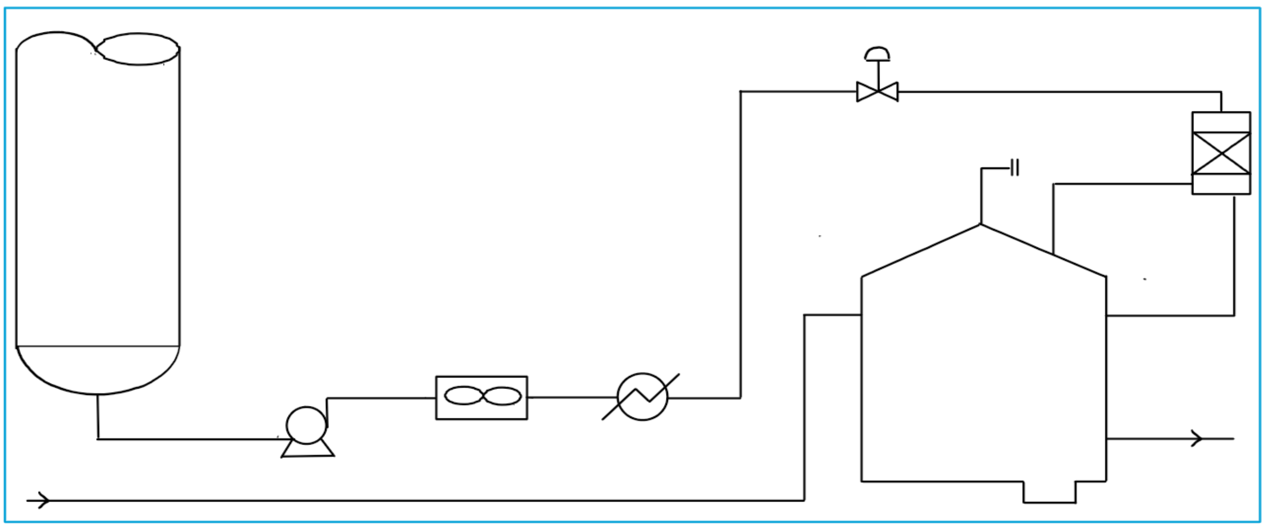
Process Plant Design Project

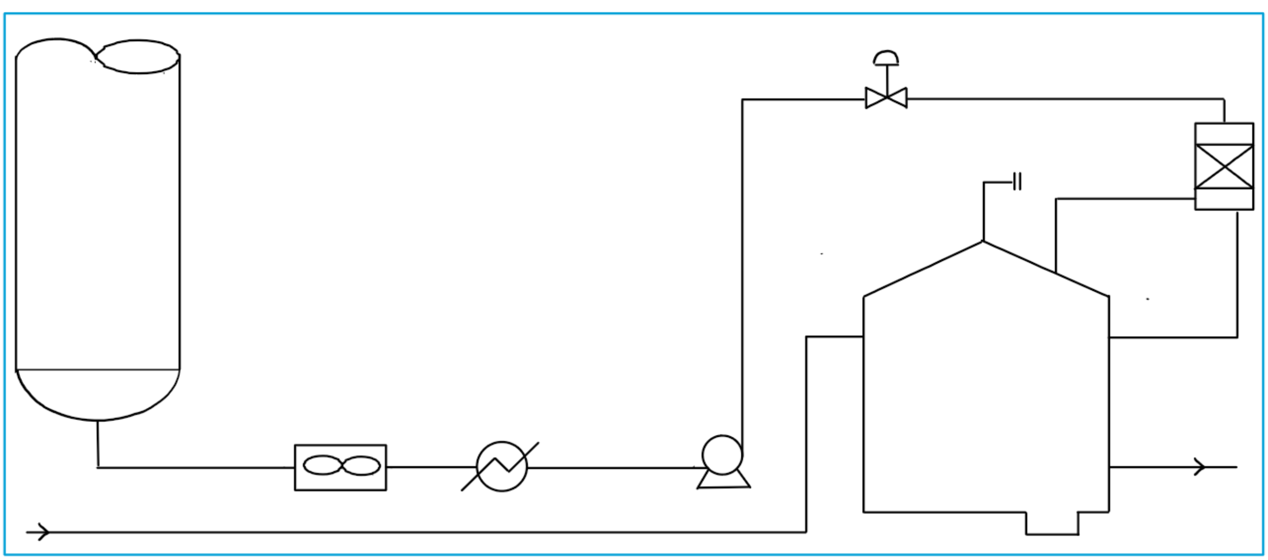
Process Description:

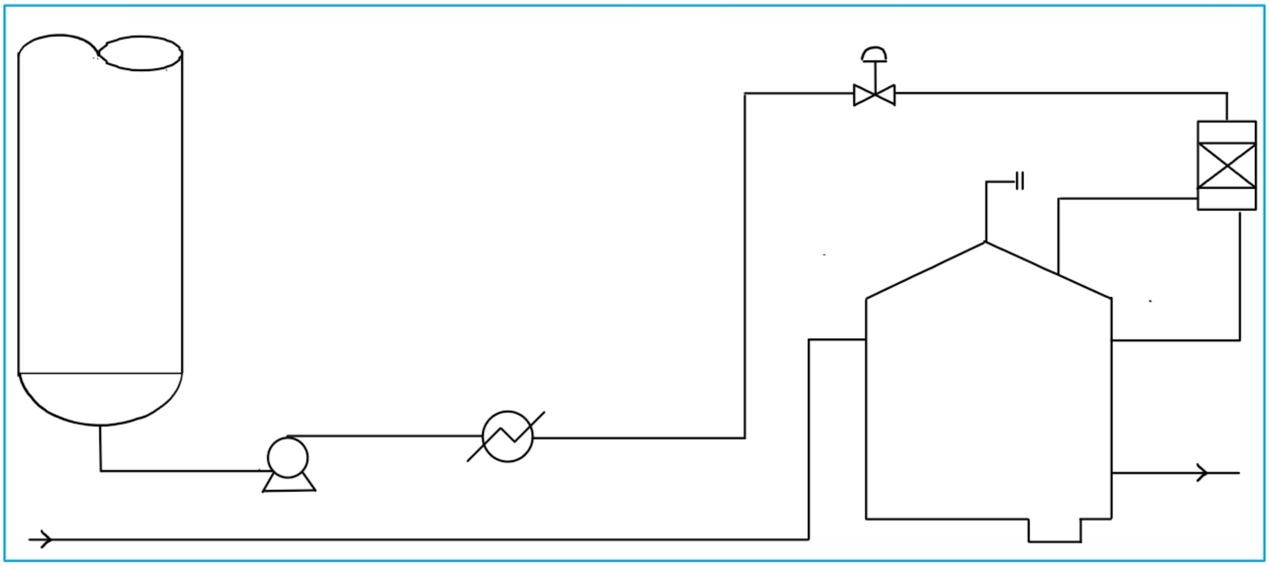
As stated before, water characteristic at the bottom of third tower is suitable to be re-used for wash column. Here is the exact info of the stream:

Temperature	148.9C
Pressure	3.6barg
Flowrate	8700 kg/hr.

Please provide process engineering sketches which are possible for this application:







Advantages and disadvantages:

First one:

- The pump casing is in contact with high-temperature fluid, thereby increasing the cost of pump.
- The pump creates the pressure and velocity suitable for the heat transfer which happens in the air-cooled heat exchanger and water-cooled heat exchanger.

Second one:

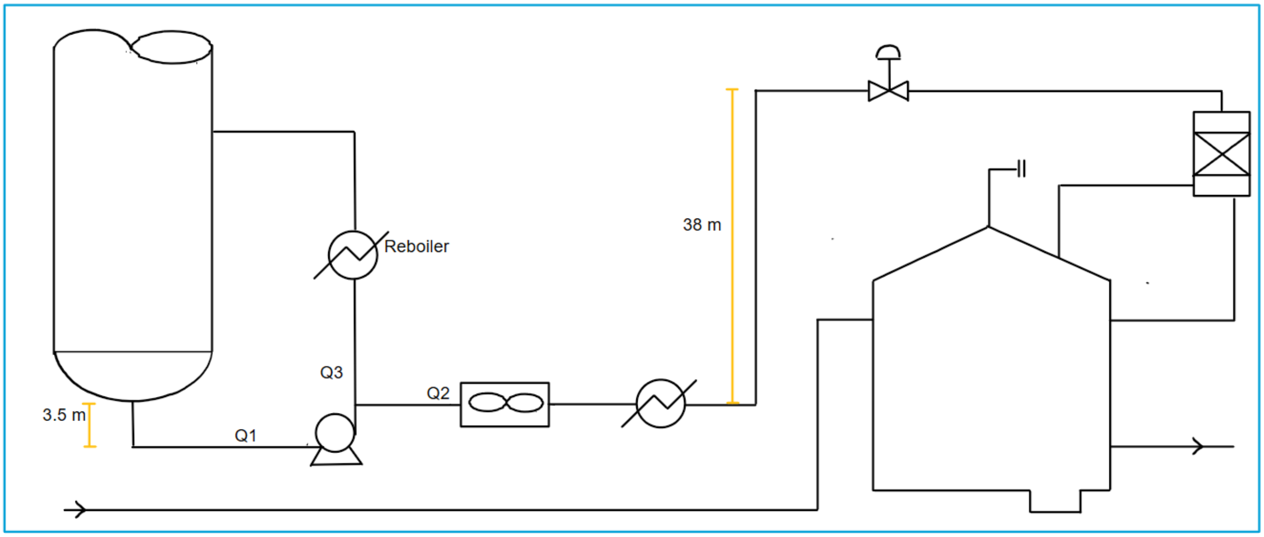
- The pump casing is in contact with low-temperature fluid, which helps the pump fabrication to be cost-effective.
- The pressure and velocity of the stream might not be suitable to get the maximum efficiency in the air-cooled heat exchanger and water-cooled heat exchanger.

Third one:

- The cost of construction and project is less due to elimination of air-cooled heat exchanger.
- The consumption of cooling water becomes dramatic.

Develop the datasheet for the pump and control valve using Hysys and Fisher FSM.

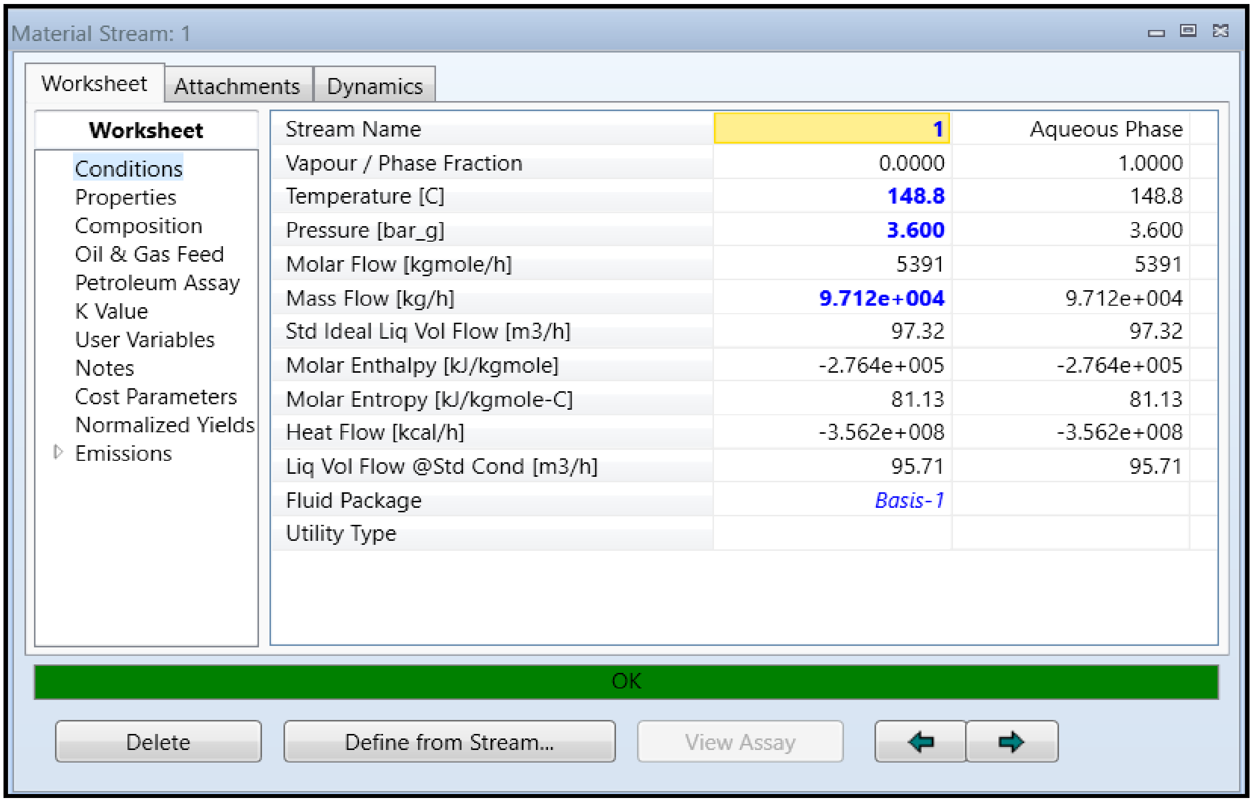
Here is more detailed sketch.



Operating Data

Capacity	105.8 m^3/hr.
Rated Capacity	105.8 × 1.1 = 116.38 m^3/hr.
Density	904 kg/hr.
Viscosity	0.1826 cP
Vapor Pressure	3.597 barg
Suction Vessel Pressure	4.6 bara
Discharge Vessel Pressure	1 bara

To determine density, Aspen Hysys is used. The stream with above conditions is defined and under property, the density is indicated.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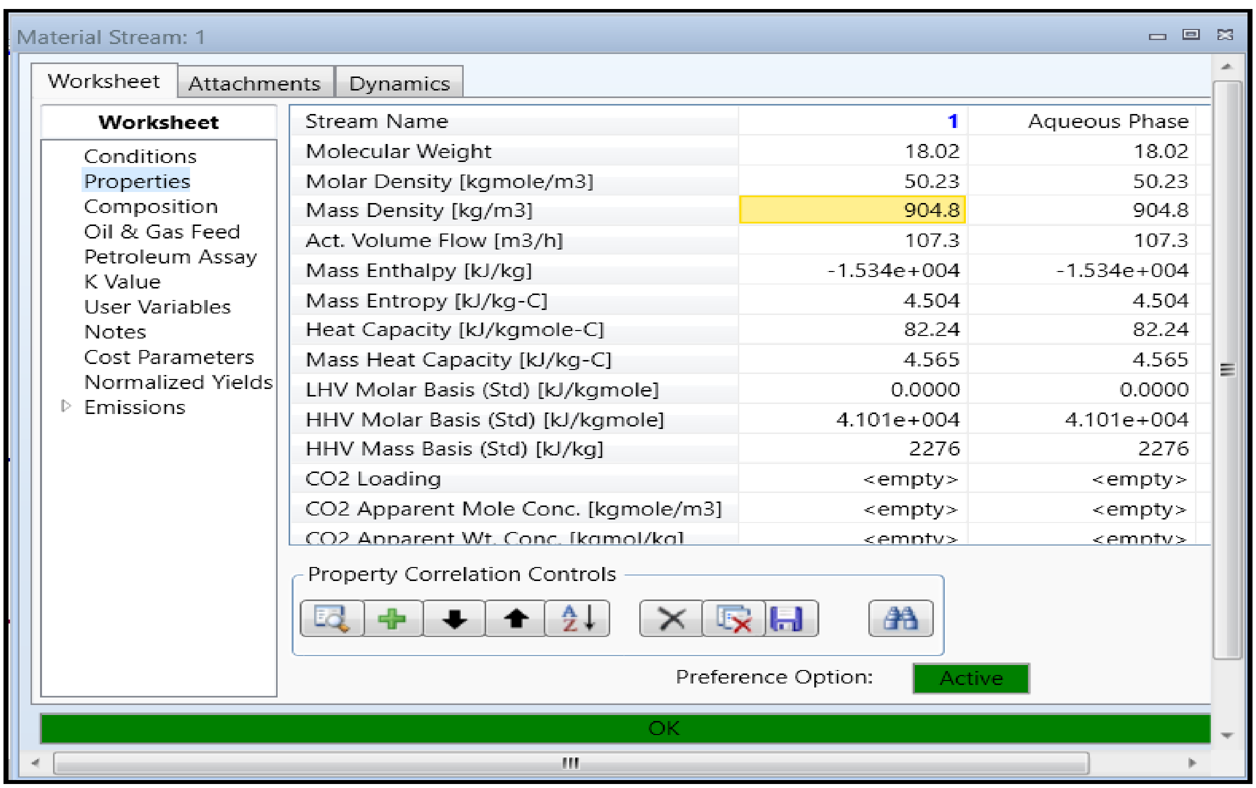
Worksheet
Attachments
Dynamics
Worksheet
Conditions
Properties
Composition
Oil & Gas Feed
Petroleum Assay
K Value
User Variables
Notes
Cost Parameters
Normalized Yields
Emissions
Stream Name 1 Aqueous Phase
Vapour / Phase Fraction 0.0000 1.0000
Temperature [C] 148.8 148.8
Pressure [bar_g] 3.600 3.600
Molar Flow [kgmole/h] 5391 5391
Mass Flow [kg/h] 9.712e+004 9.712e+004
Std Ideal Liq Vol Flow [m3/h] 97.32 97.32
Molar Enthalpy [kJ/kgmole] -2.764e+005 -2.764e+005
Molar Entropy [kJ/kgmole-C] 81.13 81.13
Heat Flow [kcal/h] -3.562e+008 -3.562e+008
Liq Vol Flow @Std Cond [m3/h] 95.71 95.71
Fluid Package Basis-1
Utility Type
OK
Delete
Define from Stream...
View Assay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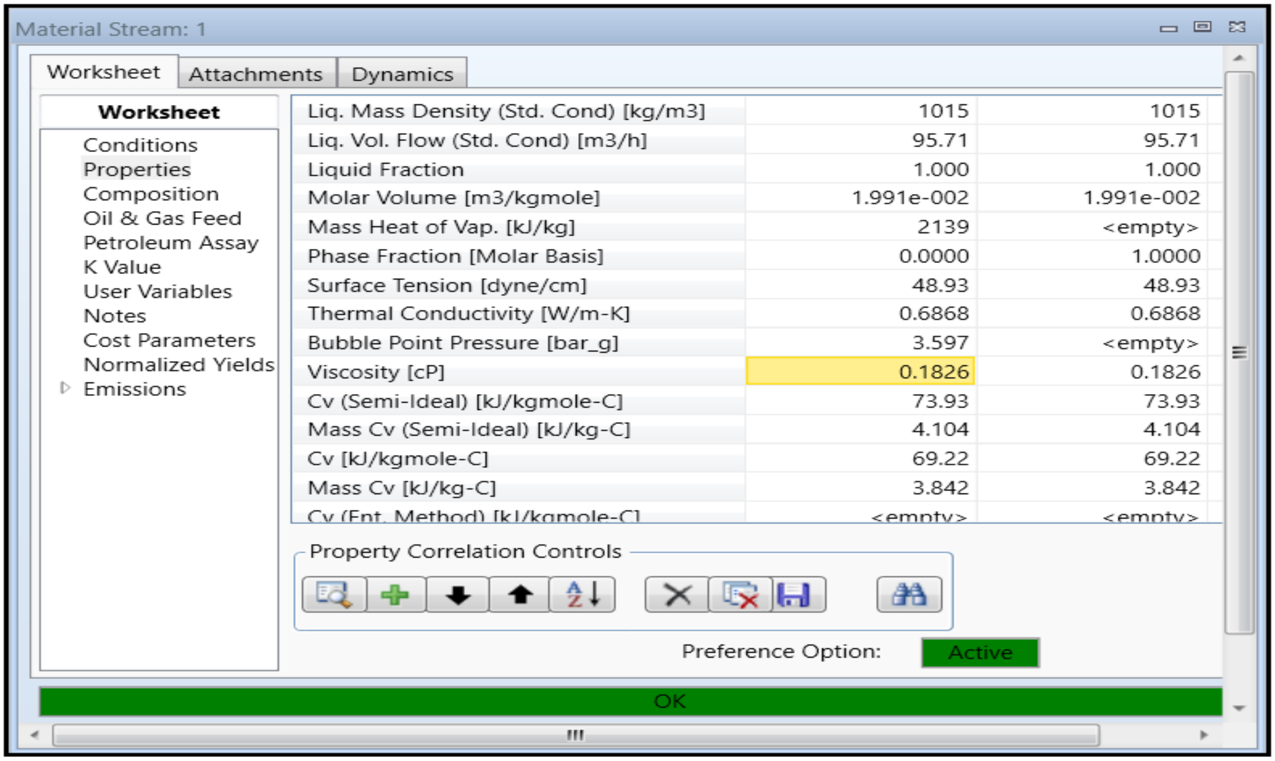
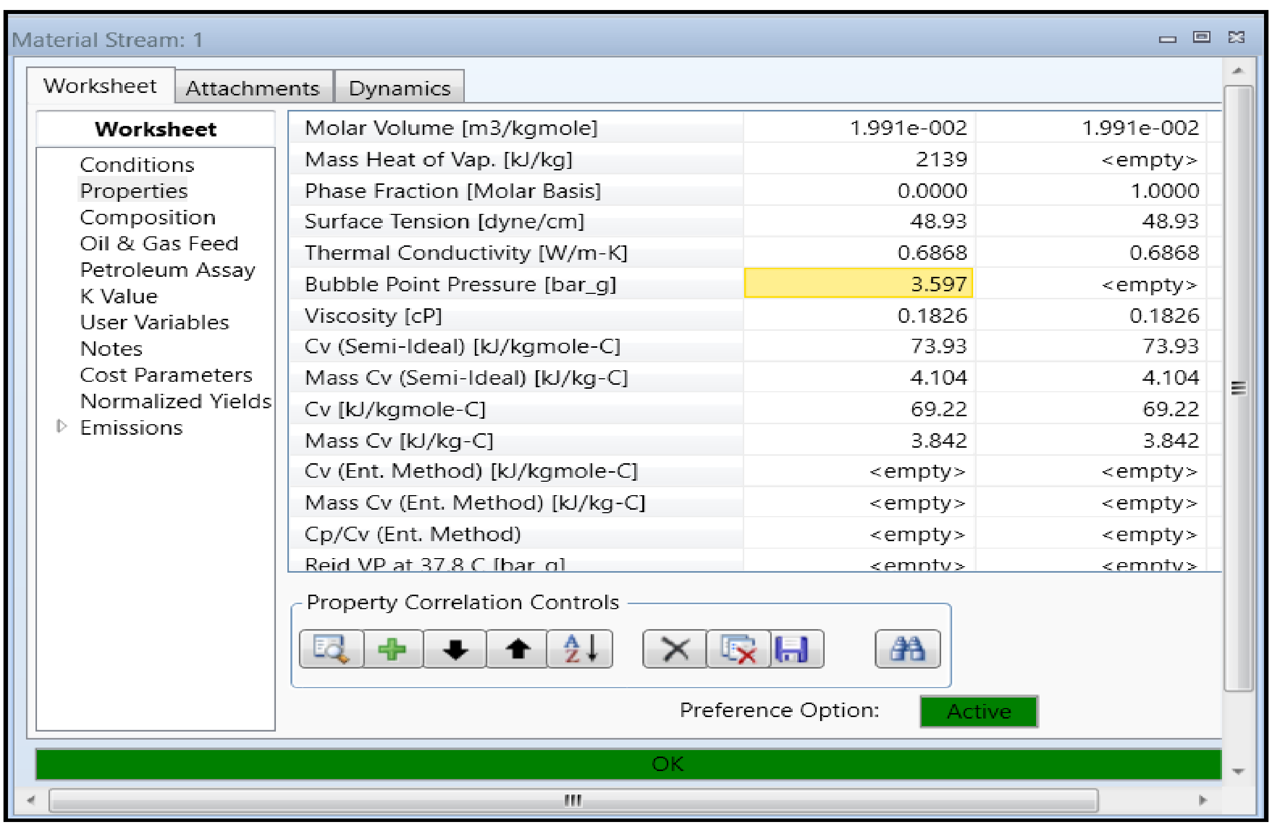
Worksheet
Attachments
Dynamics
Worksheet
Conditions
Properties
Composition
Oil & Gas Feed
Petroleum Assay
K Value
User Variables
Notes
Cost Parameters
Normalized Yields
Emissions
Stream Name 1 Aqueous Phase
Molecular Weight 18.02 18.02
Molar Density [kgmole/m3] 50.23 50.23
Mass Density [kg/m3] 904.8 904.8
Act. Volume Flow [m3/h] 107.3 107.3
Mass Enthalpy [kJ/kg] -1.534e+004 -1.534e+004
Mass Entropy [kJ/kg-C] 4.504 4.504
Heat Capacity [kJ/kgmole-C] 82.24 82.24
Mass Heat Capacity [kJ/kg-C] 4.565 4.565
LHV Molar Basis (Std) [kJ/kgmole] 0.0000 0.0000
HHV Molar Basis (Std) [kJ/kgmole] 4.101e+004 4.101e+004
HHV Mass Basis (Std) [kJ/kg] 2276 2276
CO2 Loading <empty> <empty>
CO2 Apparent Mole Conc. [kgmole/m3] <empty> <empty>
Property Correlation Controls
Preference Option: Active
OK


Material Stream: 1
Worksheet
Attachments
Dynamics
Worksheet
Conditions
Properties
Composition
Oil & Gas Feed
Petroleum Assay
K Value
User Variables
Notes
Cost Parameters
Normalized Yields
Emissions
Liq. Mass Density (Std. Cond) [kg/m3] 1015 1015
Liq. Vol. Flow (Std. Cond) [m3/h] 95.71 95.71
Liquid Fraction 1.000 1.000
Molar Volume [m3/kgmole] 1.991e-002 1.991e-002
Mass Heat of Vap. [kJ/kg] 2139 <empty>
Phase Fraction [Molar Basis] 0.0000 1.0000
Surface Tension [dyne/cm] 48.93 48.93
Thermal Conductivity [W/m-K] 0.6868 0.6868
Bubble Point Pressure [bar_g] 3.597 <empty>
Viscosity [cP] 0.1826 0.1826
Cv (Semi-Ideal) [kJ/kgmole-C] 73.93 73.93
Mass Cv (Semi-Ideal) [kJ/kg-C] 4.104 4.104
Cv [kJ/kgmole-C] 69.22 69.22
Mass Cv [kJ/kg-C] 3.842 3.842
Property Correlation Controls
Preference Option:
Active
OK


Material Stream: 1
Worksheet
Attachments
Dynamics
Worksheet
Conditions
Properties
Composition
Oil & Gas Feed
Petroleum Assay
K Value
User Variables
Notes
Cost Parameters
Normalized Yields
Emissions
Molar Volume [m3/kgmole] 1.991e-002 1.991e-002
Mass Heat of Vap. [kJ/kg] 2139 <empty>
Phase Fraction [Molar Basis] 0.0000 1.0000
Surface Tension [dyne/cm] 48.93 48.93
Thermal Conductivity [W/m-K] 0.6868 0.6868
Bubble Point Pressure [bar_g] 3.597 <empty>
Viscosity [cP] 0.1826 0.1826
Cv (Semi-Ideal) [kJ/kgmole-C] 73.93 73.93
Mass Cv (Semi-Ideal) [kJ/kg-C] 4.104 4.104
Cv [kJ/kgmole-C] 69.22 69.22
Mass Cv [kJ/kg-C] 3.842 3.842
Cv (Ent. Method) [kJ/kgmole-C] <empty> <empty>
Mass Cv (Ent. Method) [kJ/kg-C] <empty> <empty>
Cp/Cv (Ent. Method) <empty> <empty>
Property Correlation Controls
Preference Option:
Active
OK

Suction Side

Suction Vessel Head	51.87 m
Height Above Pump Center	3.5 m
Pressure Loss	
Piping	0.033 m
Equipment	0
Flow Orifice	0
Total Minimum Suction Head	51.87 + 3.5 + 0.033 = 55.4 m
Vapor Pressure	51.83 m
NPSH	3.57 m

Suction Vessel Head = (Ps × 100000)/(9.81 × 904) = (4.6 × 100000)/ (9.81 × 904) = 51.87m

Pressure Loss:

Piping:

Let's at first determine the inlet and outlet pipe size.

Line No. :	3315		**Service (From/To)**	
Total Flow Rate	kg/hr	97000	Washing Water	
Fluid phase (Liquid/Vapor)		Liquid		
Temperature	C	48		
Density	kg/m3	904.000	Material	
Viscosity	Cp	0.1826	CS	
Calculation Results		**Trial 1**	**Trial 2**	**Trial 3**
Pipe Length (DEF.)	m	1000	1000	1000
Nominal Pipe Size	inch	4	6	8
Schedule No.		80	40	80
Line Roughness (DEF.)	inch	0.0018	0.0018	0.0018
Pipe Internal Diameter	mm	97.2	154.1	193.7
Pipe Internal Area	mm^2	7,417	18,639	29,460
Reynold 's No.		1933195	1219523	970020
Friction Factor		0.0164	0.0153	0.0148
Velocity	**m/s**	**4.018**	**1.599**	**1.012**
Pressure Drop (ΔP)	**bar**	**12.2**	**1.1**	**0.3**
ρV^2	**kg/m.s2**	**14,597**	**2,312**	**925**

By checking pump suction and outlet criteria, 8 inch is selected as inlet pipe size and 6 inch as outlet pipe size.

Since the stream will be divided to two sub-streams, including one being returned to the reboilers and one being directed to wash column, another line sizing is performed for second sub-stream.

Line No. :	3315		**Service (From/To)**	
Total Flow Rate	kg/hr	9000	Washing Water	
Fluid phase (Liquid/Vapor)		Liquid		
Temperature	C	48		
Density	kg/m3	904.000	Material	
Viscosity	Cp	0.1826	CS	
Calculation Results		**Trial 1**	**Trial 2**	**Trial 3**
Pipe Length (DEF.)	m	1000	1000	1000
Nominal Pipe Size	inch	2	3	4
Schedule No.		80	80	80
Line Roughness (DEF.)	inch	0.0018	0.0018	0.0018
Pipe Internal Diameter	mm	49.3	73.7	97.2
Pipe Internal Area	mm^2	1,905	4,261	7,417
Reynold 's No.		353927	236643	179369
Friction Factor		0.0198	0.0188	0.0185
Velocity	**m/s**	**1.452**	**0.649**	**0.373**
Pressure Drop (ΔP)	**bar**	**3.8**	**0.5**	**0.1**
ρV^2	**kg/m.s2**	**1,905**	**381**	**126**

3 inch is selected.

………

Based on the piping department layout during basic design, the initial distance between pump and the packed column is approximately 150m. So, the pressure loss would be:

Pressure loss or Head = $\frac{150}{1000} \times 0.5$ = 0.075 bar × $\frac{10000}{9.81 \times 904}$ = 0.845 m

Also here is the calculation for pump inlet equivalent length:

L_e = Approximate line length × Multiplying factor = 100 × 3.4 = 340 ft = 340 × 12 × 2.54 cm = 10.363 m

………

Pressure loss or Head = $\frac{10}{1000} \times 0.3 = 0.003\ bar = \frac{0.003 \times 100000}{9.81 \times 904} = 0.033\ m$

………

Vapor Pressure = (4.597 bar × 100000)/(9.81 × 904) = 51.83 m

………

NPSH = Suction Head – Vapor Pressure = 55.4 – 51.83 = 3.57 m

………

Discharge Side

Discharge Vessel Head	11.27 m
Height Above Pump Center	38 m
Pressure Loss	
Piping	0.845 m
Equipment	11.26 m
Flow Measurement	1.57 m
Control Valve	7.89 m
Total Max. Discharge Head	70.83 m

Discharge Vessel Head = (Pd × 100000)/(9.81 × 904) = (1 × 100000)/(9.81 × 904) = 11.27 m

………

Height Above Pump Center = 38 m

………

Pressure Loss

Piping:

Based on the piping department layout during basic design, the initial distance between pump and the packed column is approximately 150m. So, the pressure loss would be:

Pressure loss or Head = $\frac{150}{1000} \times 0.5$ = 0.075 bar × $\frac{10000}{9.81 \times 904}$ = 0.845 m

Equipment:

We have air-cooled heat exchanger, water-cooled heat exchanger, orifice flowmeter and a control valve.

Equipment	Pressure Drop	Our Example	Head
Air-cooled Heat Exchanger	0.35-0.7 bar	0.5 bar	(0.5×100000)/ (9.81× 904) = 5.63m
Water-cooled Heat Exchanger	0.35-0.7 bar	0.5 bar	(0.5×100000)/ (9.81× 904) = 5.63m
Orifice Flowmeter	0.14 bar	0.14 bar	(0.14×100000)/(9.81×904) = 1.57m
Control Valve	0.7 bar	0.7 bar	(0.7×100000)/ (9.81× 904) = 7.89m

Total Max. Discharge Head: Discharge Vessel Head + Height Above Pump Center + Pressure Loss = 11.27 + 38 + 0.845 + 5.63 + 5.63 + 1.57 + 7.89 = 70.83 m

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Performance

Differential Head = Total Max. Discharge Head - Total Minimum Suction Head = 70.83 – 55.4 = 15.43 m

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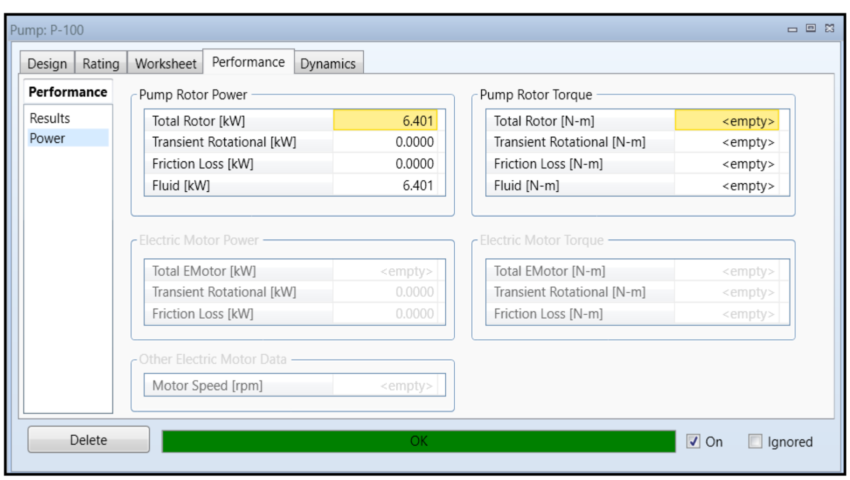
Power required = 6.4 kW. @ 75% capacity



Differential Head	15.43 m
Power Required	6.4 kW
Efficiency	75%

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Pump

Material in liquid contact: CS

………

Construction Code: API 610

………

Max allowable total noise level: 85 db

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Max acceptable $NPSH_R = NPSH_A - 1 = 3.57 - 1 = 2.57$ m

………

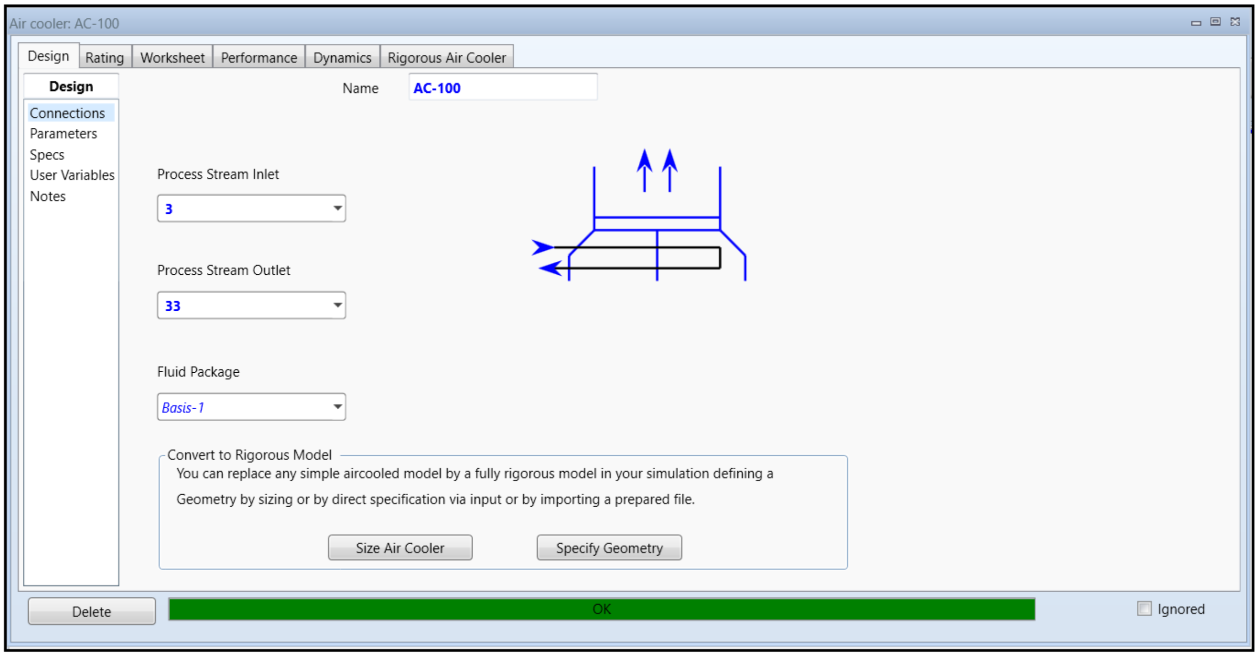
Process Plant Design	Educational Institute for Equipment and Process Design			
EIEPD	Document Number:			
	Page: 1		Item Info: P 5007 A/B	
Datasheet for Centrifugal Pump				

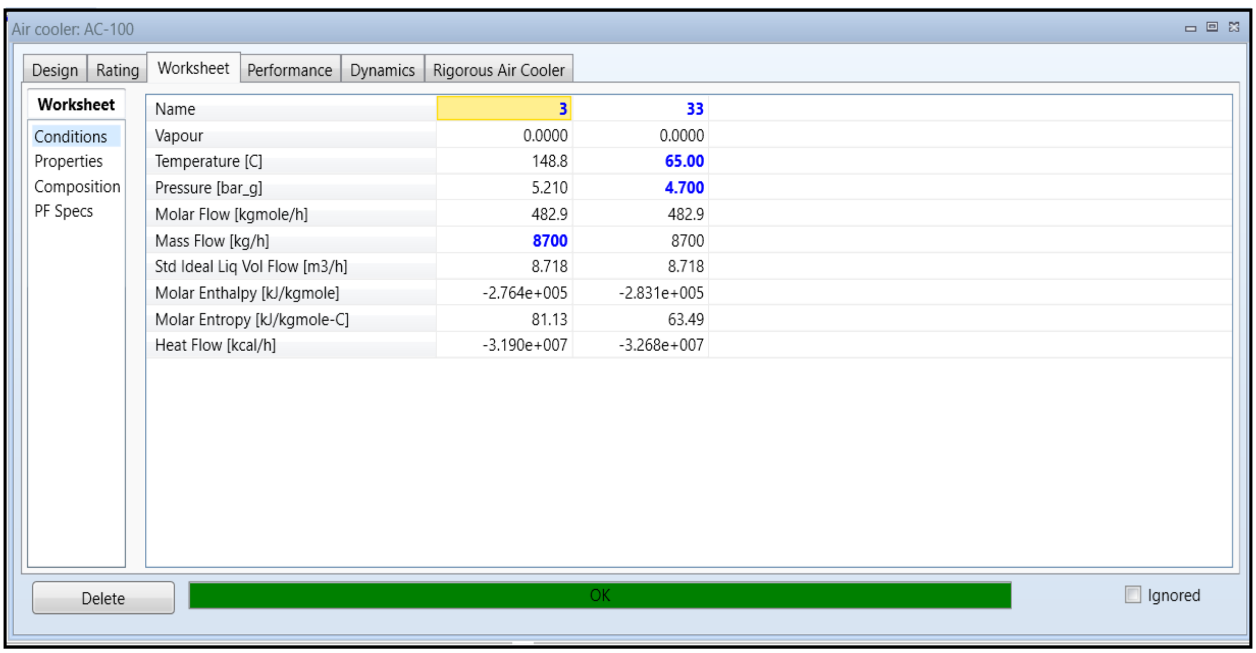
Item Info.	Pump Type	Driver Info.	Driver Type	Normal Status
P 5007 A	Centrifugal	MP 5007 A	Electric Motor	Running
P 5007 B	Centrifugal	MP 5007 B	Electric Motor	Stand-by

General Equipment Information	
Design Case	Summer-Winter or EOR/SOR Rich/Lean Case - EOR Rich Gas Case
Location	Outdoor

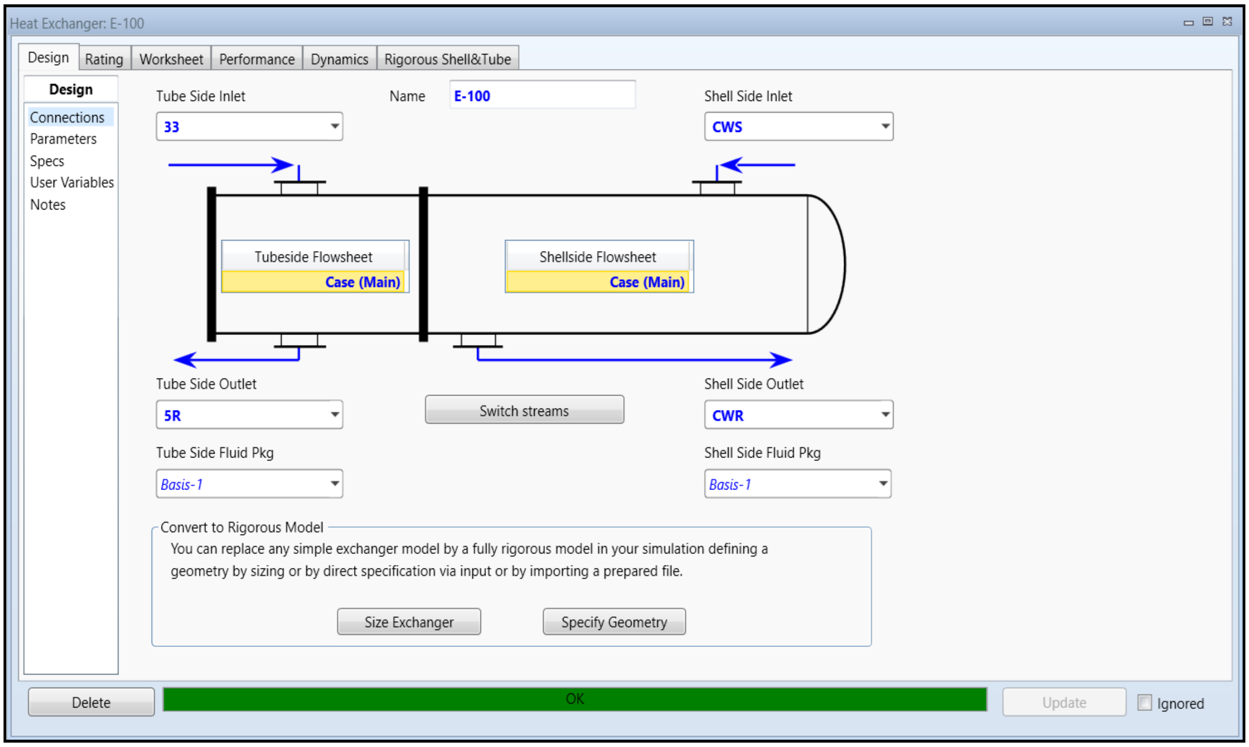
Operating Data				
Performance Point	Normal	Rated	Start-up	Unit
Capacity	105.8	116.38		m3/h
Temperature	148.8			C
Desnsity	904			kg/m3
Viscosity	0.1826			cP
Vapor Pressure	4.6			bar a
Suction Vessel Pressure	4.6			bar a
Discharge Vessel Pressure	1			bar a
Suction Side				
Suction Vessel Head	51.87			m liq.
Height Above Pump Center	3.5			m liq.
Pressure Loss: Piping	0.033			m liq.
Equipment	0			m liq.
Flow Orifice	0			m liq.
Total Min. Suction Head	55.4			m liq.
Vapour Pressure	51.83			m liq.
NPSHA	3.57			m liq.
Discharge Side				
Discharge Vessel Head	11.27			m liq.
Height Above Pump Center	38			m liq.
Pressure Loss: Piping	0.845			m liq.
Equipment	11.26			m liq.
Flow Orifice	1.57			m liq.
Control Valve	7.89			m liq.
Total Max. Discharge Pressure	70.83			m liq.
Pump Performance				
Differential Head	15.43			m liq.
Estimated Efficiancy	75			%
Estimated Shaft Power	6.4			kW

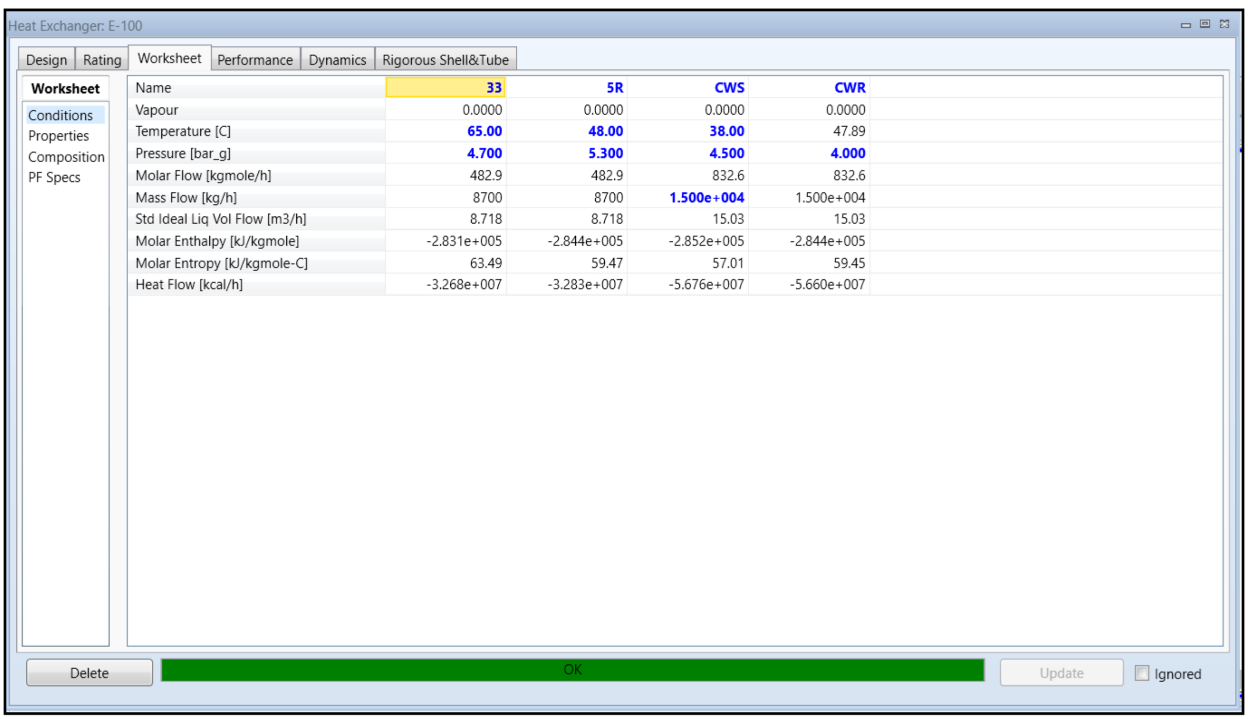
If we proceed with first sketch:



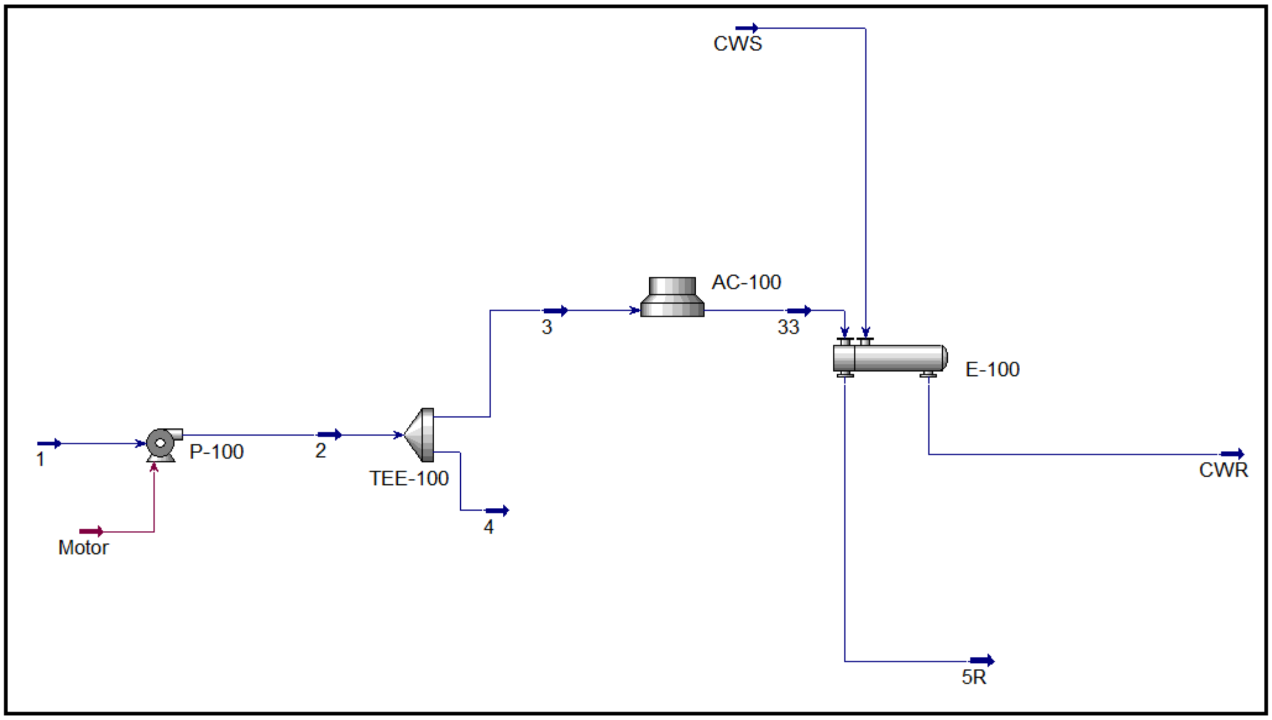


Name	3	33
Vapour	0.0000	0.0000
Temperature [C]	148.8	65.00
Pressure [bar_g]	5.210	4.700
Molar Flow [kgmole/h]	482.9	482.9
Mass Flow [kg/h]	8700	8700
Std Ideal Liq Vol Flow [m3/h]	8.718	8.718
Molar Enthalpy [kJ/kgmole]	-2.764e+005	-2.831e+005
Molar Entropy [kJ/kgmole-C]	81.13	63.49
Heat Flow [kcal/h]	-3.190e+007	-3.268e+007

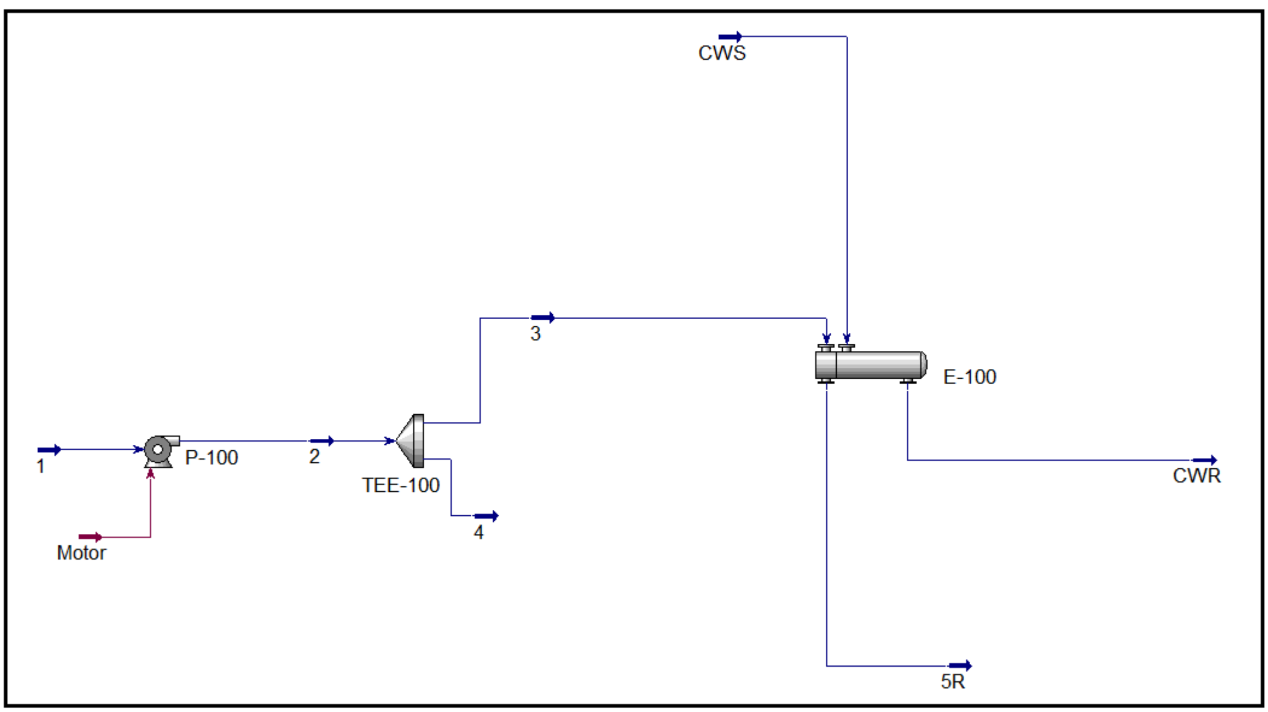


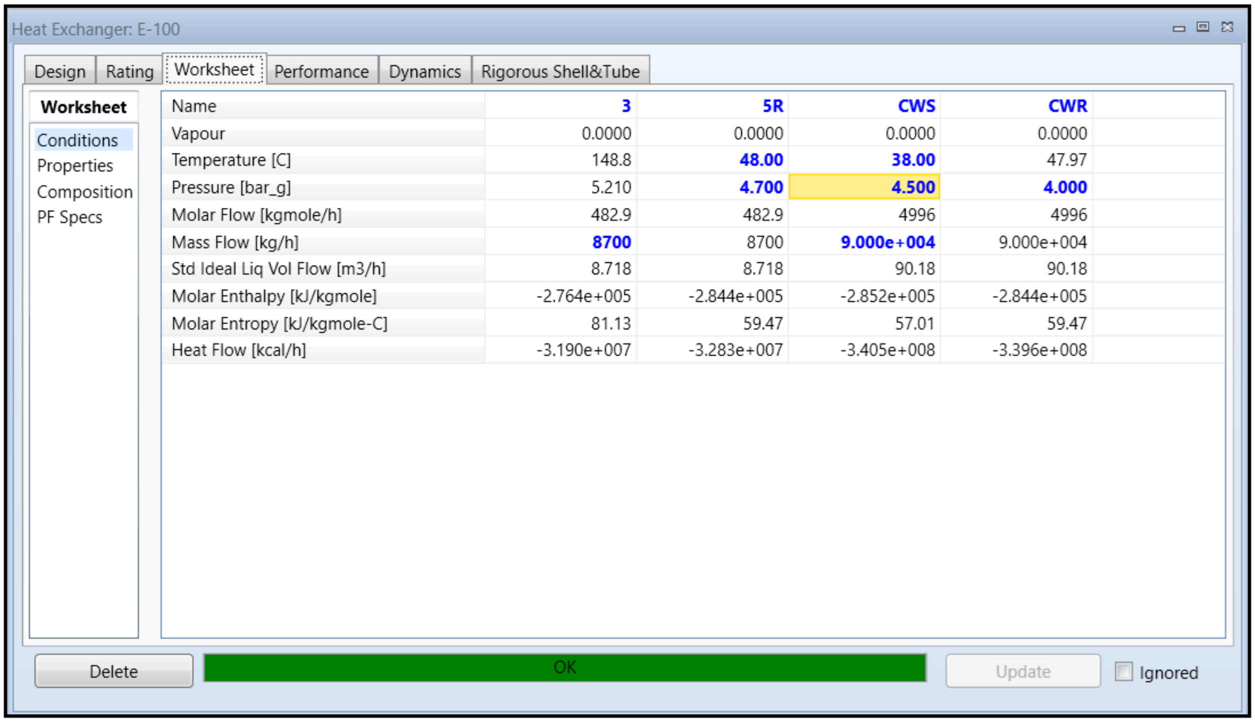


Name	33	5R	CWS	CWR
Vapour	0.0000	0.0000	0.0000	0.0000
Temperature [C]	65.00	48.00	38.00	47.89
Pressure [bar_g]	4.700	5.300	4.500	4.000
Molar Flow [kgmole/h]	482.9	482.9	832.6	832.6
Mass Flow [kg/h]	8700	8700	1.500e+004	1.500e+004
Std Ideal Liq Vol Flow [m3/h]	8.718	8.718	15.03	15.03
Molar Enthalpy [kJ/kgmole]	-2.831e+005	-2.844e+005	-2.852e+005	-2.844e+005
Molar Entropy [kJ/kgmole-C]	63.49	59.47	57.01	59.45
Heat Flow [kcal/h]	-3.268e+007	-3.283e+007	-5.676e+007	-5.660e+007



So, we need to 15 ton/hr. of cooling water to bring down the temperature to 48C. But if we change the scenario and just use water-cooled heat exchanger, then we need 90 ton/hr. of cooling water.





Name	3	5R	CWS	CWR
Vapour	0.0000	0.0000	0.0000	0.0000
Temperature [C]	148.8	48.00	38.00	47.97
Pressure [bar_g]	5.210	4.700	4.500	4.000
Molar Flow [kgmole/h]	482.9	482.9	4996	4996
Mass Flow [kg/h]	8700	8700	9.000e+004	9.000e+004
Std Ideal Liq Vol Flow [m3/h]	8.718	8.718	90.18	90.18
Molar Enthalpy [kJ/kgmole]	-2.764e+005	-2.844e+005	-2.852e+005	-2.844e+005
Molar Entropy [kJ/kgmole-C]	81.13	59.47	57.01	59.47
Heat Flow [kcal/h]	-3.190e+007	-3.283e+007	-3.405e+008	-3.396e+008

So here we have a stream with flowrate of 8700 kg/hr., temperature of 48C and pressure of 4.7 barg.

Control Valve Datasheet

In order to control the flowrate, we need a control valve. Here is the info about the stream:

1.Operating Condition

Flowrate	8700 kg/hr.
Inlet Pressure	5.3 barg
Outlet Pressure	4.6 barg
Inlet Temperature	0.48 C
Liquid Specific Gravity	0.99
Dynamic Viscosity	0.563 cP
Vapor Pressure	-0.9 barg
Critical Pressure	220 barg
Recovery Factor	0.9
Valve Style Modifier	1
Cavitation Coefficient	1
Upstream Pipe Size	3 in
Upstream Pipe Schedule	80
Downstream Pipe Size	3 in
Downstream Pipe Schedule	80
Valve Diameter	1.5 in

Here is the result of Fisher FSM

SIZING OUTPUTS					
Flow Coefficient (Cv)			12.256		
Application Ratio			0.113		
Pressure differential	bar		0.70000		
Valve dP/P1 pressure ratio			0.111		
Choked flow pressure drop	bar		4.99952		
Cavitation Pressure Drop	bar		6.12210		
Liquid critical pressure drop ratio factor			0.95		
Pipe and fitting flow correction factor			0.99		
Combined recovery factor			0.89		
Kinematic viscosity	cSt	1.000	0.569	1.000	1.000
Upstream Inside Diameter	mm		73.66		
Downstream Inside Diameter	mm		73.66		
Volumetric Flow Rate Liquid	m3/h		8.7971		
Reynolds Number			357087.08		
Inlet Density	kg/m3		989.84		
NOISE OUTPUTS					
Sound Pressure at 1m	dB(A)		< 50		
VELOCITY OUTPUTS					
Fluid Velocity Upstream	m/s		0.5732		
Fluid Velocity Downstream	m/s		0.5732		

2.Body/Bonnet

In Body/Bonnet Tab the following information should be determined:

1.Type

2. Size

3.Rating

4.Connection type

5.Body material

6.Pipe inlet and outlet

Type:

Since the valve is used for flow controlling application a Globe valve is used.

Size:

Based on above calculation, the valve diameter is 1.5 inch.

Rating:

The rating of valves is the same as the rating of connecting pipes. Since the adjacent pipe class is 300, the valve class would be 300

Connection type:

The three most common methods of installing control valves into pipelines are by means of screwed pipe threads, bolted gasketed flanges, and welded end connections. Screwed end connections, popular in small control valves, offer more economy than flanged ends. The threads usually specified are tapered female NPT (National Pipe Thread) on the valve body. They form a metal-to-metal seal by wedging over the mating male threads on the pipeline ends.

This connection style, usually limited to valves NPS 2 (DN 50) or smaller, is not recommended for elevated temperature service. Valve maintenance might be complicated by screwed end connections if it is necessary to take the body out of the pipeline because the valve cannot be removed without breaking a flanged joint or union connection to permit unscrewing the valve body from the pipeline.

Flanged end valves are easily removed from the piping and are suitable for use through the range of working pressures for which most control valves are manufactured. Flanged end connections can be used in a temperature range from near absolute zero to approximately 815°C (1500°F). They are used on all valve sizes. The most common flanged end connections include flat-face, raised-face, and ring-type joint.

Screwed End	Flanged End	Welded End
2” and smaller	Up to class 900	Suitable for class 1500 and 2500

Body material

1.A216 WCB/WCC or forged carbon steel, A105 is used in non-corrosive services from -28 to 427C.

2. If there are some severe conditions such as flashing, it is typical to use A217 WC9

3. For high temperature services like steam let-down station or HHPS it is a practice to use A217 WC6.

4. A351 CF8 is used mostly for combined flashing and corrosive services and for temperatures below -28C.

5. For oxygen services, it is highly recommended to use Monel.

A 216 WCB is selected for such applications.

3. Trim

For Trim Tab the following should be specified:

1.CV calculation

2.Charachteristic

3.Type

4.Material

5.Leakage Class

CV Calculation

CV calculated by Fisher FSM is 12.25.

Characteristic

1. Use Equal Percentage if the valve functions as FV or TV
2. Use Linear if the valve functions as PV or LV
3. Use Linear if there is Split Range Control

EQ% is selected for this flow control valve.

Type

Single-seated is the standard valve type in sizes below 8 inches in non-severe service where the pressure drop and shut-off pressure can be handled. Cage-guided globe valves shall be used for more rough services. Balanced trim can be considered for bigger sizes.

So single-seated is selected.

Material

AS standard, the material shall be AISI-316, unless otherwise specified.

Seat Leakage

Control valves are designed to throttle, but they are also often expected to provide some type of shut-off capability. A control valve's ability to shut off has to do with many factors: Balanced or unbalanced plug, seat material, actuator thrust, pressure drop, and the type of fluid can all play a part in how wella particular control valve shuts off.

Classification

Class II: 0.5% of rated capacity
Class III: 0.1% of rated capacity
Class IV: 0.01% of rated capacity
Class V: 0.03 ml water/min. per 100 mm port diameter per bar differential
Class VI

Class IV is also known as a “Metal-to-Metal” seat classification. It is the kind of leakage rate you can expect from a valve with a metal plug and metal seat.
Class VI is known as a “Soft Seat” classification. Soft Seat Valves are those where either the plug or seat or both are made from some kind of composition material such as Nitrile or Polyurethane.
Since it is with metal-to-metal seats Class IV is selected.

Actuators
As positioners are normally required, control valves shall be equipped with pneumatic actuators with a spring range from 0.4-2 barg, in order to obtain small and fast actuators. If feasible, higher ranges may be used for bigger valves, but the maximum range pressure should not exceed the minimum instrument air supply pressure minus 10%. If not otherwise specified, actuators shall be sized to obtain a stroke time in seconds that does not exceed the valve size in inches. However, higher speeds will be required for anti-surge valves and slower speed for preventing water hammer. Ball and plug valves used as shut-down valves shall have actuators designed with a safety factor of 2.5 with respect to start friction, as the friction increases if the valves have remained in one position for a long time.

As a rule, actuators shall be diaphragm or piston-type with springs to provide the necessary failure action.

Double-acting piston actuators with volume tank and lock-up valves that ensures correct failure position are acceptable where high trust is required. The volume tank shall be of stainless steel and be sized to stroke the valve twice.

For actuator and positioners Tab the following should be specified:

1.Type

2.Modulating or ON/OFF

3.Failiure position

4.dP for sizing

5.Positioner

Actuator Type:

Based on above criteria, Diaphragm with spring return with spring range of 0.4-2 bar is selected. Modulating type is selected. AIR TO CONTROL VALVE OPEN

Failure position

Control valves shall be such that on air failure the valve takes automatically a safe position either open, or close, or locked in position, depending upon the process requirements. Based on process requirement, fail to close is selected.

Positioners and tubing

Positioners shall be FF/P for Fieldbus communication with full diagnostic possibilities. Positioners shall be vibration-resistant. Output shall match bench-setting of the valve. Positioners shall have output gauges in stainless steel and filter regulators with pressure gauges. Valves in split range shall also have FF AI input; the split is done in the control system.

The positioners shall have sufficient air capacity to strokes the valves.

Air tubes and fitting shall be in stainless steel. Size shall be adequate for the stroking time required. Tubing shall be thin-walled with an OD of not less than 6 mm. Larger valve require tubing with a larger diameter.

For this valve the type of positioner for this valve is FF/P.
Air tubes and fitting are in SUS.

Additional

Packing

The packing design for linear motion valves shall include a packing flange. PTFE shall be used as standard packing material for bonnet temperature below 230C and graphite for higher temperatures. Higher temperatures can be accepted for PTFE if the bonnet is extended. Packing design and material shall be selected carefully for minimum stem friction and live-loading packing boxes shall be considered for PTFE packing.

Vacuum service and special services like oxygen, require special packing materials and should be given special consideration.

Since the temperature is less than 230C then PTFE or equivalent is selected as packing for the valve.

Depending upon design of the valve, an extension bonnet may be required to keep the temperature at the stuffing box to an acceptable value for the applied packing. An extension bonnet may also be required, when the operating differential pressure across the valve may cause freezing of the stuffing box/packing and/or ice formation on the trim. This may be the case, for instance, on compressor recycle (anti-surge) valves. For valves in vacuum service, the bonnet shall have an extended stuffing box, a lantern ring and a number of packing rings. Special attention shall be paid to the type of stem packing/sealing facilities as well as stem surface finish. Packing lubricators with steel isolating control valve shall be provided if required.

The bonnet shall be bolted according to ASME B31.3 and material shall be the same as the body material. Requirements for an extended bonnet depend on the fluid temperature and the chosen packing material.

Fluid Type	Bonnet Style		
	Plain	Extension	Finned
Gas	0	100	135
Superheated Vapor	0	100	135
Saturated Vapor	0	0	0
Liquid	0	140	185

Based on water temperature which is 48C, a standard bonnet is selected.

Flow Tendency

For valves in shut-off service, flow tendency shall comply with the action required to put the plant in a safe condition in the case of power failure. In some cases it is the back-flow scenario that shall be considered.

Generally, it is the flow-to-open tendency that is the most stable type of operation for modulating control valves. This is therefore the preferred flow direction for globe valves. For angle valves, the direction should be flow-tends-to-close. The direction of flow shall be clearly marked on the valve body.

There is a practice by some vendors which as follows:

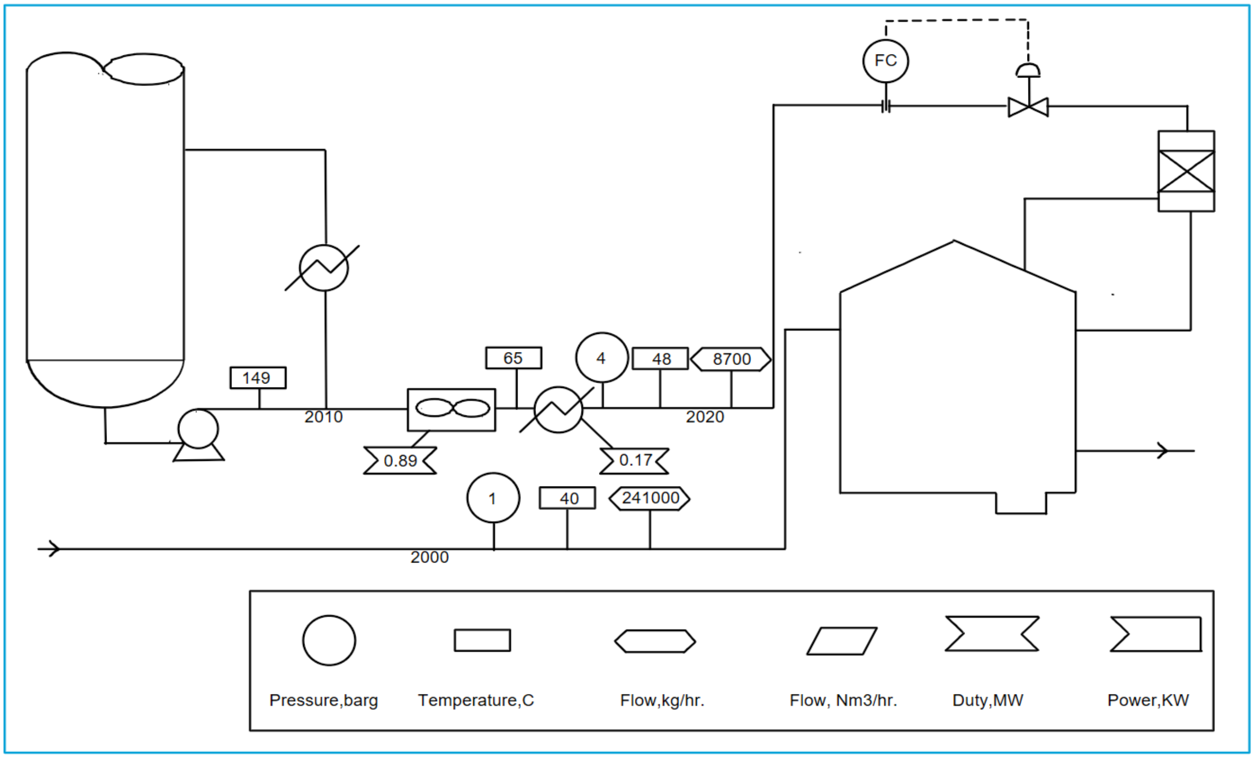
Over-plug flow for liquid services
Under-plug flow for gas and vapor services

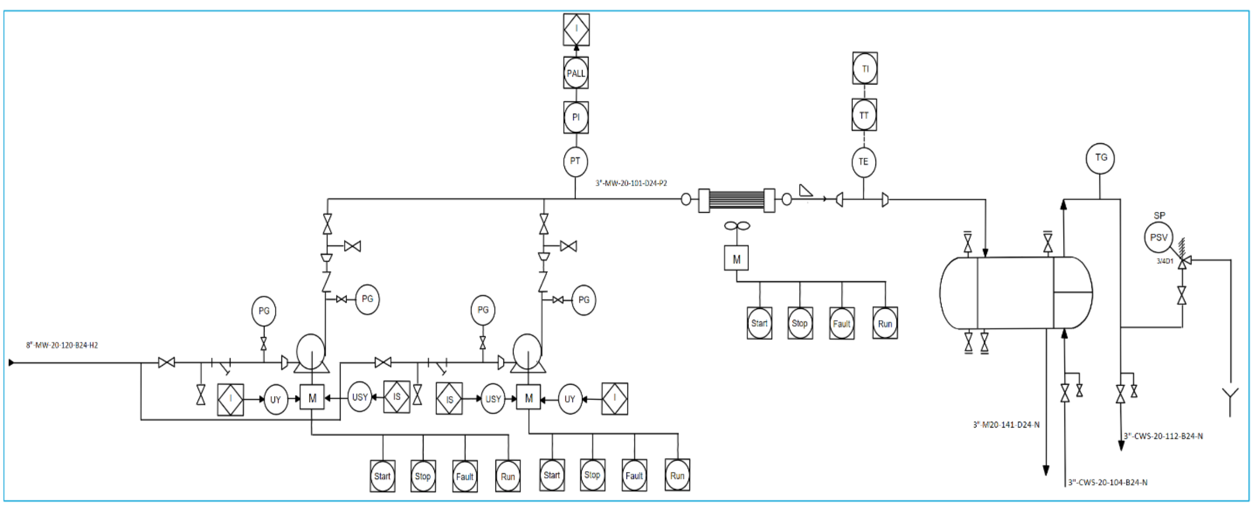
For the valve with water as fluid a Over-plug flow with flow-to-open tendency is selected.

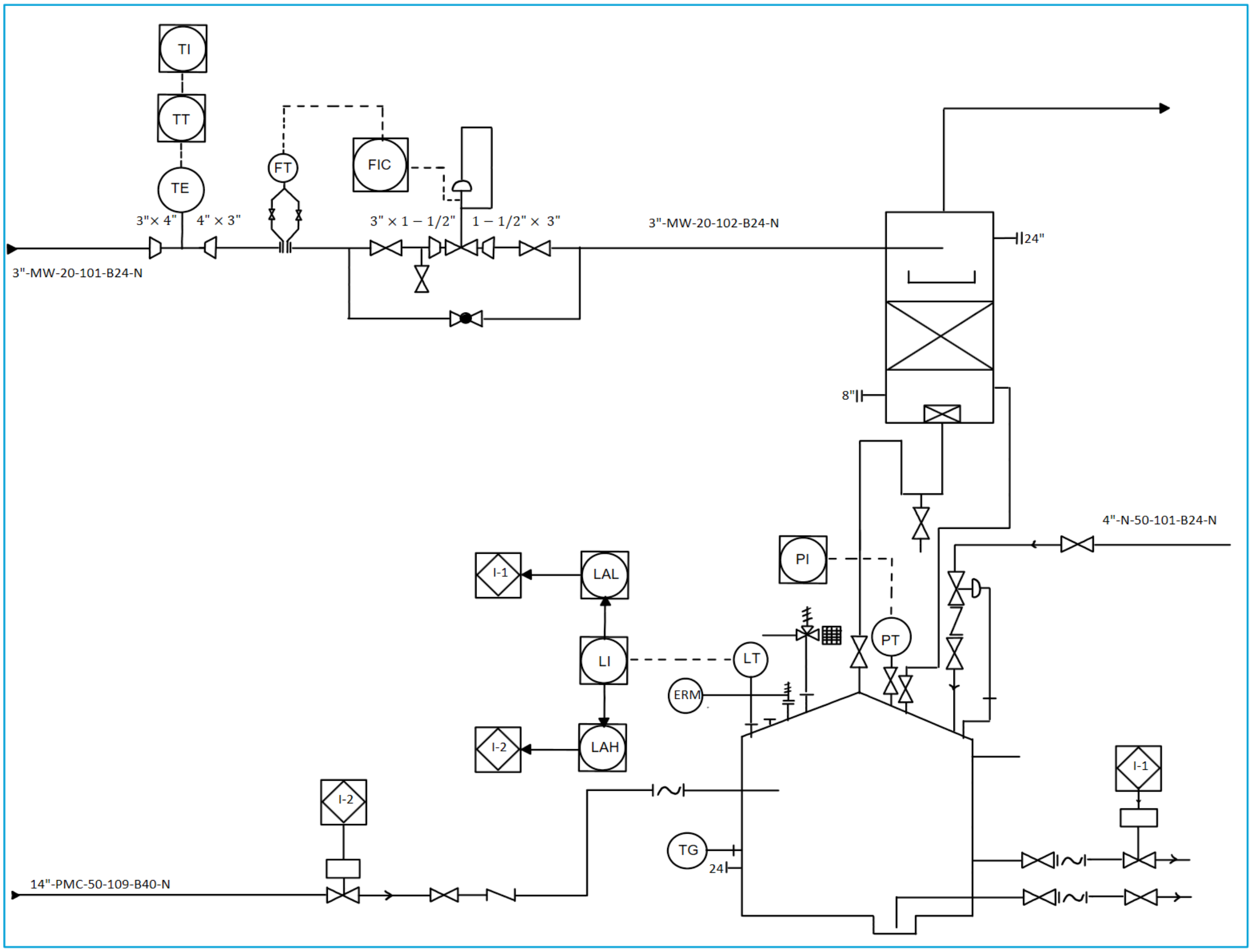
Educational Institute for Equipment and Process Design

EIEPD			DATA SHEET FOR PNEUMATIC CONTROL VALVE			Document Number: Sheet Number:
			Client :			
General	1	Item No.	Tag No.	-		FV-5020
	2	Service		Wash water to packed column flow control		
	3	Line No.				
	4	P&ID No.	Inlet/Outlet Pipe Size		3	3
	5	Ambient Temperature	Area Classification	5-52 C		Zone X
Process Data	6	Process Fluid	Fluid State	Water		Liquid
	7	Flow Min./Nor./Max.	kg/h	3480	8700	9570
	8	Ambient Temperature, C		48	48	48
	9	Inlet Pressure, barg		5.3	5.3	5.3
	10	Outlet Pressure, barg		4.6	4.6	4.6
	11	Shut-off Pressure, barg	Refer. Density kg/Nm3			
	12	Viscosity, cP	Density at Operating Condition, kg/m3	0.563		990
	13	Molecular Wt.	Corrosive / Toxic	18.01		None
	14	Liquid Vapor Pressure, barg	Critical Pressure, barg	-0.9		220
	15	Vapour Compressibility	Cp/Cv @ Flow Condition	-		-
	16	Design Temperature, C	Design pressure, barg	-		-
Body & Bonnet	17	Model	Allowable SPL			85dBA
	18	Calculated Cv Min./Norm./Max.	Rated Cv	4.84/12.25/13.52		17.57
	19	Body Type	Body Material	Globe		A216 WCB/A 105
	20	Body Size	End Conn Type & Standard	1-1/2"		Flanged, ASME B16.5
	21	Inlet Connection Size /Ratg/Facg	Outlet Connection Size /Ratg/Facg	1.5", Class 300 RF		1.5", Class 300 RF
	22	No. of Ports	Flow Direction	Single		Over-plug
	23	Bonnet Type	Packing Material	Standard		PTFE
	24	Bellows & Material	Steam Jacket			
Trim	25	Trim Style	Trim Size	Plug		1-1/2"
	26	Flow Characteristic	Rated Travel	EQ%		100%(full open position)
	27	Plug/Ball/Disk Material	Seat Material	-		-
	28	Cage/Guide Material	Stem Material	-		-
	29	Valve Leakage Class		IV		
Actuator	30	Manufacturer	Model	-		-
	31	Actuator Type	Handwheel Type	Diaphragm, spring-return		
	32	Connecttion Type	Regulator Set Pressure			
Positioner	33	Manufacturer	Model			
	34	Type/Characteristic	Input Signal	Digital	Linear	FF/P
	35	Electrical Connection	Certification/Housing			
Accessories	36	Air Set	Model/Air Connection			
	37	Solenoid Valve: Manufacturer	Qty./Model			
	38	Type	Certification/Housing			
	39	Power Supply	Electrical Connection			
	40	Body Material	JB & Material			
	41	Limit Switch : Manufacturer	Model/Electrical Connection			
	42	Type	Certification/Housing			
	43	Transmitter: Manufacturer	Model/Electrical Connection			
	44	Type	Certification/Housing			
Others	45	Failsafe Requirement	Safety Integrated Level (SIL)			
	46	Valve Fail Position	Travel Time(sec.)			
	47	Air Supply barg				
	48	Manufecturer				
Notes	49					
	50					
	51					
	52					
	53					

PFD and P&ID Development






TI
TT
TE
FT
FIC
3"× 4"
4" × 3"
3" × 1 − 1/2"
1 − 1/2" × 3"
3"-MW-20-101-B24-N
3"-MW-20-102-B24-N
24"
8"
4"-N-50-101-B24-N
PI
PT
LT
ERM
LAL
LI
LAH
I-1
I-2
I-2
I-1
TG
24
14"-PMC-50-109-B40-N

Interlocks and Process Emergency Description

IS-5007: Trip of distillation water pumps P-5007 A/B

The causes for trip are:
- Manual panel trip
- Low level in MP methanol column T-X, LSAL-X

The following actions are carried out automatically:
- Stop MP column recycle pump P-5007 A, stop MP-5007A
- Stop MP column recycle pump P-5007 B, stop MP-5007B

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I-5007: Auto-start of standby pump P-5007

The causes for the auto-start of standby pump are:
- Low pressure downstream of P-5007

Note: The pumps should not be in tripped state.

The following actions are carried out automatically:
- Start the pump P 5007 A, start MP-5007A
- Start the pump P 5007 B, start MP-5007B

………

IS-5001: High level in raw methanol buffer tank TK-X
The causes for trip are:

- Manual panel trip
- High level in raw methanol buffer tank TK-X

The following actions are carried out automatically:
- Stop water to vent wash column T 5004, close FV-5020
- Stop crude methanol to TK 5001, close USV

………

IS-5002: Trip of raw methanol pump, P 5001 A/B
The causes for trip are:
- Manual panel trip
- Low level in raw methanol buffer tank TK 5001, LSAL-5002

The following actions are carried out automatically:
- Stop raw methanol pump P 5001 A, stop MP-5001A
- Stop raw methanol pump P 5001 B, stop MP-5001B

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