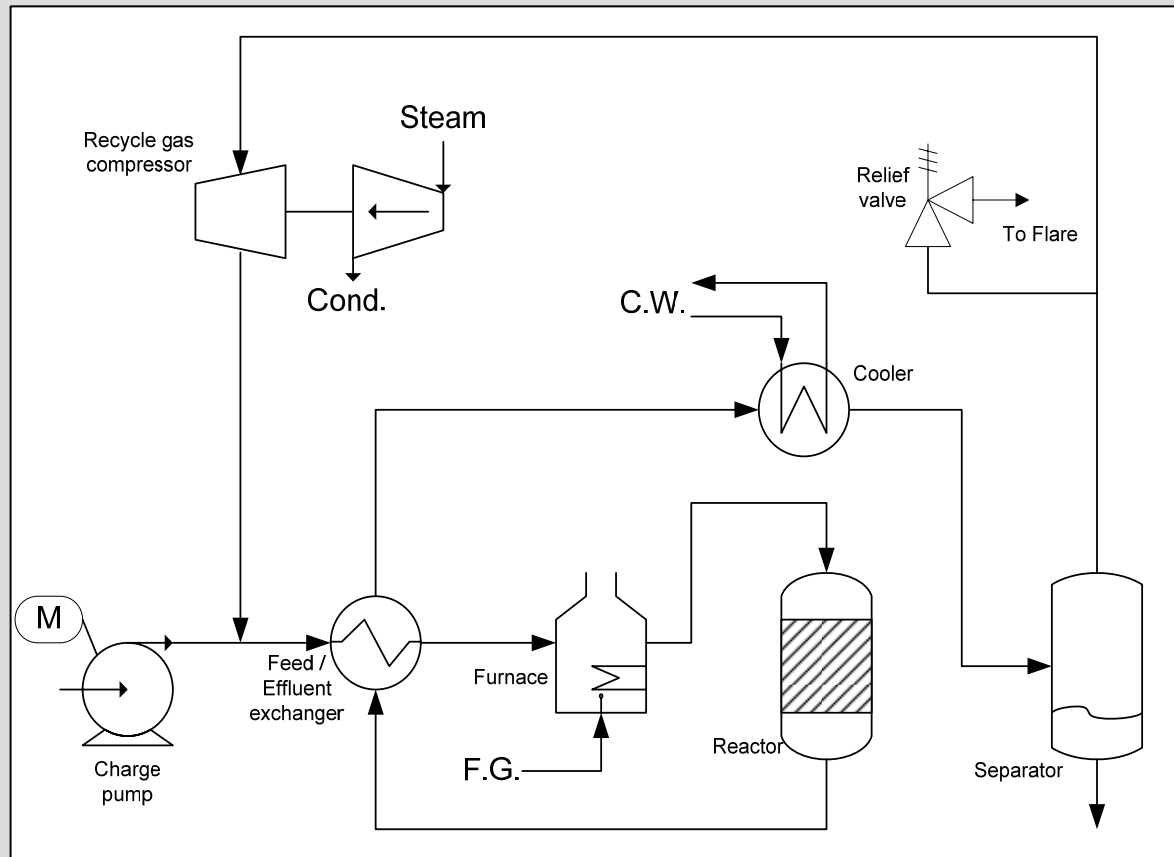
- Cooling water
- Fuel gas

RELIEF LOAD

Separator has lowest MAWP in the circuit

Several scenarios result in large vapor load to flare, among them loss of cooling water

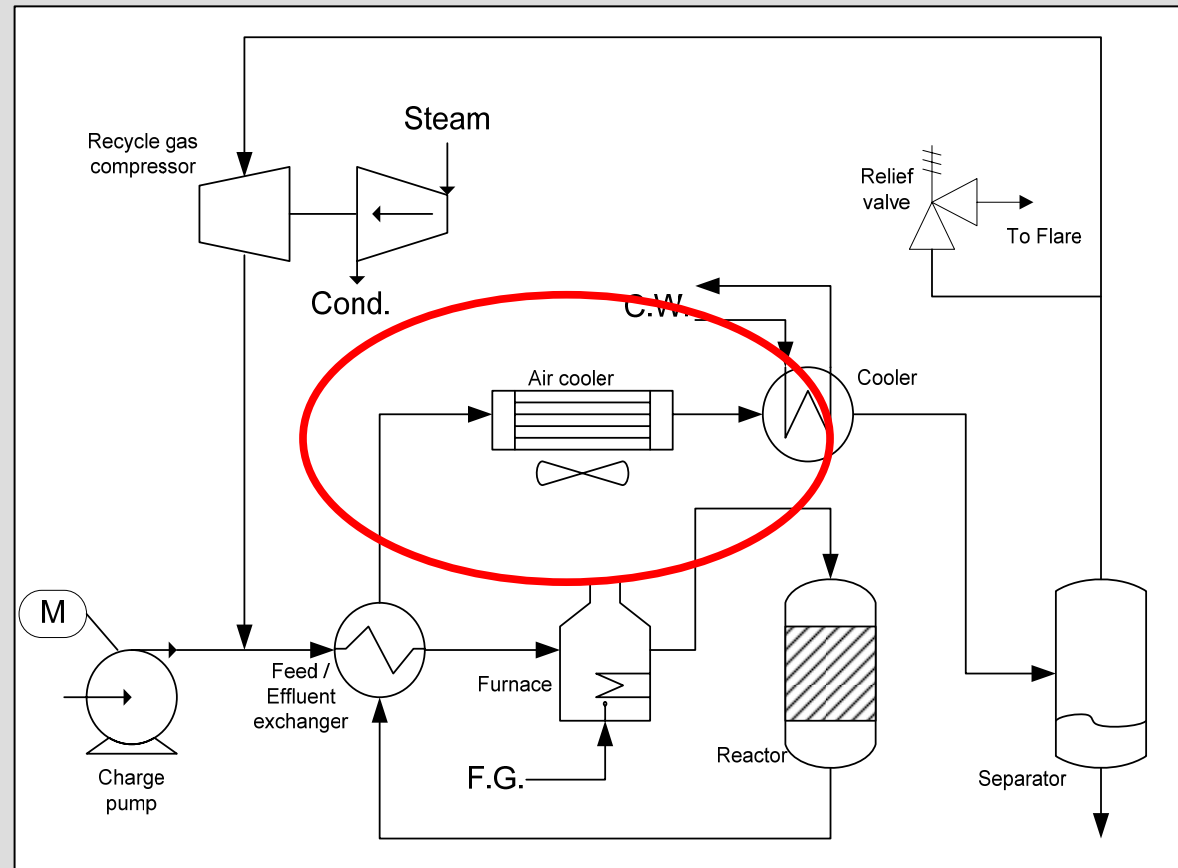
Flare maximum case is cooling water failure



Example 2: Cooling upstream of product separator

POTENTIAL SOLUTION

Add air cooler upstream of
CW cooler



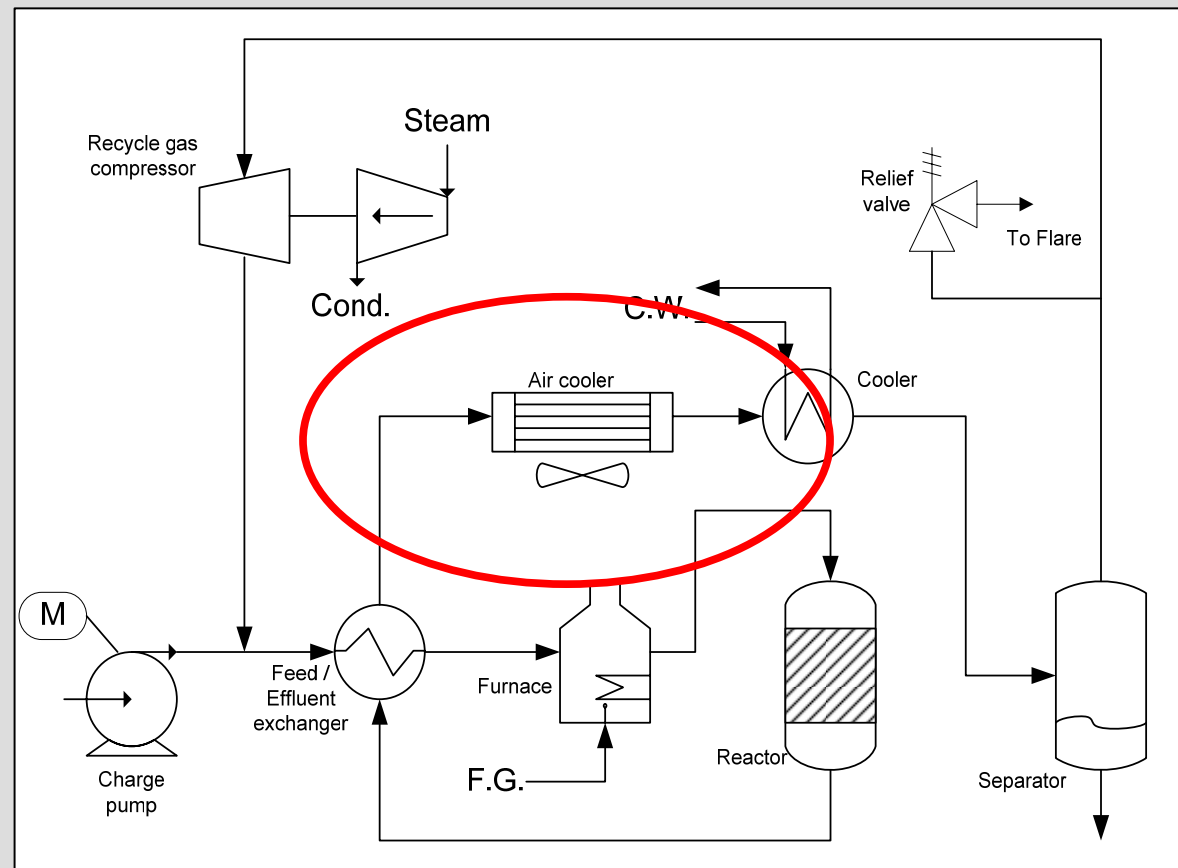
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POTENTIAL SOLUTION

Add air cooler upstream of water cooler

ENERGY BENEFITS

Reduced cooling water demand



Example 2: Cooling upstream of product separator

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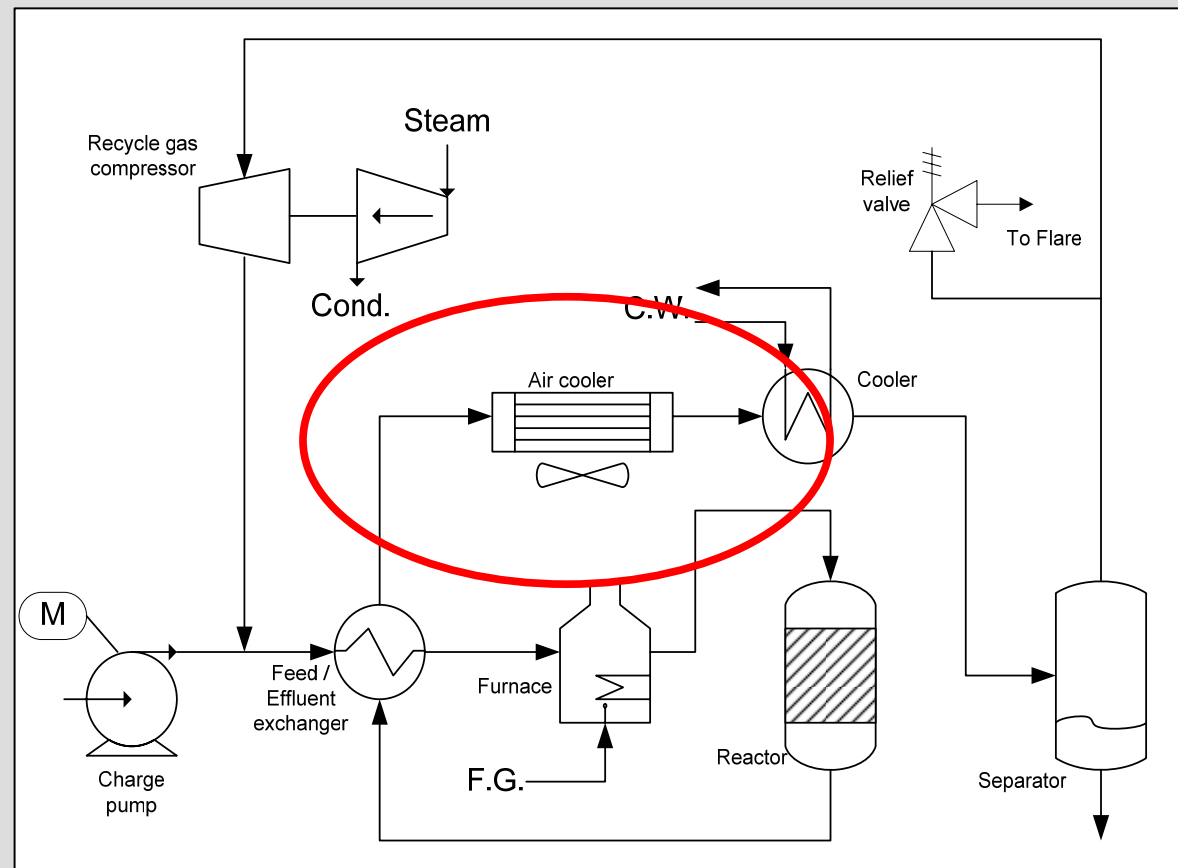
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RELIEF LOAD BENEFITS

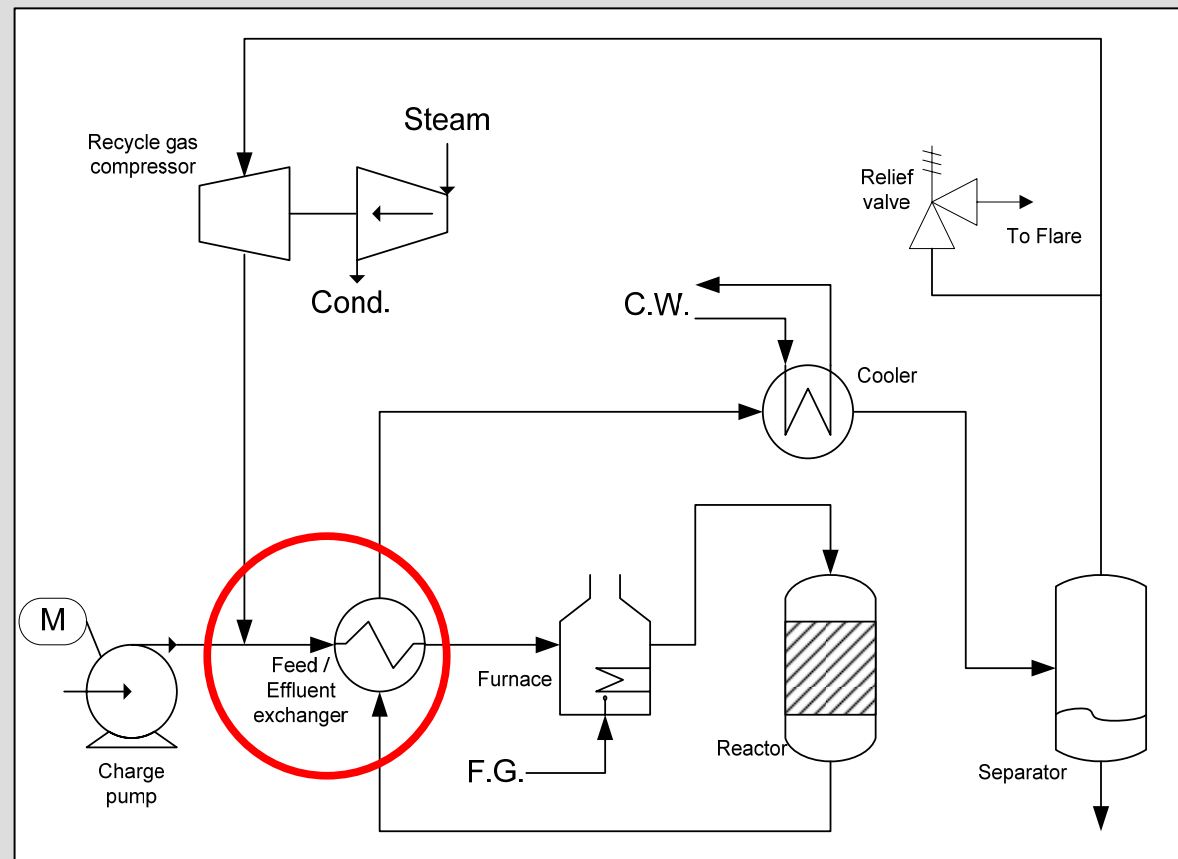
Reduced relief load upon cooling water failure



Example 2: Cooling upstream of product separator

ALTERNATE SOLUTION

Enhance feed/effluent heat exchange capacity



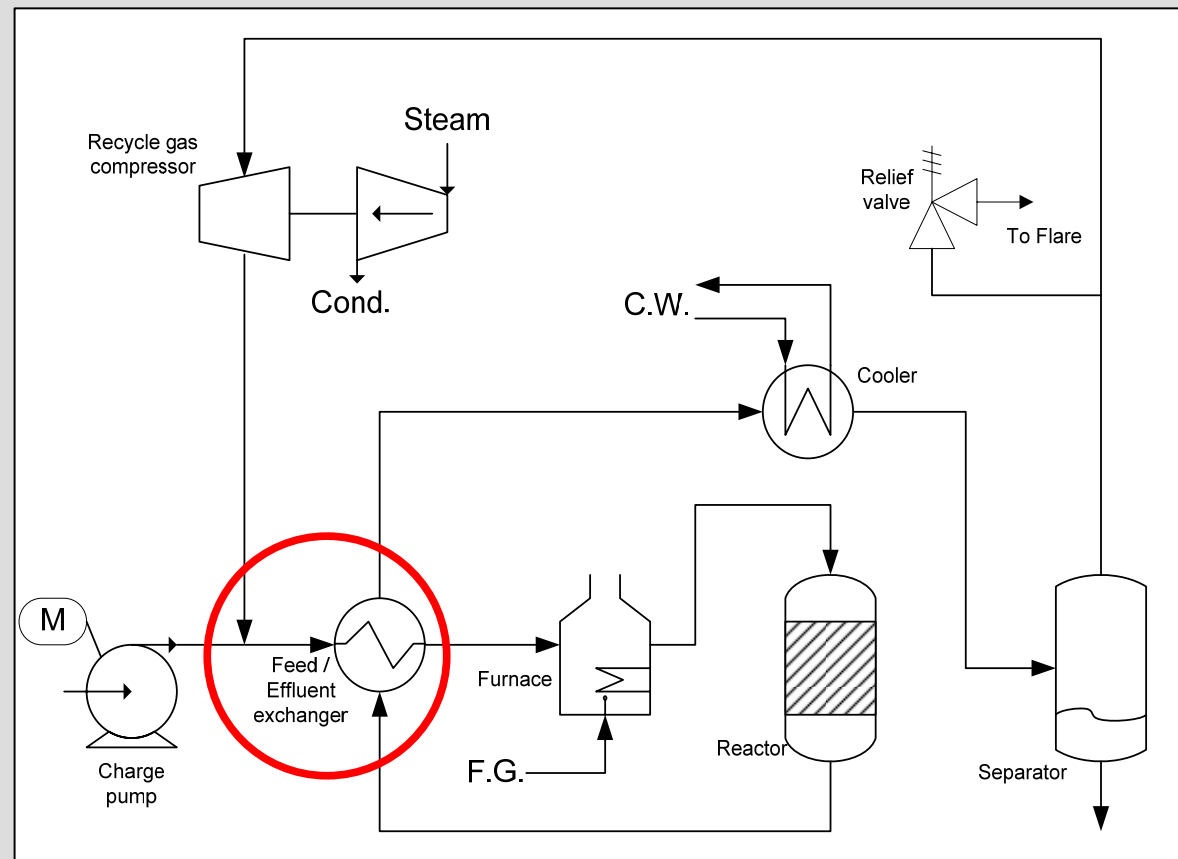
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Reduced cooling water demand
and reduced fuel gas demand



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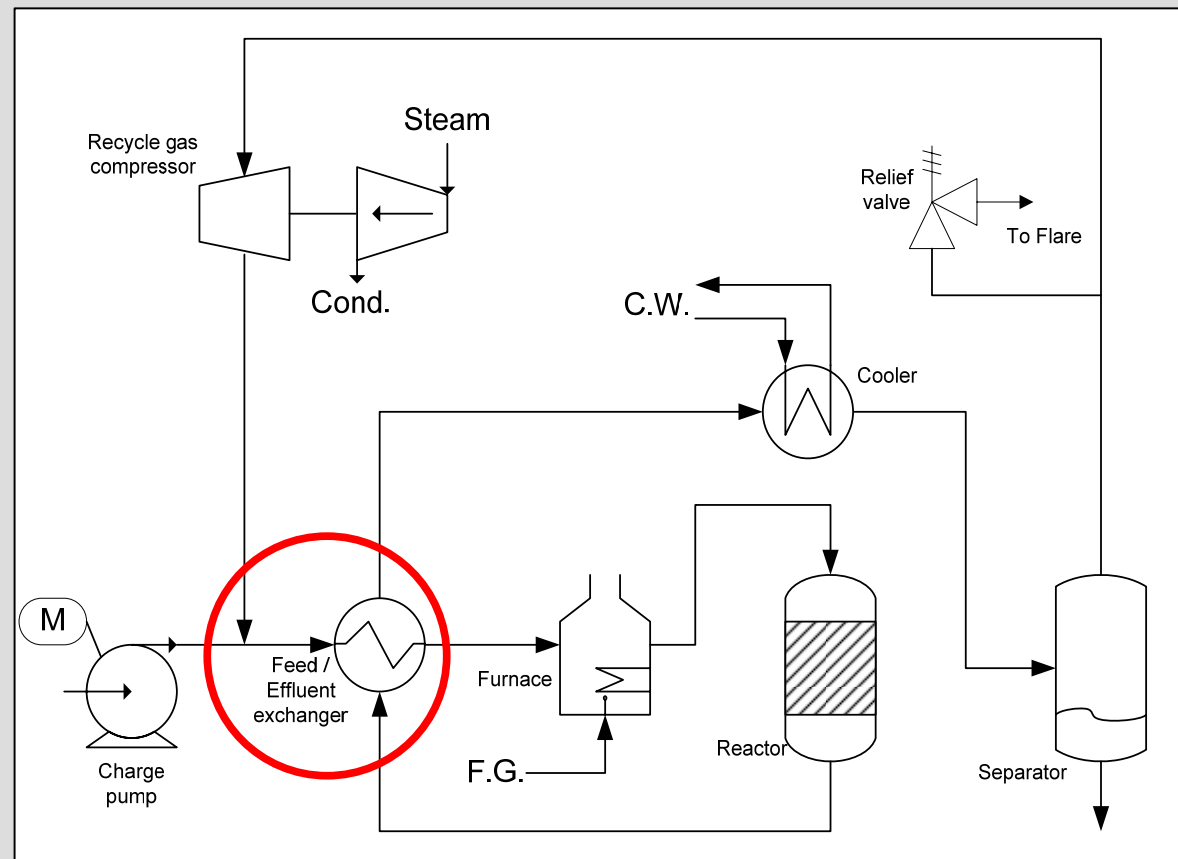
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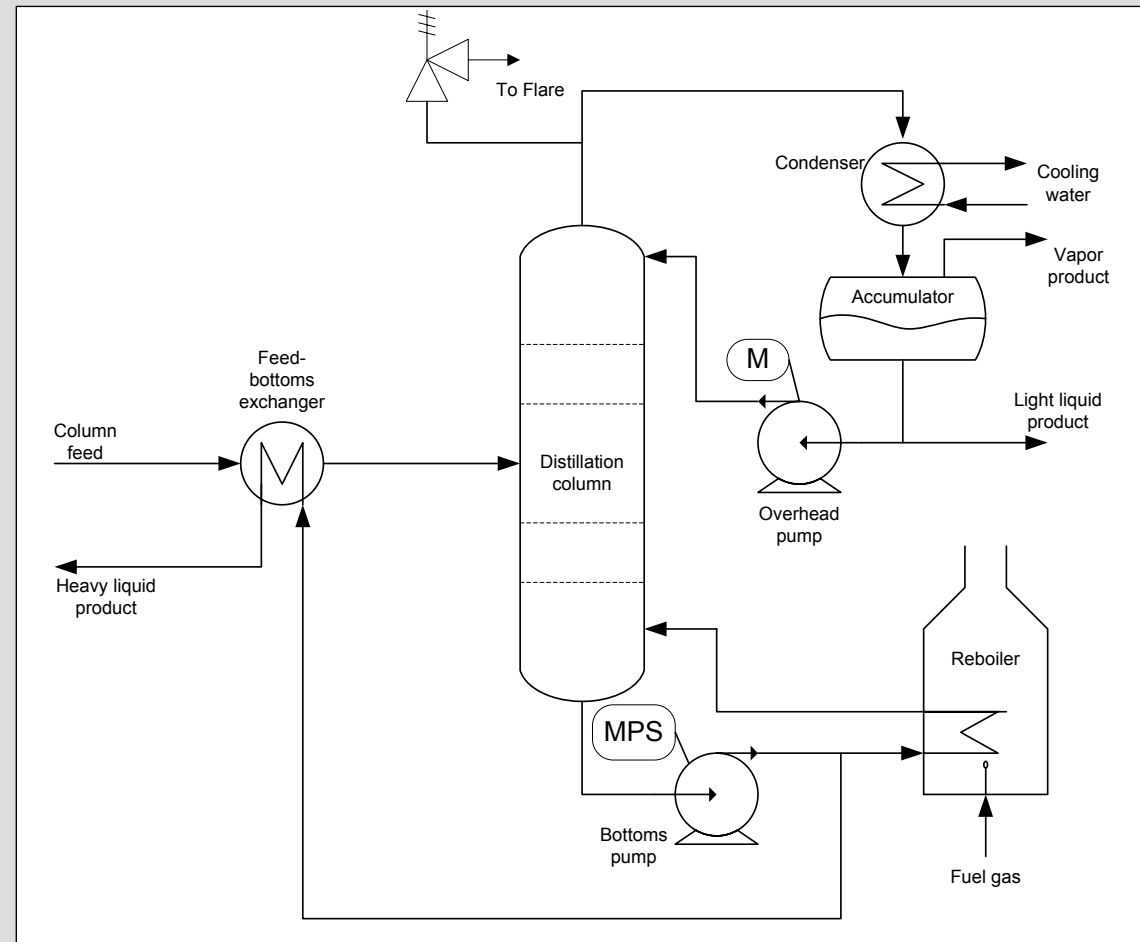
Larger reduction in relief load for
cooling water failure case



Example 3: Three-product distillation column

ENERGY

- Fuel gas short; make-up with purchased natural gas
- Excess medium-pressure steam; let-down to LPS; LPS is vented



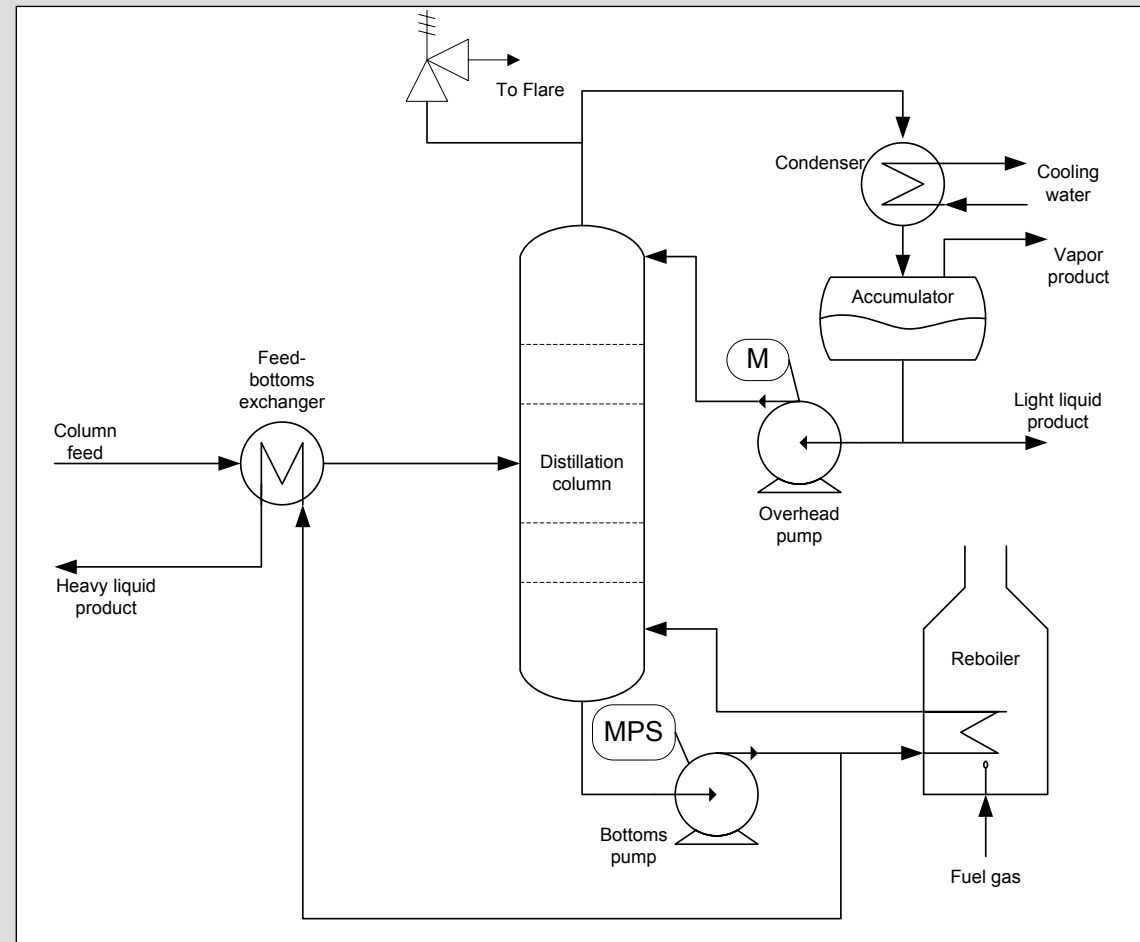
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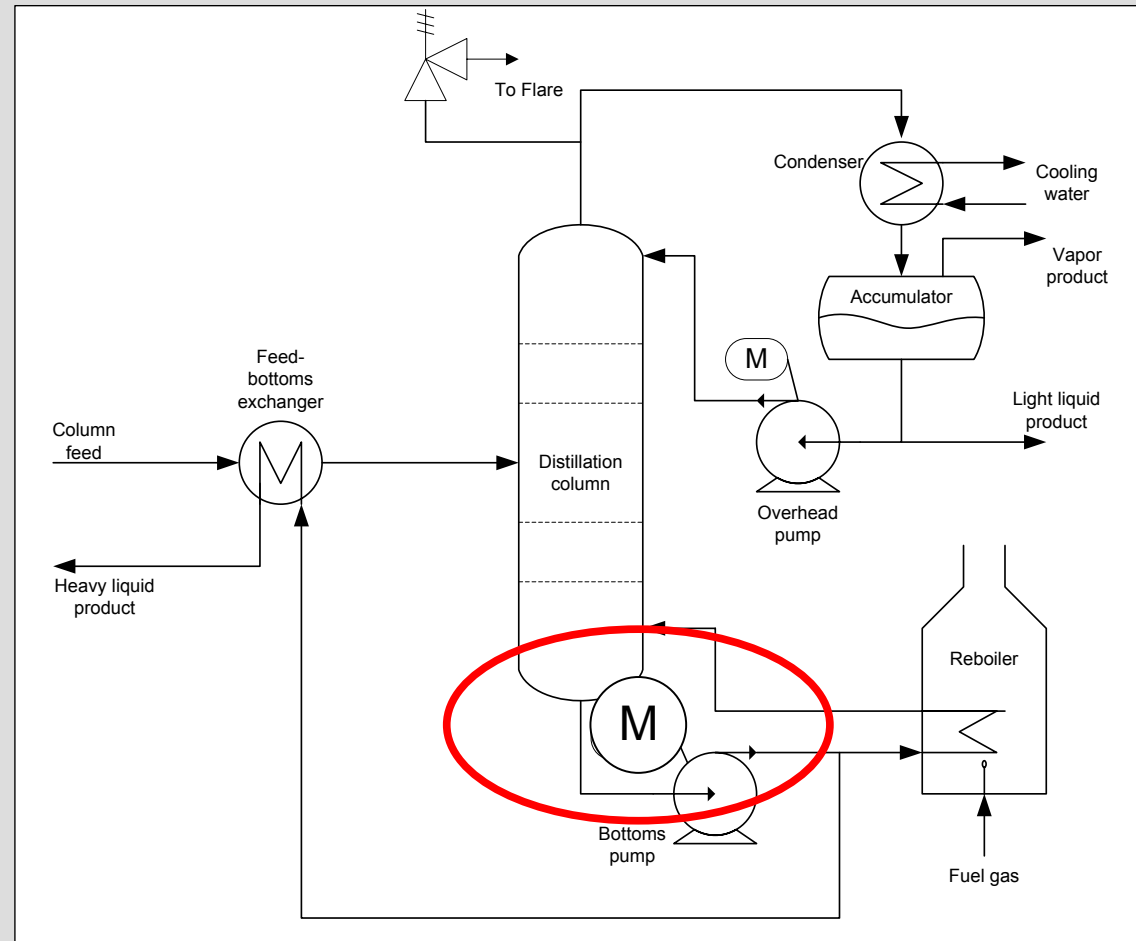
- Flare system loaded during power failure event
- Large PF load from this column



Example 3: Three-product distillation column

POTENTIAL SOLUTION

- Convert bottoms pump driver to motor



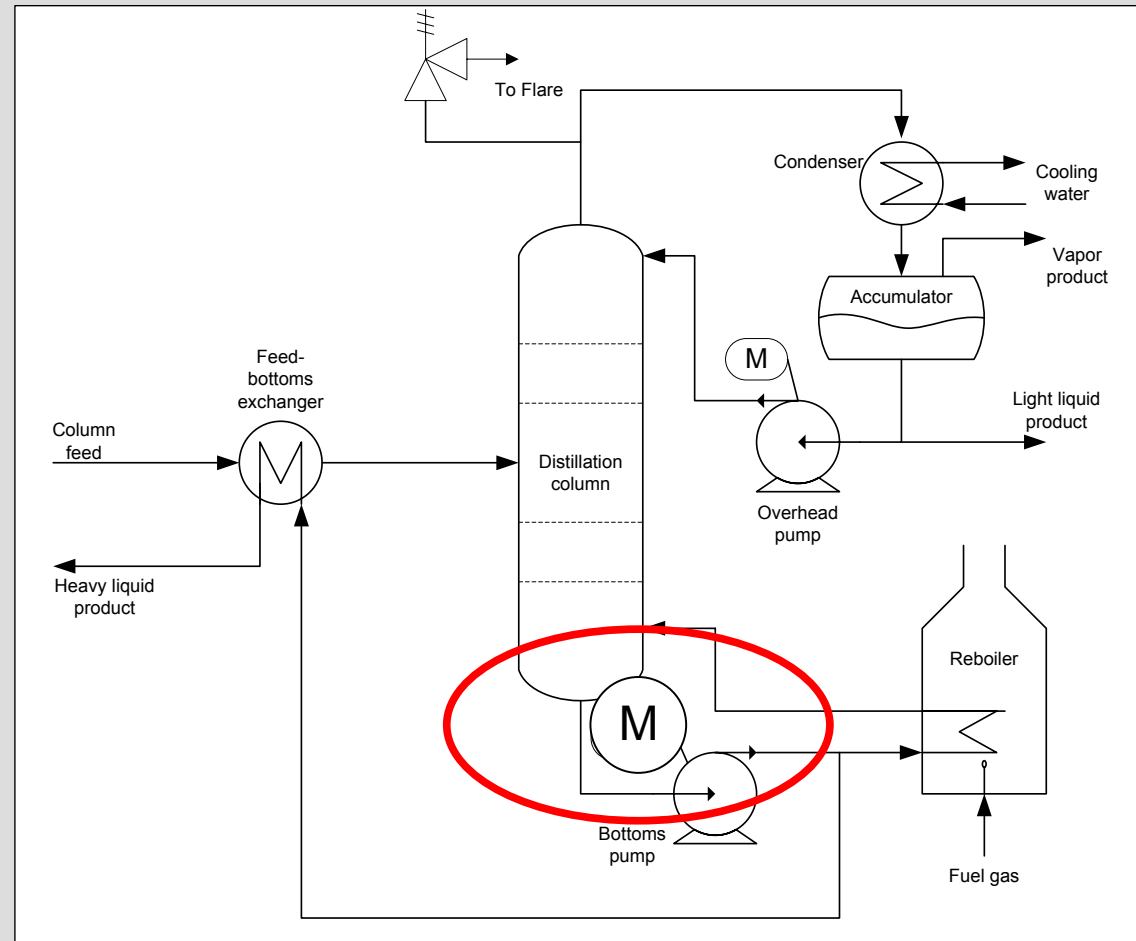
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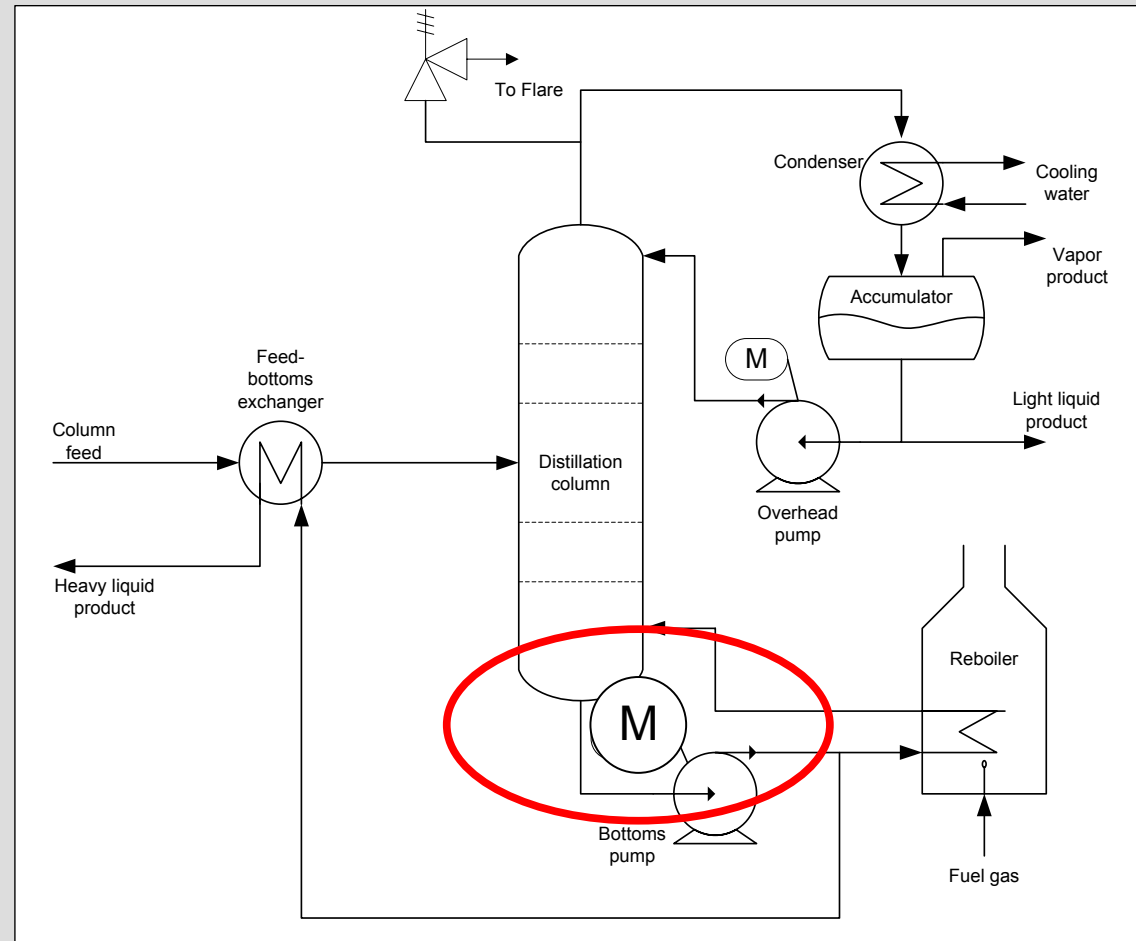
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RELIEF

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ENERGY

- Reduces consumption of MPS -- which means more is vented

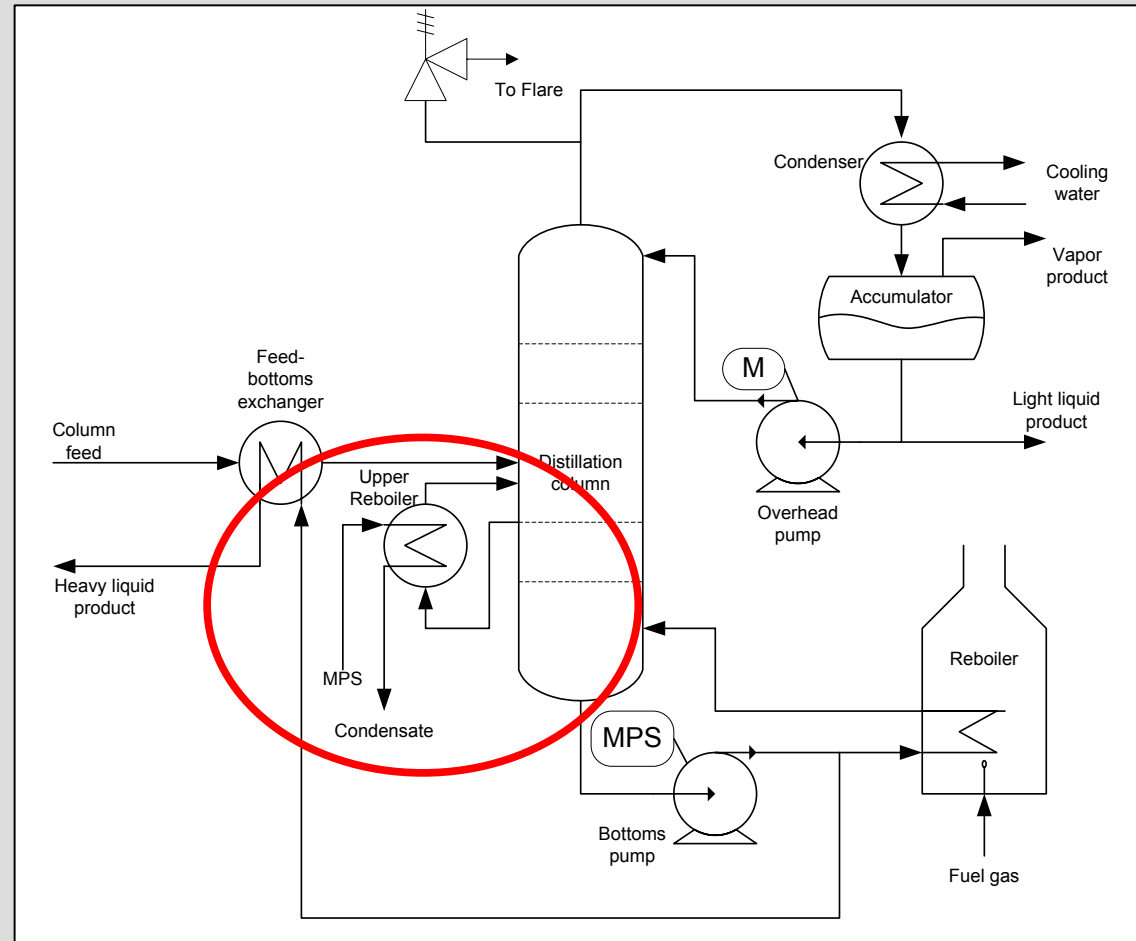


Example 3: Three-product distillation column

ALTERNATE SOLUTION

- Add upper reboiler

- MPSteam → condensate



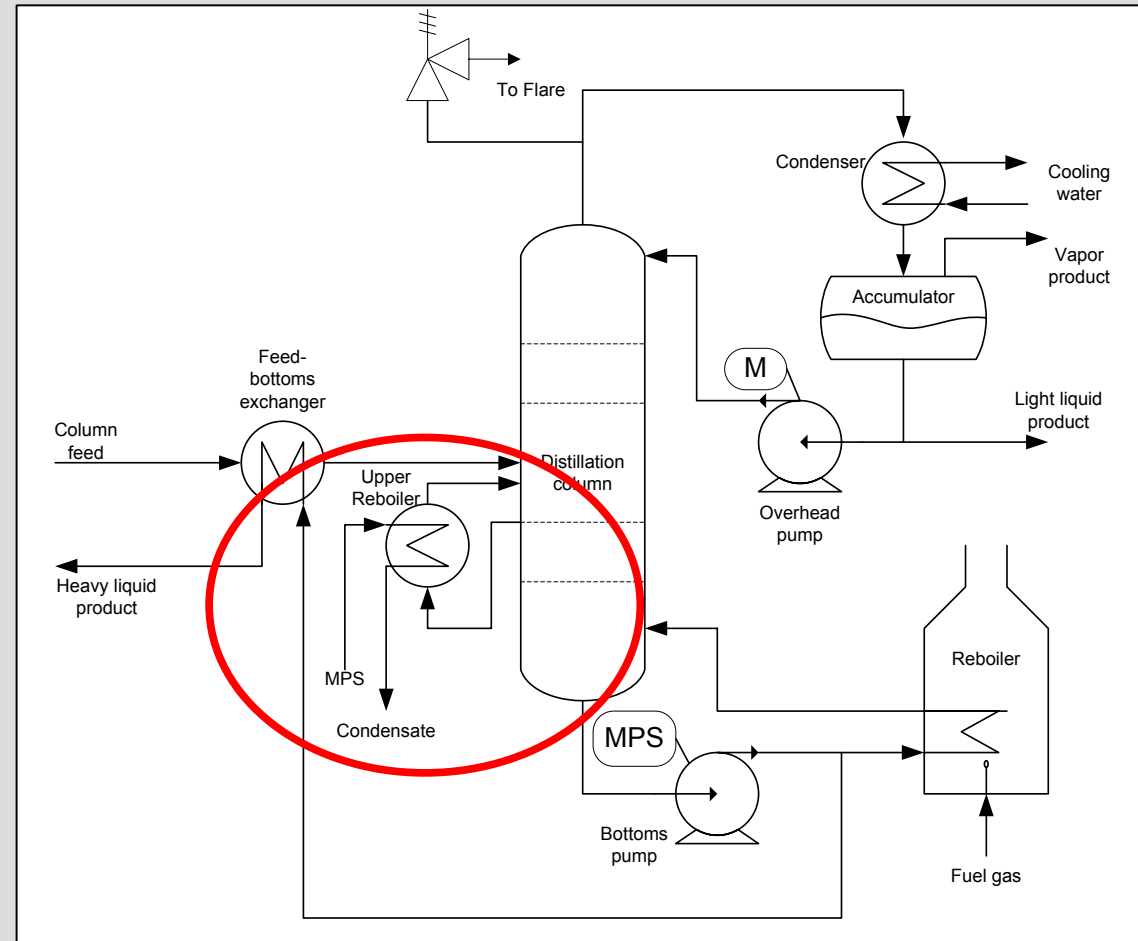
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ALTERNATE SOLUTION

- Add upper reboiler
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ENERGY

- Trades off fuel gas consumption for MPSteam consumption
- Reduces venting of MPSteam



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ALTERNATE SOLUTION

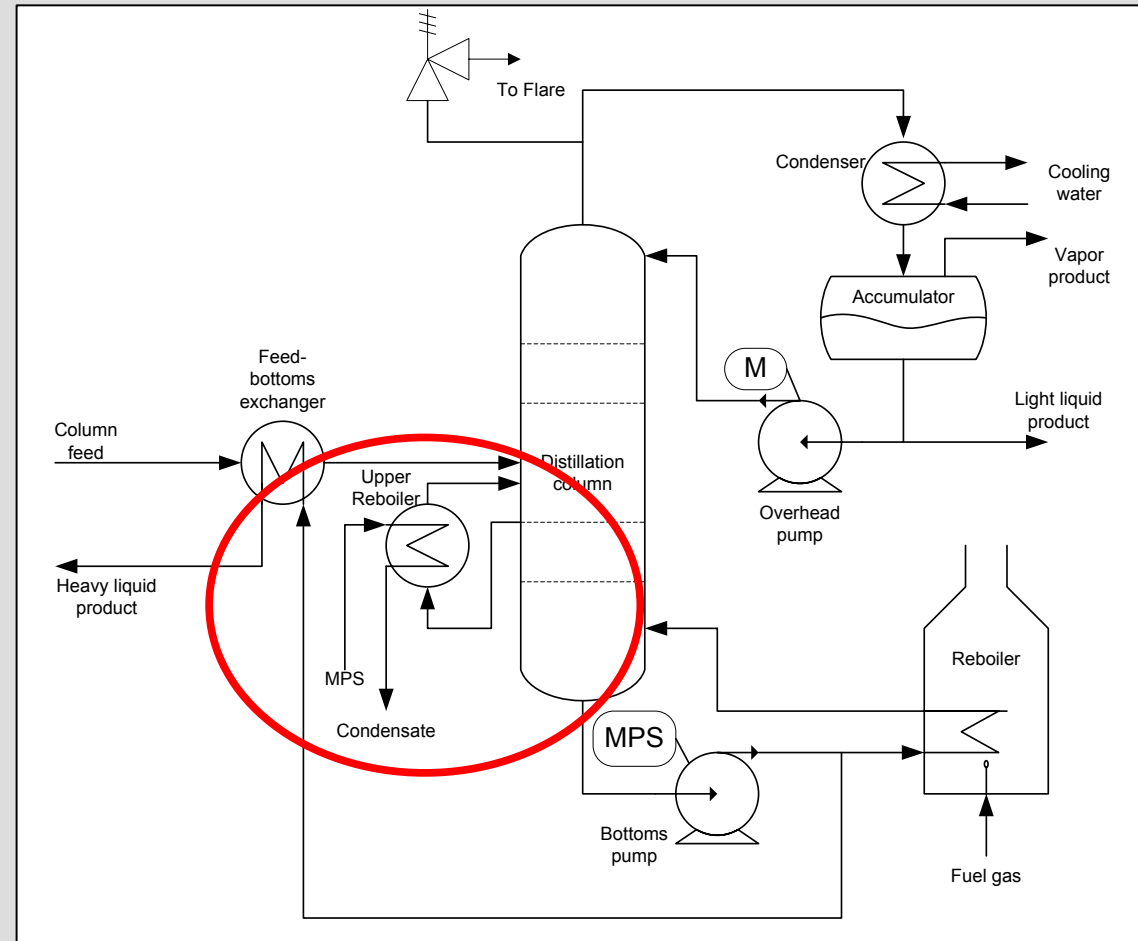
- Add upper reboiler
- MPSteam → condensate

ENERGY

- Trades off reduced fuel gas consumption for increased MPSteam consumption
- Reduces venting of MPSteam

RELIEF LOAD

- Upper reboiler pinches out during relief
- Power failure relief load decreases somewhat



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Dual benefit is less common for the reverse – i.e., reducing relief load is less likely to reduce energy consumption

Synergies between process energy efficiency and relief loads

Q & (perhaps) A

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