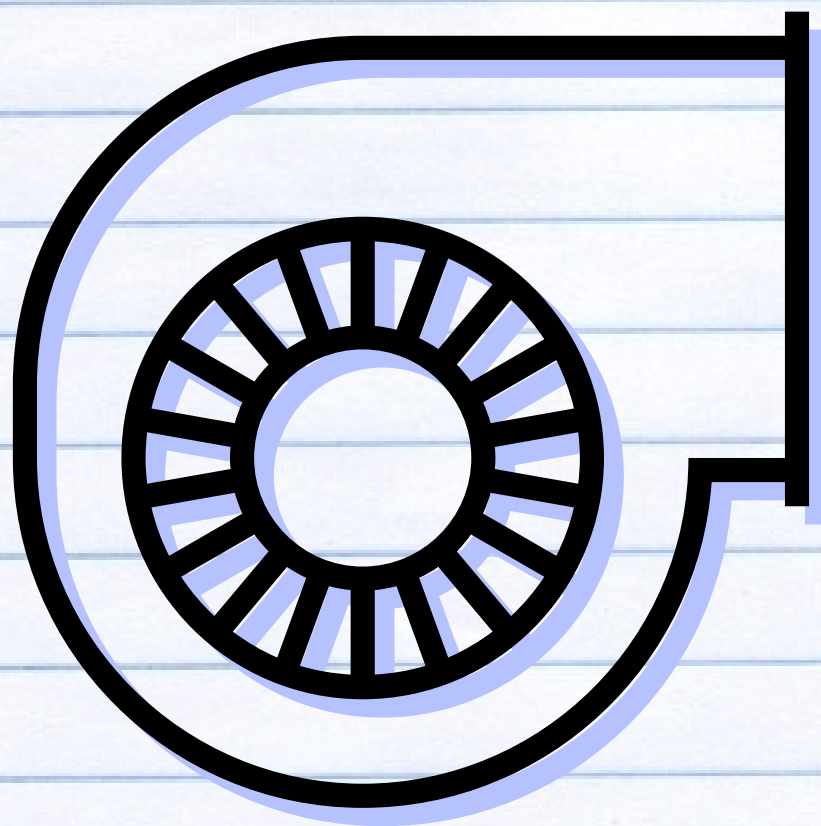
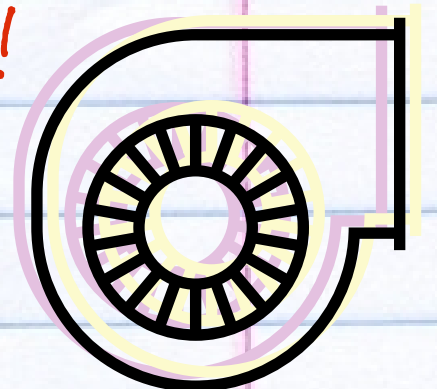


UNDERSTANDING :

A large, stylized icon of a centrifugal pump. It features a circular impeller with multiple blades, mounted on a curved shaft. The icon is rendered in black outlines with a light blue shadow effect.

**PROCESS &
INSTRUMENTATION
DIAGRAM OF A
PUMP**

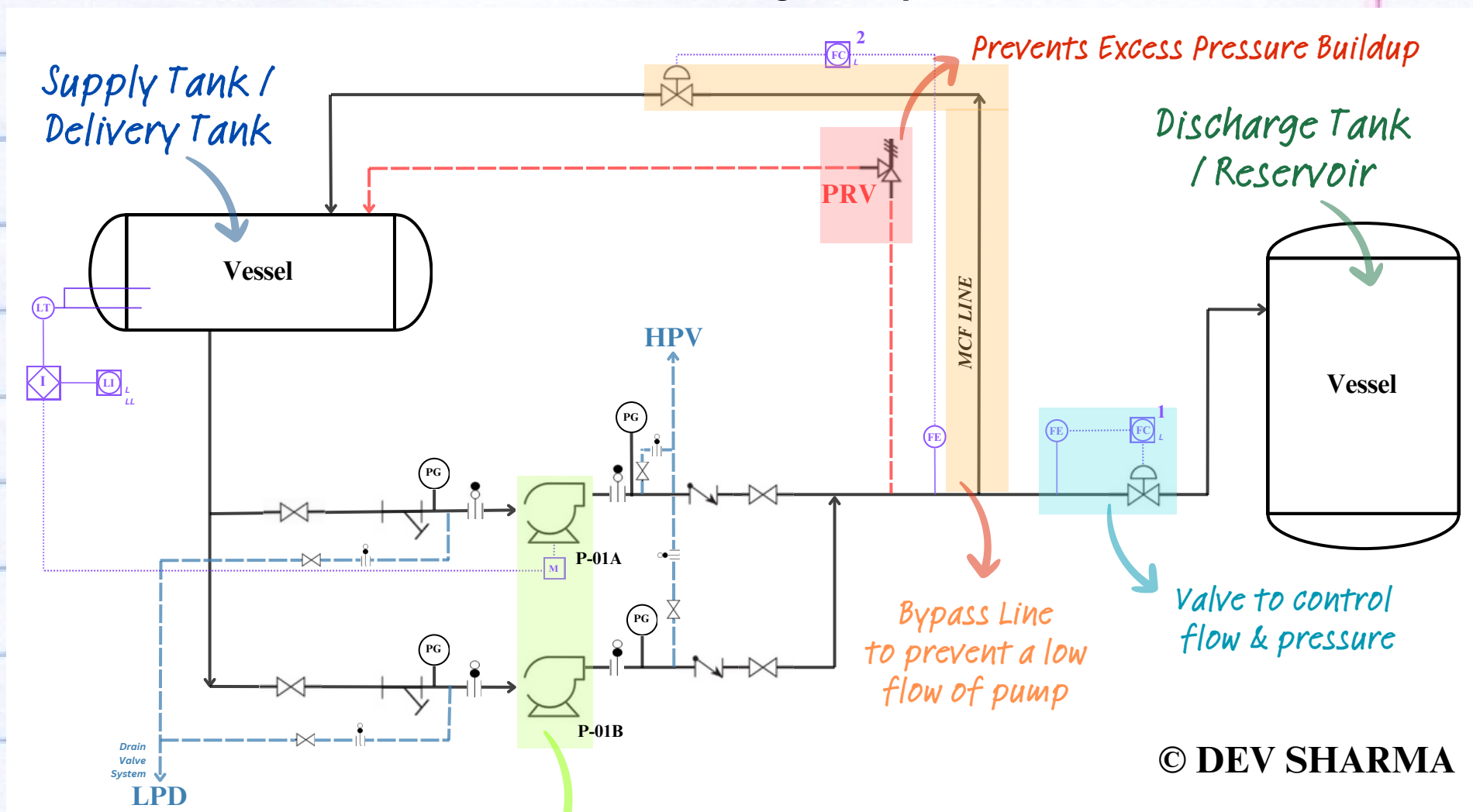
A Must-Read for Process Engineers!



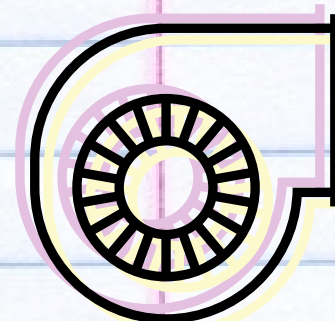
OVERVIEW:

UNDERSTANDING P&ID OF A PUMP

P&ID of a Centrifugal Pump Circuit

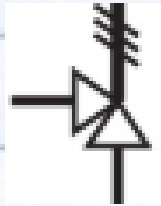


Pumps in parallel
To reduce the downtime while maintainance



IMPORTANT TERMS:

UNDERSTANDING PROCESS ELEMENTS



Pressure Relief Valve

A safety device designed to **release excess pressure** from a system to prevent overpressure conditions, protecting equipment and personnel.

Isolation Valves

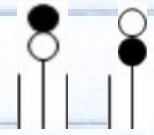


A valve used to stop or allow flow in a pipeline, enabling **system isolation for maintenance** or emergency shutdown. Common types: gate valve, ball valve, and butterfly valve.



Check Valve

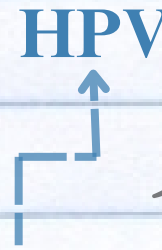
A **one-way valve** that allows fluid to flow in only one direction, preventing backflow. Types include swing check, lift check, and diaphragm check valves.



Blinds

Solid metal plates used to completely block flow in a pipeline during **maintenance** or system **shutdown**.

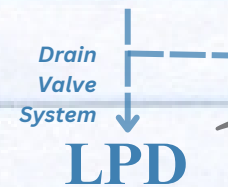
High Point Vent



*Not high pressure vent!
useful while pipe cleaning or purging using inert gas.*

Removes trapped air or gases from the highest point in a system.

Low Point Drain



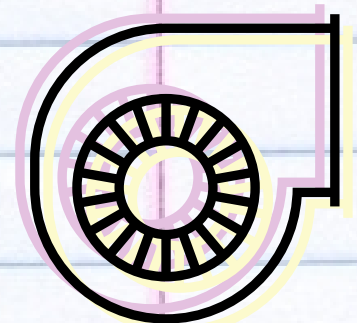
Drains out liquid or condensate from the lowest point in a system.

*Not low pressure drain!
useful while pipe cleaning or washing using liquid utility.*



Strainer

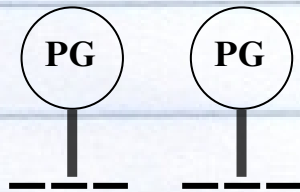
A mechanical device that **removes solid particles** from a fluid stream, **protecting downstream equipment** like pumps, valves, and heat exchangers from debris.



IMPORTANT TERMS:

UNDERSTANDING CONTROL LOOP ELEMENTS

Pressure Gauge

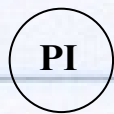


A mechanical device that provides a direct, local pressure reading.

Pressure Transmitter & Indicator



Converts pressure into an electrical signal for remote monitoring and control.



Displays pressure readings on a control panel or instrument display.

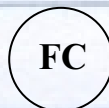
Flow Element



A sensor (like an orifice plate or flow meter) that measures flow rate in a pipeline.

Signal to FC

Flow Controller



Instrument used to regulate the flow rate of a fluid within a process by adjusting a control valve based on feedback from a flow measurement device (such as a flow meter or flow element).



1 For MCF line in a pump – Maintains a minimum continuous flow (MCF) to prevent pump damage.

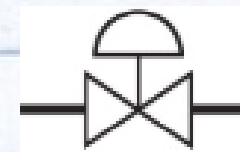


2 For pump outlet flow – Adjusts flow based on the discharge vessel's process requirements.

Level Control System



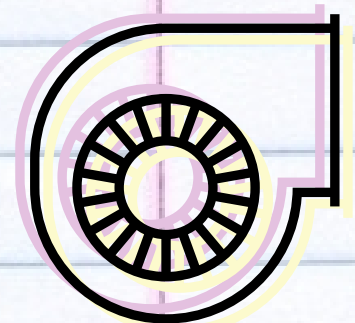
Controls the outlet flow from vessel by controlling pump motor speed based on vessel liquid level



Control Valve

A valve that modulates fluid flow, pressure, or temperature in response to signals from a control system. It plays a crucial role in **process automation**.

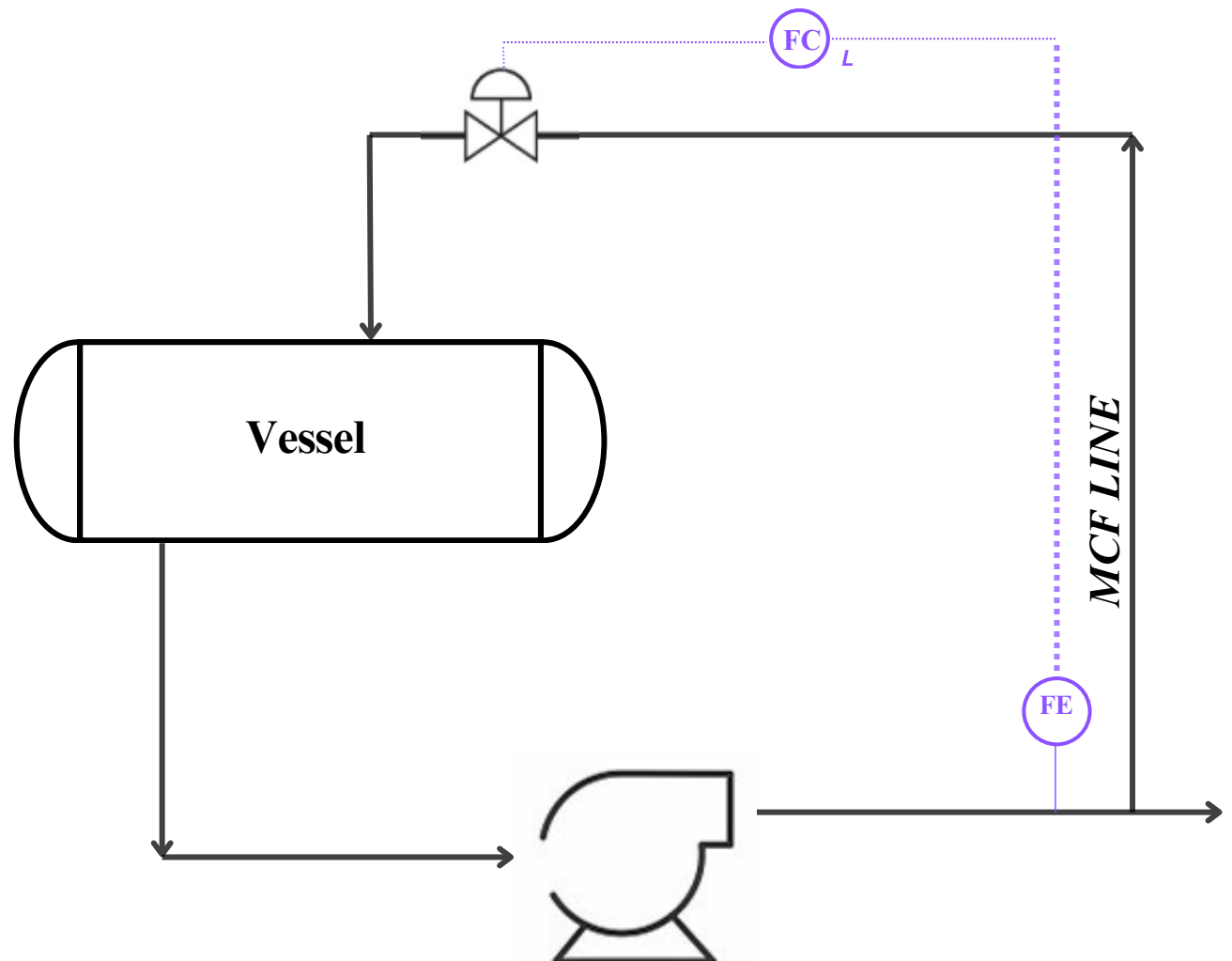
Further signal to Control element i.e. control valve



IMPORTANT TERMS:

MINIMUM CIRCULATION FLOW (MCF)

Minimum Circulation Flow (MCF) is the lowest flow rate at which a pump can operate continuously without overheating, cavitation, or mechanical damage. Running below this limit can cause excessive wear and reduce pump lifespan.

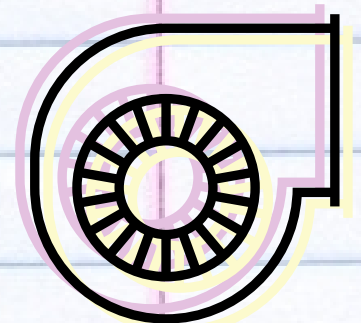


WHAT IS THE CONTROLLER LOGIC?



If the flow drops below the MCF setpoint, the controller opens a recirculation control valve (typically an automatic bypass valve or a modulating control valve) to divert flow back to the pump suction or recirculation line.

Once the main discharge flow recovers above MCF, the controller closes or modulates the recirculation valve accordingly.



WHEN TO USE MCF?

MCF CRITERIA

MCSF CRITERIA

MCSF - Minimum continuous stable flow : lowest flowrate at which pump can operate without an adverse effect.

$$Q_{\text{operating}} < 1.2 \text{ or } 1.3 \text{ MCSF}$$

** might differ for other cases*

SPECIFIC SPEED

$$N_s = \frac{N\sqrt{Q}}{H^{3/4}}$$

N : rotary speed of impeller
 Q : Capacity of pump
 H : Head

SUCTION ENERGY

Suction energy is the measure of energy available at the suction side of the pump.

SE Criteria for the lower cap of suction energy

TEMP. RISE

ΔT Criteria for the minimum temp diff for MCF

PUMP SIZE & CAPACITY

$$Q > 200 \text{ m}^3/\text{h}$$

** approximate value - based on a generalized overview*

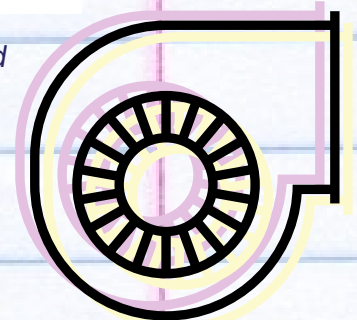
Large Impeller design / High Discharge Capacity

PRESSURE DROP

$$\Delta P > 10 \text{ bar}$$

** approximate value - based on a generalized overview*

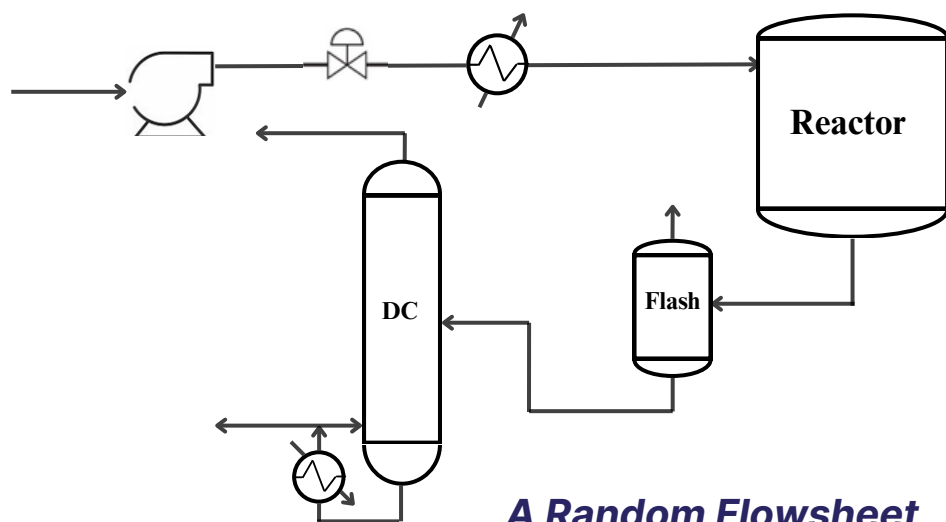
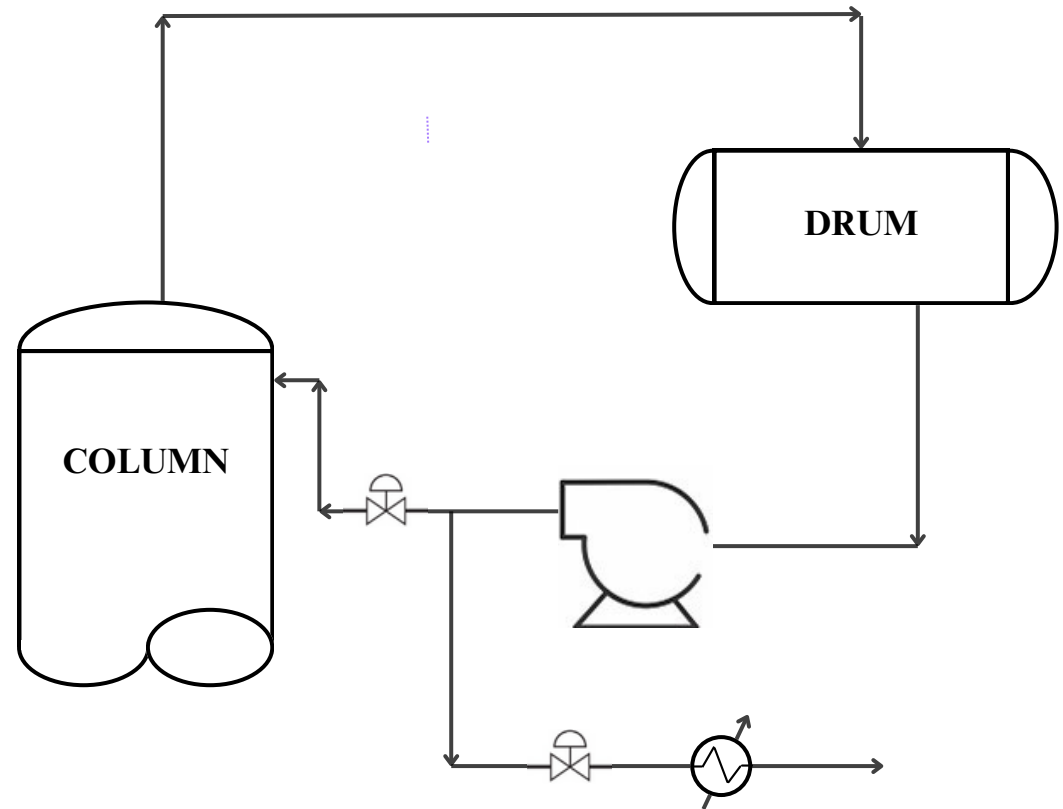
MCF LINE REQUIRED!!



COMPLEX CIRCUIT SCENARIOS

PUMP DISCHARGE TO MULTIPLE OUTLET POINTS WITH VARYING PRESSURES

Calculate the scenario where maximum discharge pressure is required, using back tracing evaluate individual stream pressure at split points by adjusting the pressure drop by control valve in each split



A Random Flowsheet

PUMP DISCHARGE PRESSURE FOR FLUID WITH MULTIPLE VESSELS & UNIT OPERATIONS

Need to back calculate and see whether or not the pump provides enough head such that fluid gets traversed to the last equipment in the circuit

