Process Water Mixing Description

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Description for Hot-Cold Water Mixing Tank Process

1- I&C Design Project Map

To make the documentation easier and more manageable to be made, the document is used the project workflow that had been mentioned in Bela G Liptak : Instrumentation Engineer's Handbook; Process Software and Digital Networks.

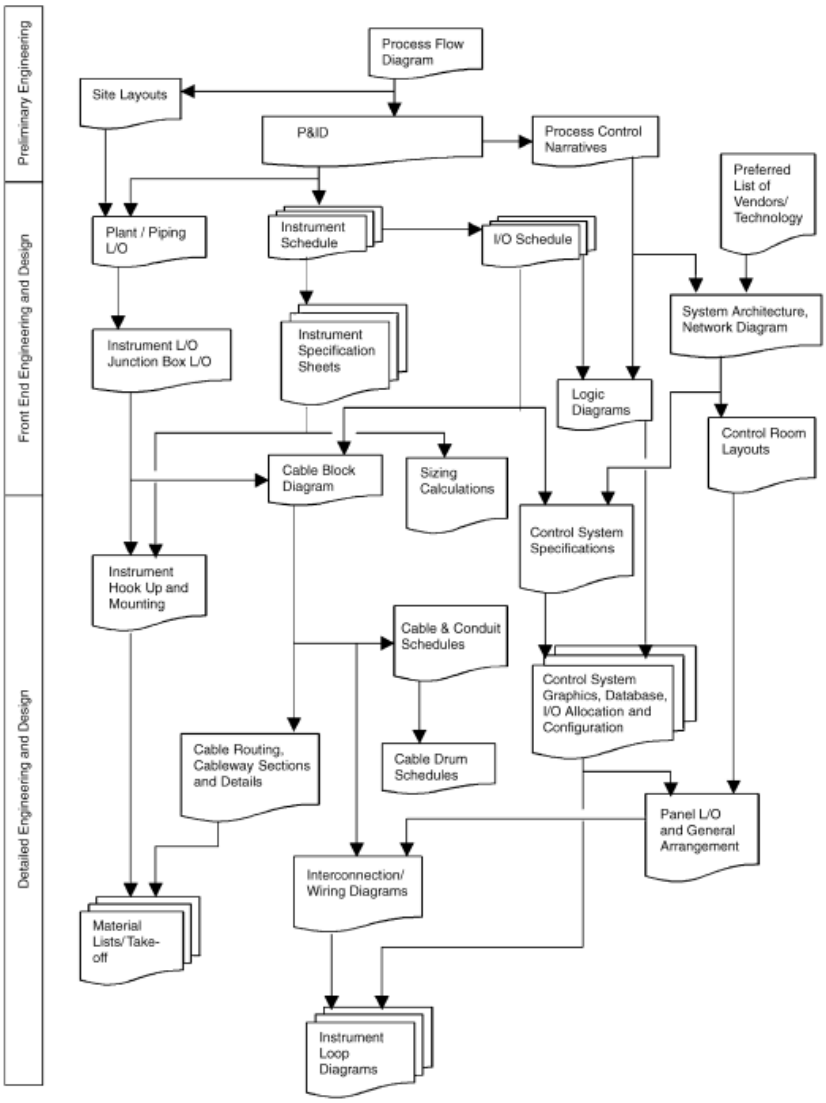


FIG. 1.2b
A document dependency map of instrumentation and control system design project.

2- Define Process Description

Process Purposes : Mixing Hot and Cold Water in Atmospheric Tanks

Process Output : Result of the mixing as the product flow

Process Variable (PV)	PV Value	PV Unit
Cold Water Temperature	20	°C
Cold Water Flowrate	0-100	L/s
Hot Water Temperature	90	°C
Hot Water Flowrate	0-100	L/s
Product Temperature	40-50	°C
Product Flowrate	0-100	L/s
Water Density	997.01	Kg/m^3
Specific Water Heat Capacity	4182	J/kg°C

After the process properties is defined, the process variable need to be defined also to see what the process variable that need to be controlled and what variable to be manipulated to achieve the setpoint desired.

The Disturbance variable is optional to be added, so we know what variable that could change our process variable stability

Controlled Variable (CV)	Manipulated Variable (MV)	Disturbance (D)
Tank Level	Hot Fluid Flowrate	Product Flowrate
		Cold Water Flowrate
Product Temperature	Cold Fluid Flowrate	Hot Water Flowrate

After that, the Process Flow Diagram and P&ID could be made as per process requirement as seen above:

See the P&ID Visio here
//if seen from Github, please refer to the repository itself

If the P&ID is finalized, then need to list all the Instrument, Valve/Actuator, and the Equipment needed in the systems :

Codename	Equipment Name	Brand / Model	Specification	Serial Number
PUMP1-1	Centrifugal Pump	xxxxxxxxxxx	Xxxxxxxxx L/s Head xxxxx m	xxxxxxxxxxx
PUMP1-2	Centrifugal Pump	xxxxxxxxxxx	Xxxxxxxxx L/s Head xxxxx m	xxxxxxxxxxx
PUMP1-3	Centrifugal Pump	xxxxxxxxxxx	Xxxxxxxxx L/s Head xxxxx m	xxxxxxxxxxx

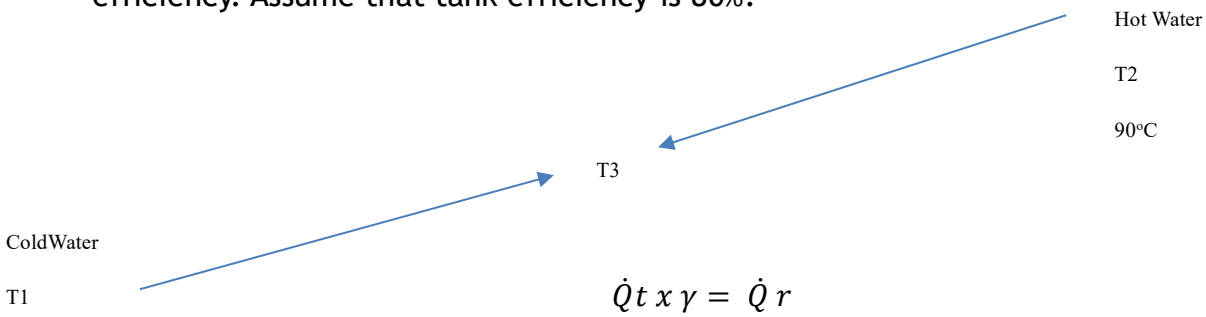
Codename	Instrument Name	Brand / Model	Specification	Serial Number
FE11 FT11	Turbine Flowmeter	xxxxxxxxxxx	Xxxxxxxxx L/s	xxxxxxxxxxx
FE12 FT12	Turbine Flowmeter	xxxxxxxxxxx	Xxxxxxxxx L/s	xxxxxxxxxxx
FE13 FT13	Turbine Flowmeter	xxxxxxxxxxx	Xxxxxxxxx L/s	xxxxxxxxxxx
FIC11	Flow Indicator Controller	PLC/DCS xxxx	xxxxxxxxxxx	xxxxxxxxxxx
FIC12	Flow Indicator Controller	PLC/DCS xxxx	xxxxxxxxxxx	xxxxxxxxxxx
FIC13	Flow Indicator Controller	PLC/DCS xxxx	xxxxxxxxxxx	xxxxxxxxxxx
LG11	Level Gauge	xxxxxxxxxxx	Xxxxxxxxxx m	xxxxxxxxxxx
LT11	Level transmitter	xxxxxxxxxxxx	Xxxxxxxxxx m	xxxxxxxxxxx
LSH11	Level Switch High	Xxxxxxxxxxx	Xxxxxxxxxx	Xxxxxxxx
LSL11	Level Switch Low	xxxxxxxxxxx	xxxxxxxxxx	xxxxxxxx
LIC11	Level Indicator Controller	PLC/DCS xxxx	xxxxxxxxxxx	xxxxxxxxxxx
PSHL11	Pressure Switch High Low	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx
PSHL12	Pressure Switch High Low	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx
PSHL13	Pressure Switch High Low	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx
TE11 TT11	RTD Temp Transmitter	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx
TE12 TT12	RTD Temp Transmitter	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx
TE13 TIT13	RTD Temp Transmitter	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx
TIC11	Temperature Indicator Transmitter	PLC/DCS xxxx	xxxxxxxxxxx	xxxxxxxxxxx

Codename	Valve Name	Brand / Model	Specification	Serial Number
FCV11	Diaphragm Control Valve Linier Fail Closed	xxxxxxxxxxx	XXXXXXXX	xxxxxxxxxxx
LCV11	Diaphragm	xxxxxxxxxxx	XXXXXXXXXX	xxxxxxxxxxx

	Control Valve Linier Fail Closed			
TCV11	Diaphragm Control Valve Linier Fail Closed	xxxxxxxxxxx	XXXXXXXXXX	xxxxxxxxxxx
SDV11	Solenoid Shutdown Valve	xxxxxxxxxxx	XXXXXXXXXX	XXXXXXXXXX
SDV12	Solenoid Shutdown Valve	xxxxxxxxxxx	XXXXXXXXXX	XXXXXXXXXX
SDV13	Solenoid Shutdown Valve	xxxxxxxxxxx	XXXXXXXXXX	XXXXXXXXXX

//Gate valve for Control Valve Maintenance bypass and all check valve assume not defined.
//All model, specs, and serial number would be updated after further searching and research.

For Temperature inside tanks is following the Black Rules, which the heat transferred is equal to heat received multiplied by the tanks heat absorb efficiency. Assume that tank efficiency is 80%.



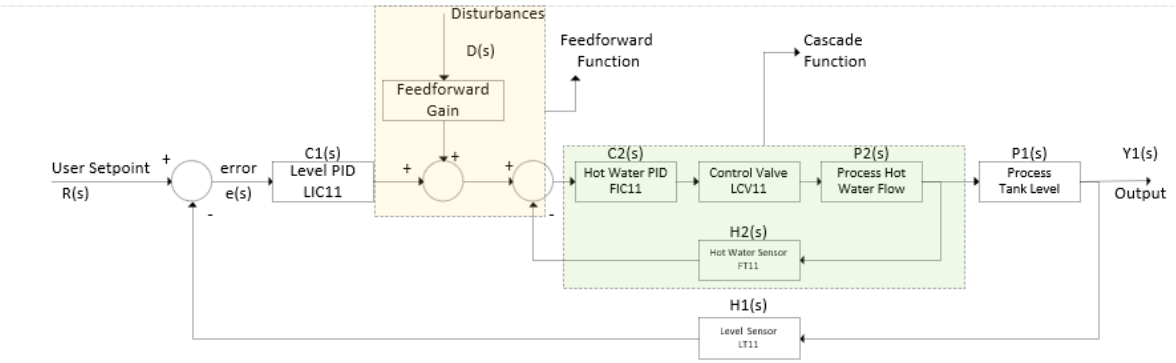
$$\dot{Q}t\ x\ \gamma = \dot{Q}\ r$$
$$\dot{m}t\ x\ c\ x\ \Delta Tt\ x\ \gamma = \dot{m}r\ x\ c\ x\ \Delta Tr$$
$$\dot{m}t\ x\ c\ x\ (T2 - T3)\ x\ \gamma = \dot{m}r\ x\ c\ x\ (T3 - T1)$$
$$T3 = \frac{\dot{m}t\ T2\ \gamma + \dot{m}r\ T1}{\dot{m}t\ \gamma + \dot{m}r}$$

3- Process Control Narrative

As seen from P&ID and Process Variable Requirement, the process control would be derivate into 3 main process control

A. Tank Level Control

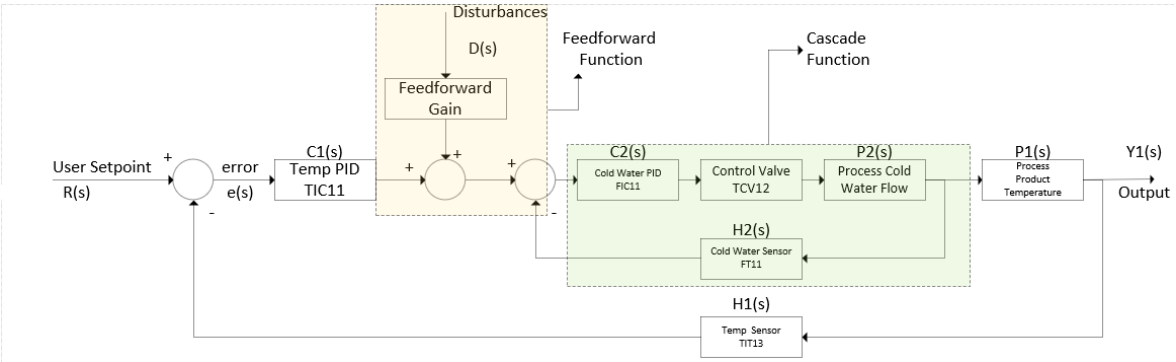
To maintain the Tanks level always on the optimum level and not over level nor under level, the tank level would be manipulated trough the hot fluid intake into the tanks.



Shown that the block diagram for the Tank Level Control could be accommodate 3 control strategy: Simple Feedback, Cascade Control, and Feedforward Control. User can choose what control strategy that want to be used for their operation later.

B. Product Temperature Control

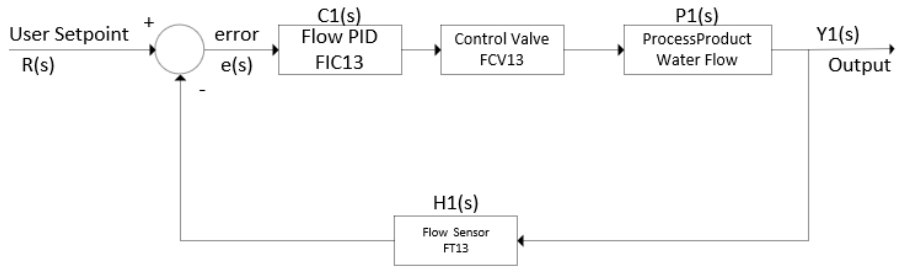
To maintain the product temperature, agreed that the manipulated variable that need to control to achieve the desired product temperature is to manipulate cold water flowrate



The description is same with the level block diagram, refer above.

C. Product Flowrate Control

The product flowrate is just disturbances variable into other system, so no need any advanced control strategy, feedback only is enough.



4- Basic Process Control System Algorithm

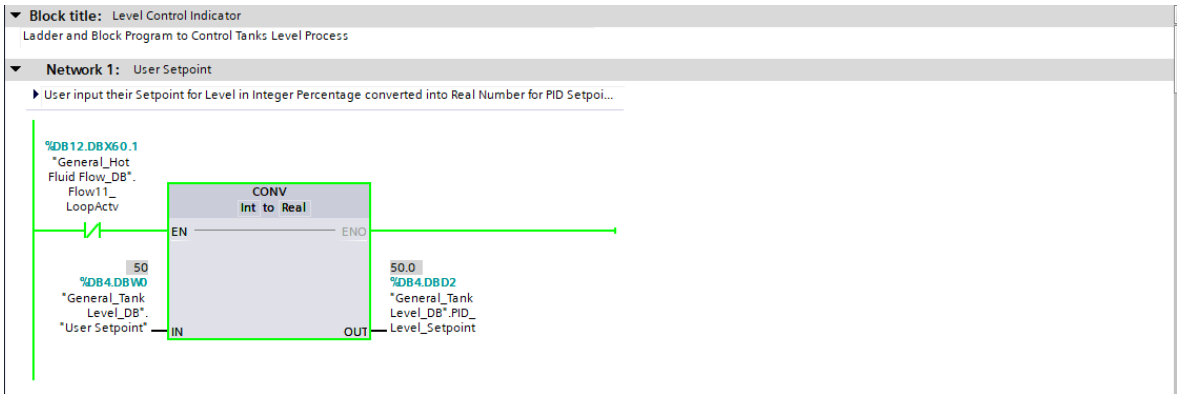
After the Block Diagram is built, the program at PLC would be followed the block diagram before as the main references.

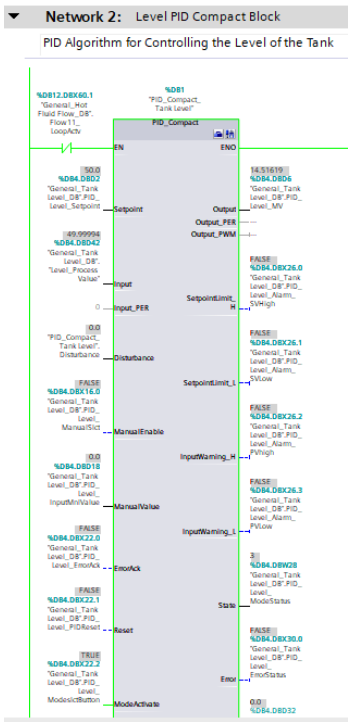
A. Level Indicating Controller (LIC) Function Block and Ladder

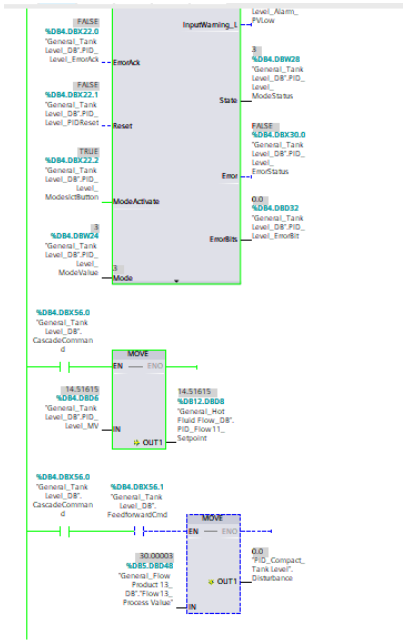
To make sure the algorithm work as simple feedback the program needs to follow the attached scheme:

//IMPORTANT: MAKE SURE THE MAIN PROGRAM BLOCK IS USING CYCLIC INTERUPT BLOCK TO MAKE PID FUNCTION WORKS! (Set time interrupt: 0.1 s)

// Set cyclic all FB to 0.3 is OK and set Cyclic for Cpu time to 0.1 s.

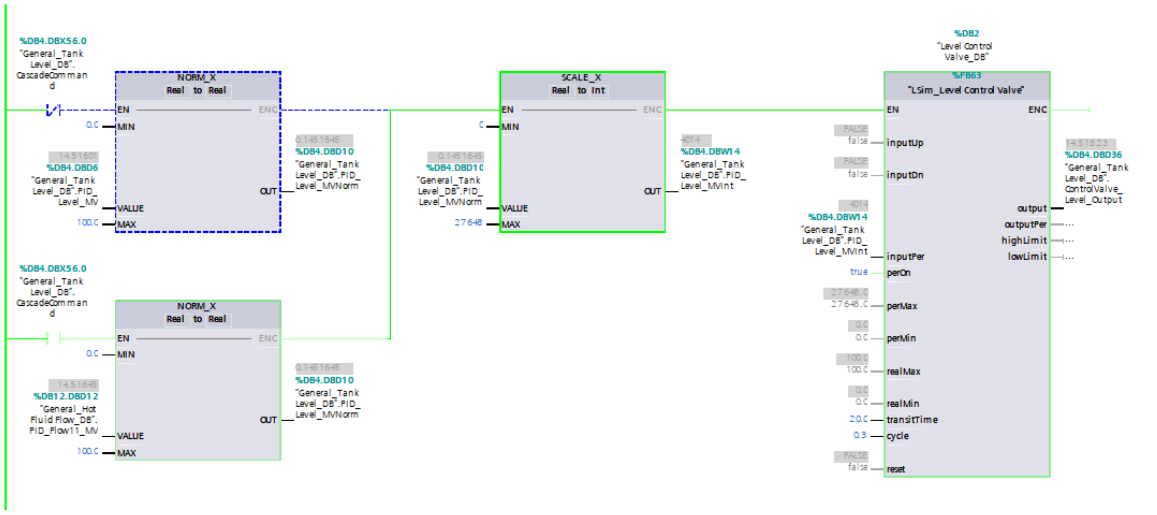






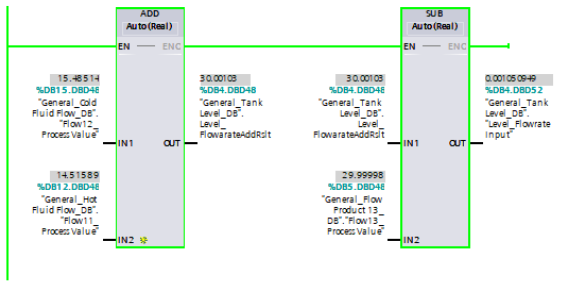
Network 3: Level Control Valve Control Block

Control Valve Process to Control the Tanks Level



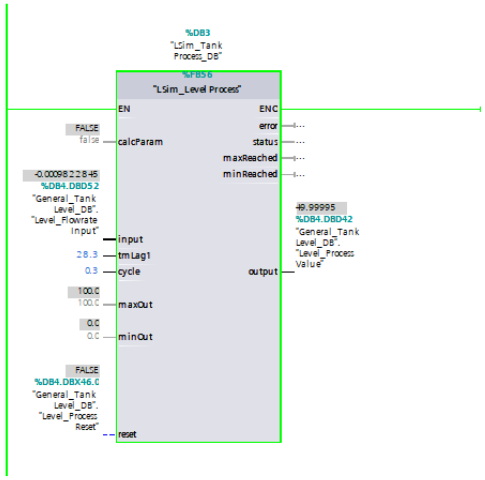
Network 4: Subsidiary Function for Level Process

Subsidiary for Level Proses between LCV and Product FCV



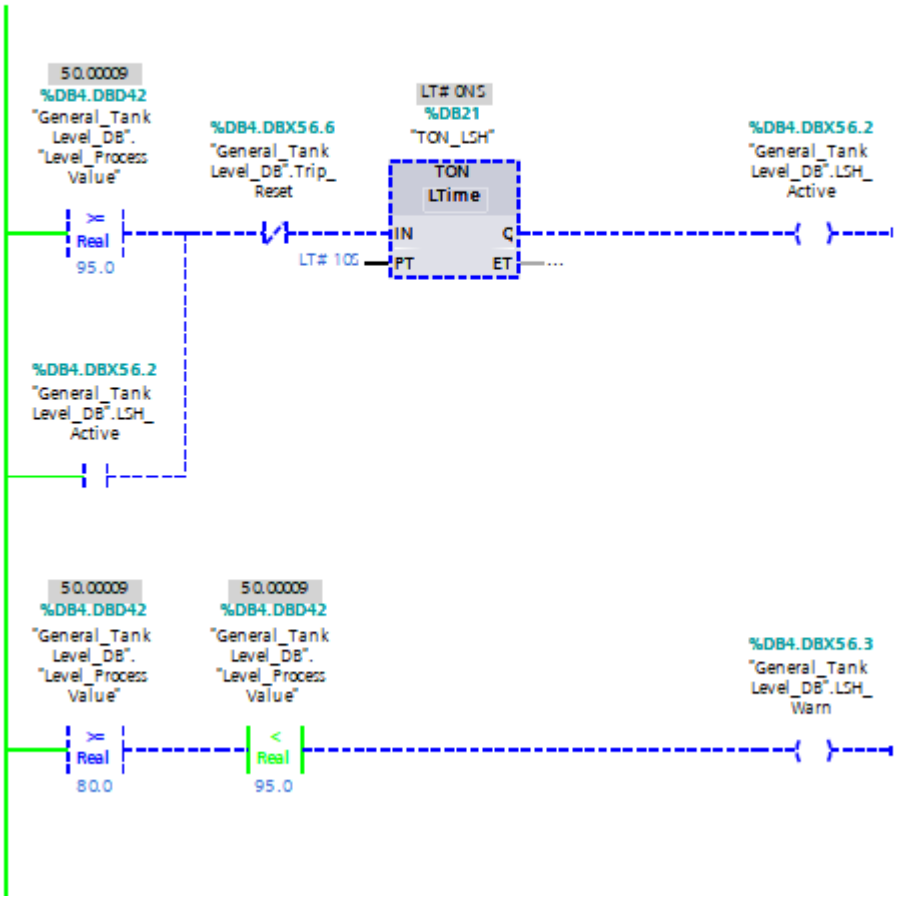
Network 5: Level Process Control Block

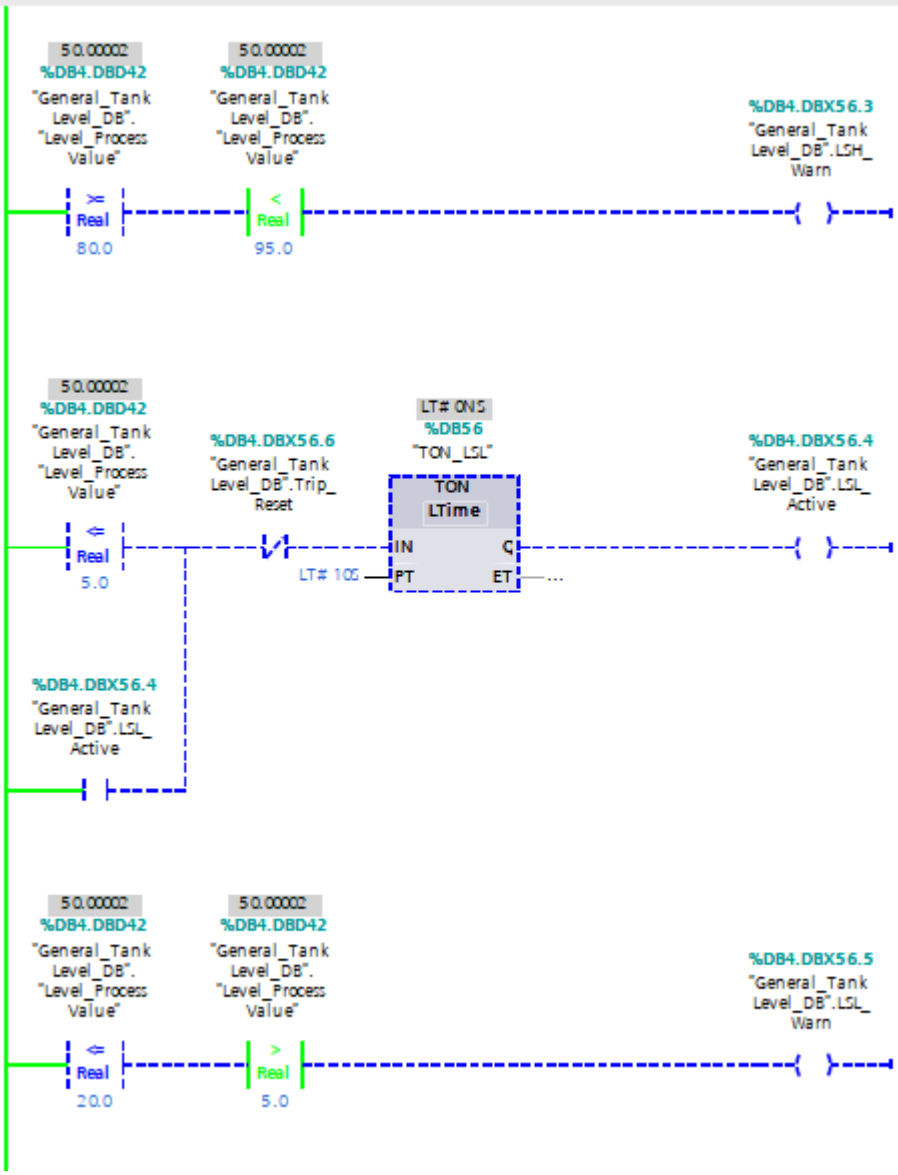
Process for Level Tank Simulated as Integral Response

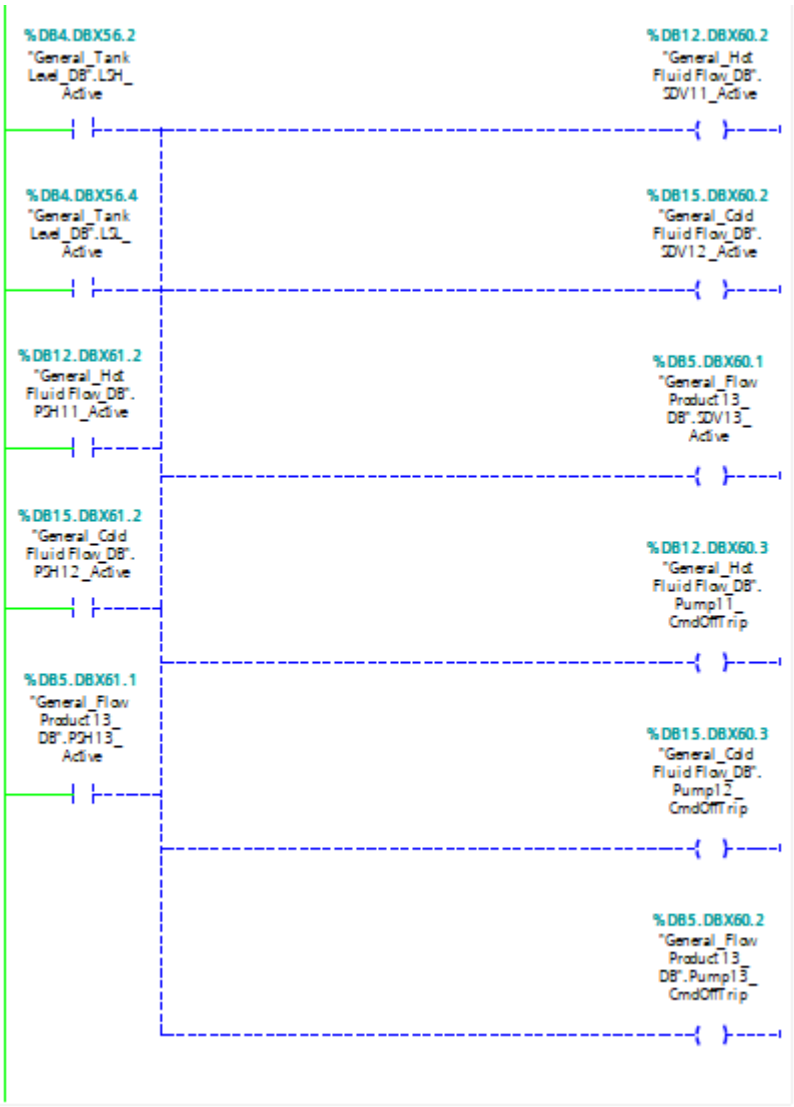


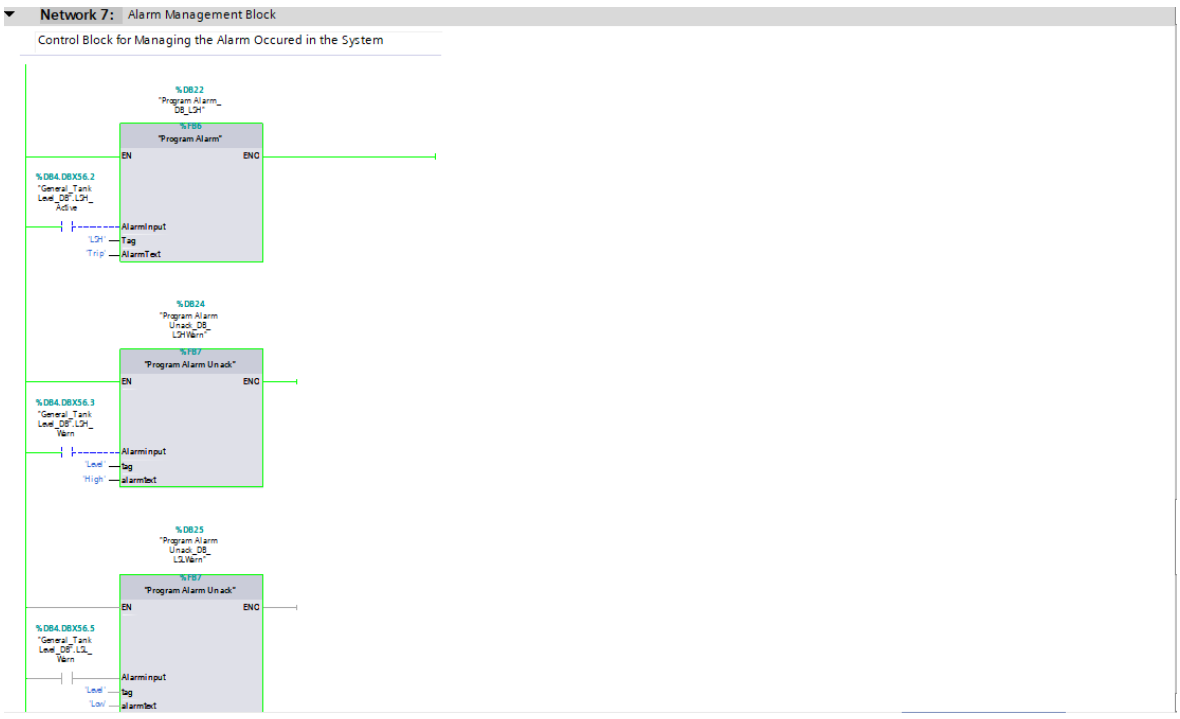
Network 6: Safety Block For Level Limit

Set Alarm Limit for LSH and LSL activate when Level at 90% and 10%



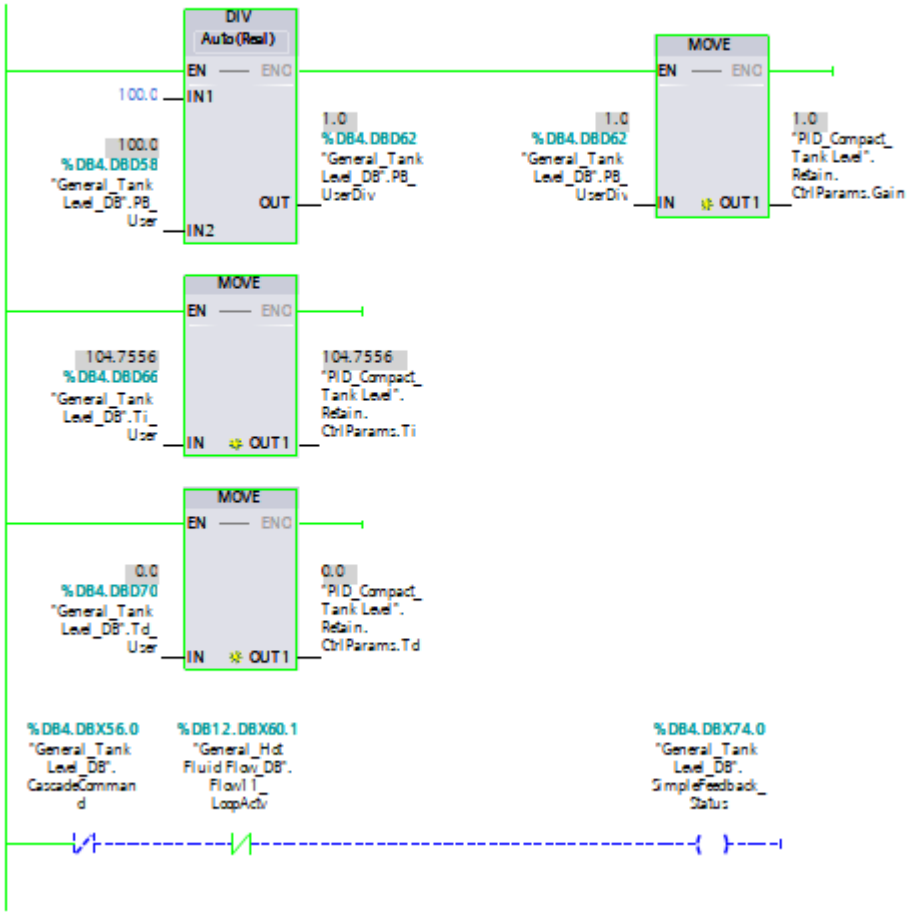

50.00002
%DB4.DBD42
"General_Tank Level_DB". "Level_Process Value"
>= Real
80.0
50.00002
%DB4.DBD42
"General_Tank Level_DB". "Level_Process Value"
< Real
95.0
%DB4.DBX56.3
"General_Tank Level_DB".LSH_ Warn
50.00002
%DB4.DBD42
"General_Tank Level_DB". "Level_Process Value"
<= Real
5.0
%DB4.DBX56.6
"General_Tank Level_DB".Trip_ Reset
LT# 0NS
%DB56
"TON_LSL"
TON
LTime
IN
Q
LT# 10S
PT
ET
%DB4.DBX56.4
"General_Tank Level_DB".LSL_ Active
%DB4.DBX56.4
"General_Tank Level_DB".LSL_ Active
50.00002
%DB4.DBD42
"General_Tank Level_DB". "Level_Process Value"
<= Real
20.0
50.00002
%DB4.DBD42
"General_Tank Level_DB". "Level_Process Value"
> Real
5.0
%DB4.DBX56.5
"General_Tank Level_DB".LSL_ Warn


%DB4.DBX56.2
"General_Tank Level_DB".LSH_ Active
%DB12.DBX60.2
"General_Hot Fluid Flow_DB". SDV11_Active
%DB4.DBX56.4
"General_Tank Level_DB".LSL_ Active
%DB15.DBX60.2
"General_Cold Fluid Flow_DB". SDV12_Active
%DB12.DBX61.2
"General_Hot Fluid Flow_DB". PSH11_Active
%DB5.DBX60.1
"General_Flow Product13_ DB".SDV13_ Active
%DB15.DBX61.2
"General_Cold Fluid Flow_DB". PSH12_Active
%DB12.DBX60.3
"General_Hot Fluid Flow_DB". Pump11_ CmdOffTrip
%DB5.DBX61.1
"General_Flow Product13_ DB".PSH13_ Active
%DB15.DBX60.3
"General_Cold Fluid Flow_DB". Pump12_ CmdOffTrip
%DB5.DBX60.2
"General_Flow Product13_ DB".Pump13_ CmdOffTrip


Network 7: Alarm Management Block
Control Block for Managing the Alarm Occured in the System
%DB22
"Program Alarm_ DB_LSH"
%FB6
"Program Alarm"
EN
ENO
%DB4.DBX56.2
"General_Tank Level_DB".LSH_ Active
AlarmInput
'LSH'
Tag
'Trip'
AlarmText
%DB24
"Program Alarm Unack_DB_ LSHWarn"
%FB7
"Program Alarm Unack"
EN
ENO
%DB4.DBX56.3
"General_Tank Level_DB".LSH_ Warn
AlarmInput
'Level'
tag
'High'
alarmtext
%DB25
"Program Alarm Unack_DB_ LSLWarn"
%FB7
"Program Alarm Unack"
EN
ENO
%DB4.DBX56.5
"General_Tank Level_DB".LSL_ Warn
AlarmInput
'Level'
tag
'Low'
alarmtext

Network 8: User Additional Feature

Put additional feature that user can use to easier the system operation

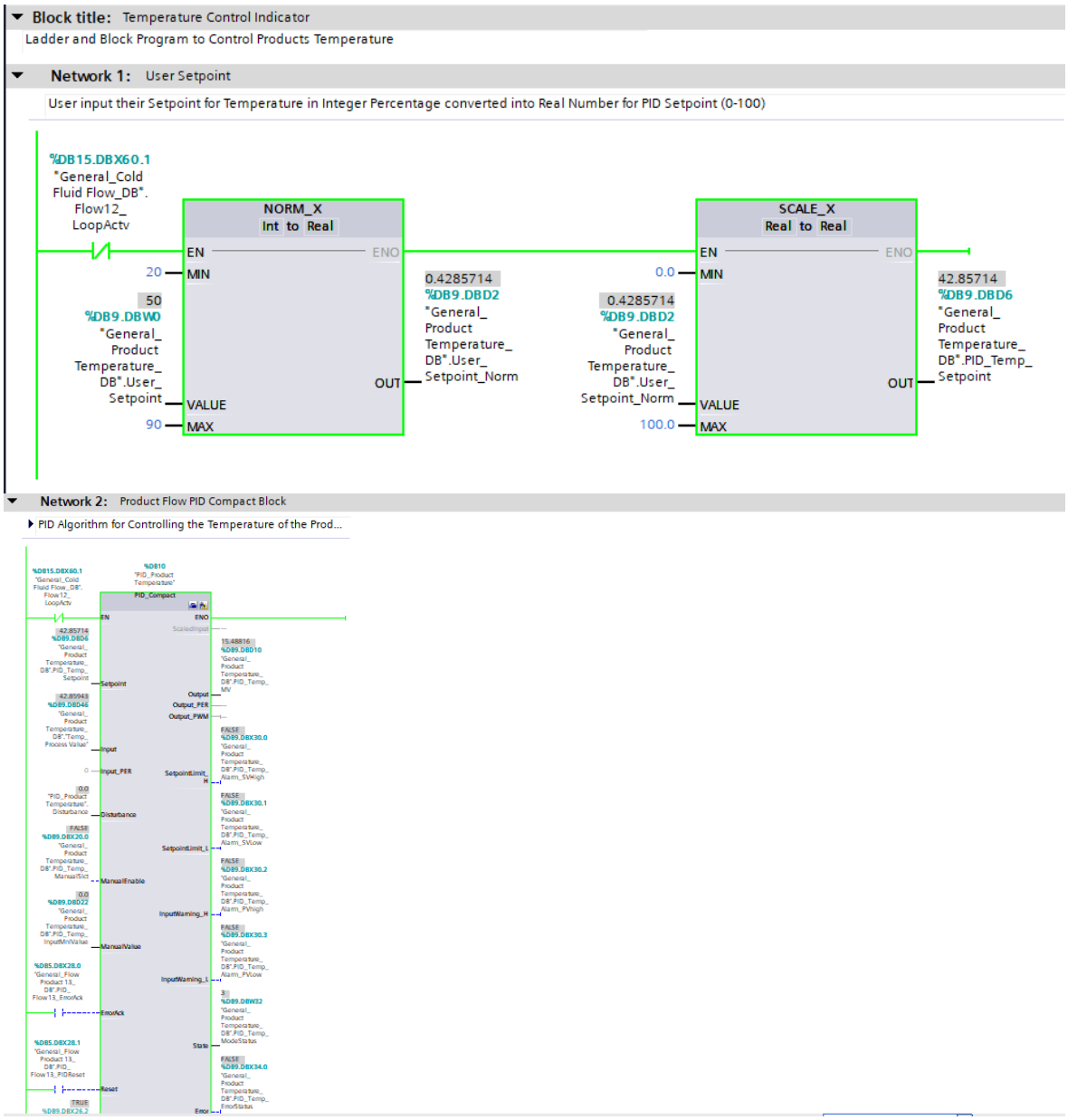


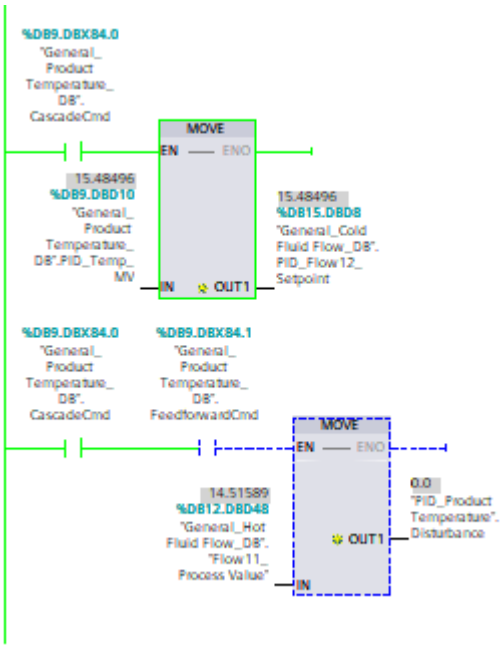
General_Tank Level_DB

	Name	Data type	Offset	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint	Supervision	Comment
1	Static										
2	User Setpoint	Int	0.0	30							Setpoint Input fro...
3	PID_Level_Setpoint	Real	2.0	0.0							Setpoint into PID L...
4	PID_Level_MV	Real	6.0	0.0							Output of PID Lev...
5	PID_Level_MVNorm	Real	10.0	0.0							Output of PID Lev...
6	PID_Level_MVInt	Int	14.0	0							Output of PID Lev...
7	PID_Level_ManualSlct	Bool	16.0	false							Switch for Activat...
8	PID_Level_InputMnlValue	Real	18.0	0.0							User Input Value f...
9	PID_Level_ErrorAck	Bool	22.0	false							Acknowledged Bu...
10	PID_Level_PIDReset	Bool	22.1	false							Reset Button for PI...
11	PID_Level_ModeSlctButton	Bool	22.2	true							Activate Mode Sel...
12	PID_Level_ModeValue	Int	24.0	3							Select Mode for PI...
13	PID_Level_Alarm_SVHigh	Bool	26.0	false							Alarm from PID Le...
14	PID_Level_Alarm_SVLow	Bool	26.1	false							Alarm from PID Le...
15	PID_Level_Alarm_PVhigh	Bool	26.2	false							Alarm from PID Le...
16	PID_Level_Alarm_PVLow	Bool	26.3	false							Alarm from PID Le...
17	PID_Level_ModeStatus	Int	28.0	0							Status Mode for PI...
18	PID_Level_ErrorStatus	Bool	30.0	false							Error Flag if PID Bl...
19	PID_Level_ErrorBit	Real	32.0	0.0							Error Code if PID B...
20	ControlValve_Level_Output	Real	36.0	0.0							Output of Level C...
21	ControlValve_Level_TravelMax	Bool	40.0	false							Level Control Valv...
22	ControlValve_Level_TravelMin	Bool	40.1	false							Level Control Valv...
23	Level_Process Value	Real	42.0	50.0							Output from Level...
24	Level_Process Reset	Bool	46.0	false							Reset The Level Pr...
25	Level_FlowarateAddRslt	Real	48.0	0.0							Additional PV fro...
26	Level_Flowrate Input	Real	52.0	0.0							Total net flowrate ...
27	CascadeCommand	Bool	56.0	false							Command to acti...
28	FeedforwardCmd	Bool	56.1	false							Command to acti...
29	LSH_Active	Bool	56.2	false							Alarm : Level Swit...
30	LSH_Warn	Bool	56.3	false							Alarm : Warning b...
31	LSL_Active	Bool	56.4	false							Alarm : Level Swit...
32	LSL_Warn	Bool	56.5	false							Alarm : Warning b...
33	Trip_Reset	Bool	56.6	false							Alarm : Trip Com...
34	PB_User	Real	58.0	100.0							User Input for Pro...
35	PB_UserDiv	Real	62.0	0.0							User Input for Kp (...
36	Ti_User	Real	66.0	104.7556							User Input for Inte...
37	Td_User	Real	70.0	0.0							User Input for Deri...
38	SimpleFeedback_Status	Bool	74.0	false							Simple Feedback ...

//Make sure to turn off optimization at the DB, so we can fill the offset address for easier addressing at OPC

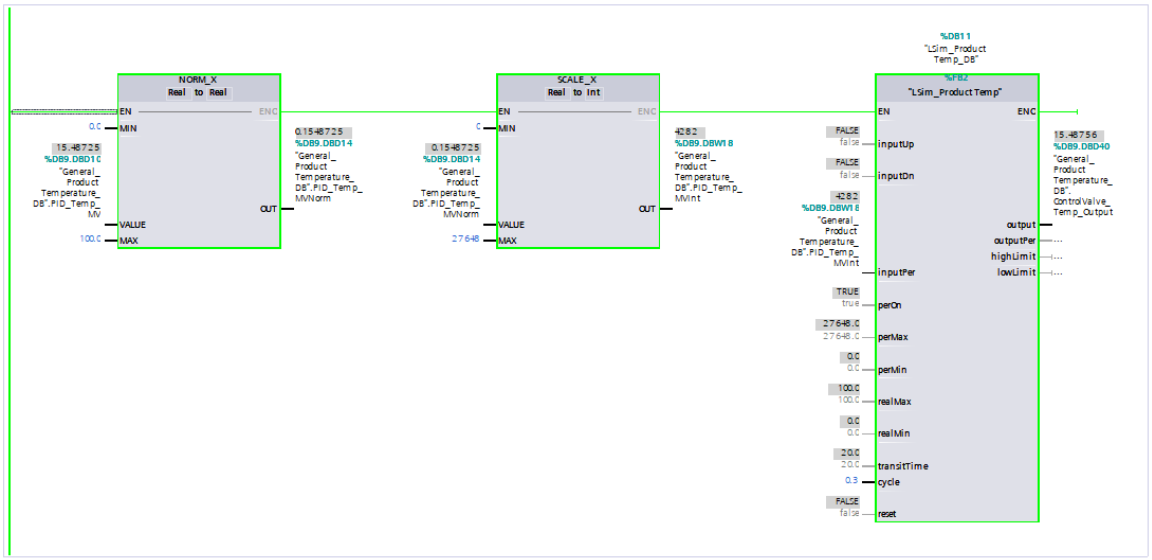
B. Temperature Indicating Controller (TIC) Function Block and Ladder





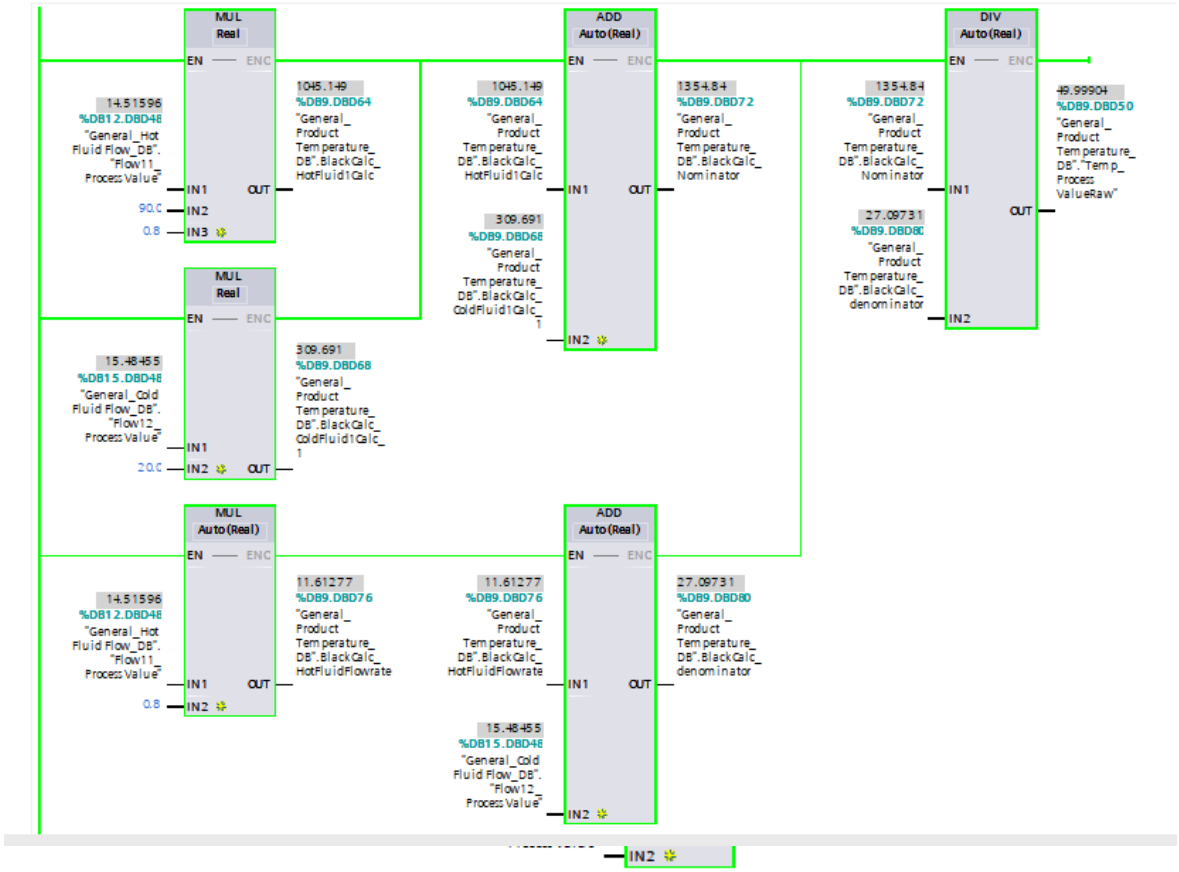
Network 3: Temperature Control Valve 13 Control Block

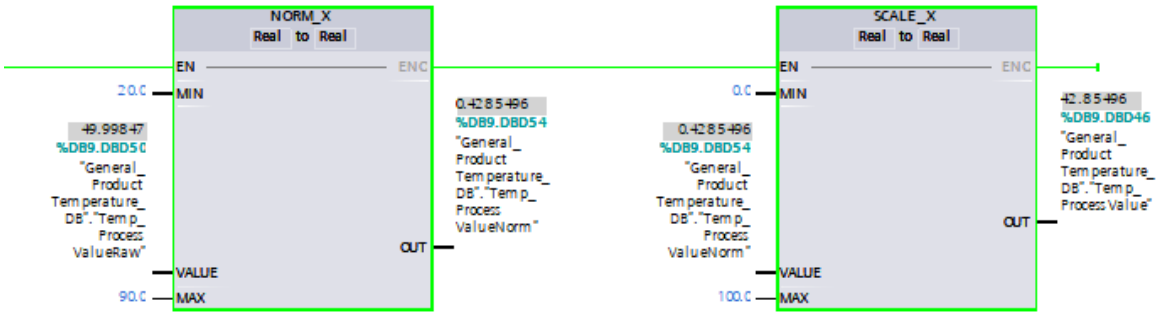
Control Valve Process to Control the Product Temperature



Network 4: Product Temperature Process Control Block

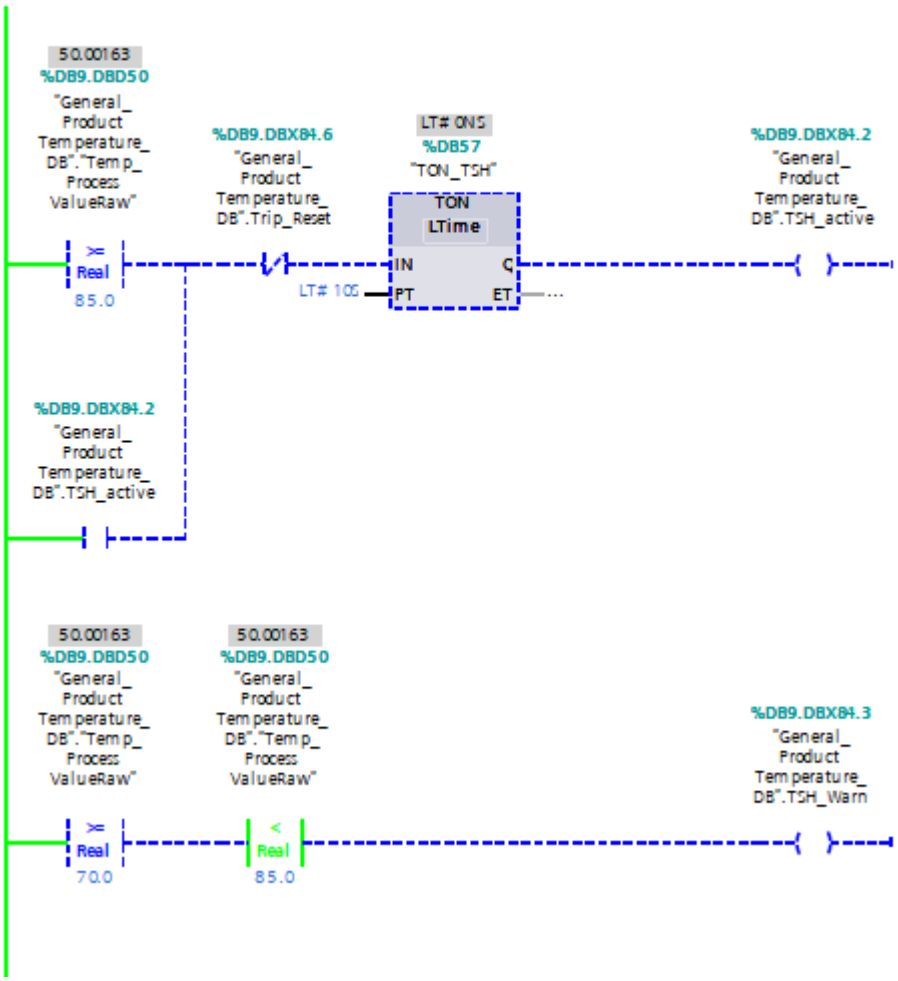
Process for Flowrate as Black Rules Formula

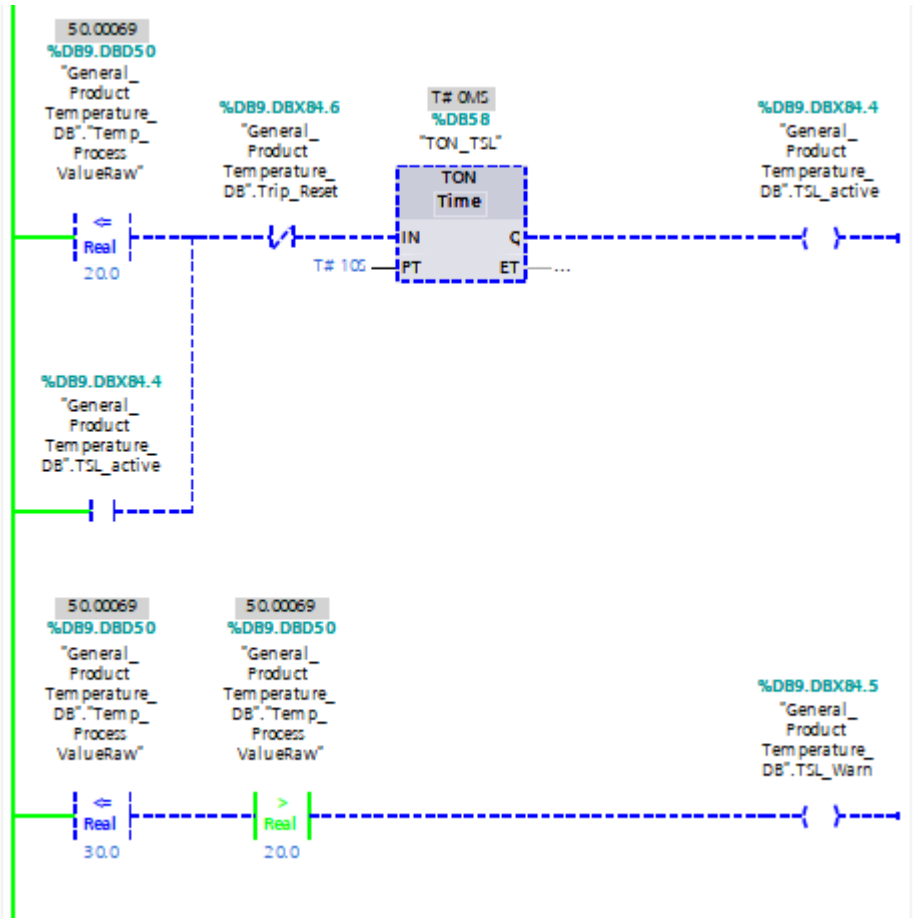


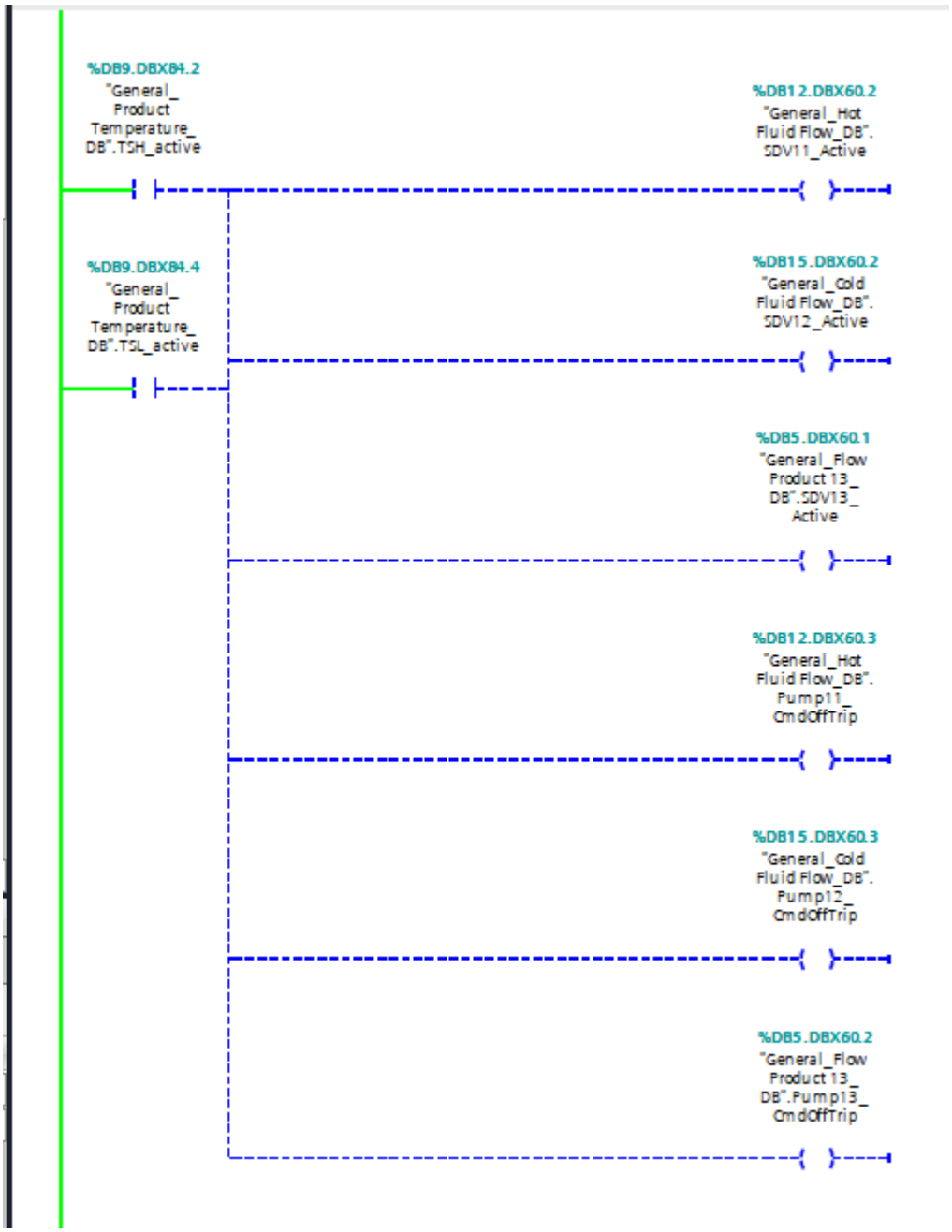


Network 5: Safety Block For Temperature Limit

Set Alarm Limit for TSH and TSL activate when Level at 85 C and 20 C

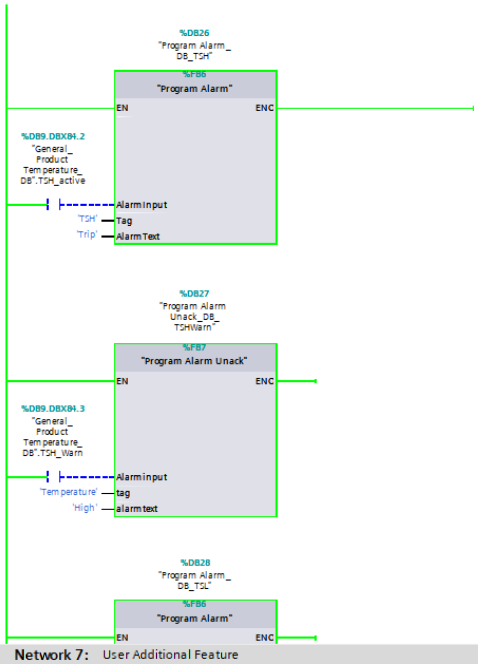



50.00069
%DB9.DBD50
"General_ Product Temperature_ DB".Temp_ Process ValueRaw"
<= Real
20.0
%DB9.DBX84.6
"General_ Product Temperature_ DB".Trip_Reset
T# 0MS
%DB58
"TON_TSL"
TON
Time
IN
Q
T# 10S
PT
ET
%DB9.DBX84.4
"General_ Product Temperature_ DB".TSL_active
%DB9.DBX84.4
"General_ Product Temperature_ DB".TSL_active
50.00069
%DB9.DBD50
"General_ Product Temperature_ DB".Temp_ Process ValueRaw"
<= Real
30.0
50.00069
%DB9.DBD50
"General_ Product Temperature_ DB".Temp_ Process ValueRaw"
> Real
20.0
%DB9.DBX84.5
"General_ Product Temperature_ DB".TSL_Warn


%DB9.DBX84.2
"General_
Product
Temperature_
DB".TSH_active
%DB12.DBX60.2
"General_Hot
Fluid Flow_DB".
SDV11_Active
%DB9.DBX84.4
"General_
Product
Temperature_
DB".TSL_active
%DB15.DBX60.2
"General_Cold
Fluid Flow_DB".
SDV12_Active
%DB5.DBX60.1
"General_Flow
Product 13_
DB".SDV13_
Active
%DB12.DBX60.3
"General_Hot
Fluid Flow_DB".
Pump11_
CmdOffTrip
%DB15.DBX60.3
"General_Cold
Fluid Flow_DB".
Pump12_
CmdOffTrip
%DB5.DBX60.2
"General_Flow
Product 13_
DB".Pump13_
CmdOffTrip

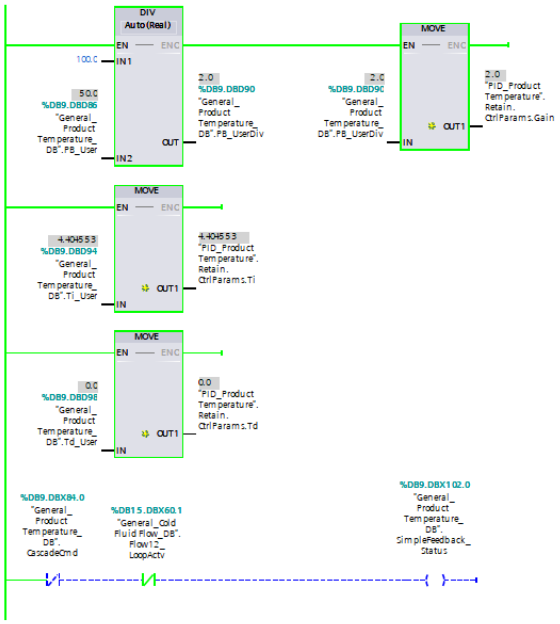
Network 6: Alarm Management Block

Control Block for Managing the Alarm Occured in the System



Network 7: User Additional Feature

Put additional feature that user can use to easier the system operation



General_Product Temperature_DB

	Name	Data type	Offset	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint	Supervision	Comment
1	Static										
2	User_Setpoint	Int	0.0	40							Setpoint Input from User
3	User_Setpoint_Norm	Real	2.0	0.0							Setpoint Input from User Normalized
4	PID_Temp_Setpoint	Real	6.0	0.0							Setpoint into PID Product Temperature
5	PID_Temp_MV	Real	10.0	0.0							Output of PID Product Temperature(Manipula...
6	PID_Temp_MVNorm	Real	14.0	0.0							Output of PID Product Temperature(Manipula...
7	PID_Temp_MVInt	Int	18.0	0							Output of PID Product Temperature (Manipula...
8	PID_Temp_ManualSlct	Bool	20.0	false							Switch for Activate Manual Mode
9	PID_Temp_InputMnlValue	Real	22.0	0.0							User Input Value for Manual MV
10	PID_Temp_ErrorAck	Bool	26.0	false							Acknowledged Button for Operator
11	PID_Temp_PIDReset	Bool	26.1	false							Reset Button for PID Compact
12	PID_Temp_ModeSlctButton	Bool	26.2	true							Activate Mode Selection for PID Operation
13	PID_Temp_ModeValue	Int	28.0	3							Select Mode for PID Operation from 1-4
14	PID_Temp_Alarm_SVHigh	Bool	30.0	false							Alarm from PID Product Temperature if Setpoi...
15	PID_Temp_Alarm_SVLow	Bool	30.1	false							Alarm from PID Product Temperature if Setpoi...
16	PID_Temp_Alarm_PVhigh	Bool	30.2	false							Alarm from PID Product Temperature if Proces...
17	PID_Temp_Alarm_PVLow	Bool	30.3	false							Alarm from PID Product Temperature if Proces...
18	PID_Temp_ModeStatus	Int	32.0	0							Status Mode for PID Operation
19	PID_Temp_ErrorStatus	Bool	34.0	false							Error Flag if PID Block is Occured
20	PID_Temp_ErrorBit	Real	36.0	0.0							Error Code if PID Block is Occured
21	ControlValve_Temp_Output	Real	40.0	0.0							Output of Product Temperature Control Valve
22	ControlValve_Temp_TravelMax	Bool	44.0	false							Product Temperature Control Valve Travel Max
23	ControlValve_Temp_TravelMin	Bool	44.1	false							Product Temperature Control Valve Travel Min
24	Temp_Process Value	Real	46.0	0.0							Output from Product Temperature Process
25	Temp_Process ValueRaw	Real	50.0	50.0							Output from Product Temperature Process raw
26	Temp_Process ValueNorm	Real	54.0	0.0							Output fromProduct Temperature Process Nor...
27	Temp_Process Value_Status	Real	58.0	0.0							Output Status from Product Temperature
28	Temp_Process Reset	Bool	62.0	false							Reset The Product TemperatureProcess
29	BlackCalc_HotFluid1Calc	Real	64.0	0.0							Hot Fluid Aspect Flowarate Heat released
30	BlackCalc_ColdFluid1Calc_1	Real	68.0	0.0							Hot Fluid Aspect Flowarate Heat received
31	BlackCalc_Nominator	Real	72.0	0.0							Total additional of Black Calculation in Nomin...
32	BlackCalc_HotFluidFlowrate	Real	76.0	0.0							Flowrate of Hot Fluid in System
33	BlackCalc_denominator	Real	80.0	0.0							Total additional of Black Calculation in deno...
34	CascadeCmd	Bool	84.0	false							Cascade Command between Temp Product - ...
35	FeedforwardCmd	Bool	84.1	false							Feedforward Command for Product Temp Co...
36	TSH_active	Bool	84.2	false							Alarm : Temp Switch High Activate
37	TSH_Warn	Bool	84.3	false							Alarm : Warning before TSH Active
38	TSL_active	Bool	84.4	false							Alarm : Temp Switch Low Activate
39	TSL_Warn	Bool	84.5	false							Alarm : Warning before LSL Active
40	Trip_Reset	Bool	84.6	false							Alarm : Trip Command Reset
41	PB_User	Real	86.0	50.0							User Input for Proportional Band

//Make sure to turn off optimization at the DB, so we can fill the offset address for easier addressing at OPC

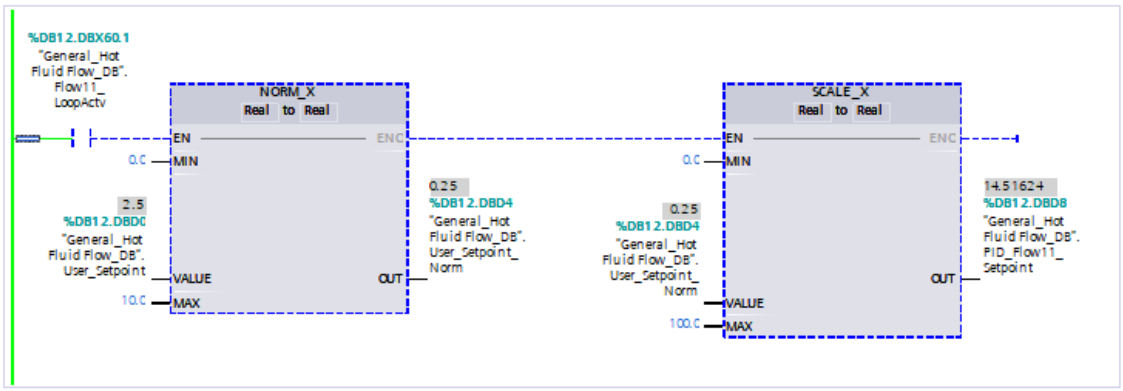
C. Flow Indicating Controller 11 (FIC11) Function Block and Ladder

Block title: Flow Indicator Controller 11 (Hot Fluid)

Ladder and Block Program to control flowrate of Hot Fluid (Tank Input)

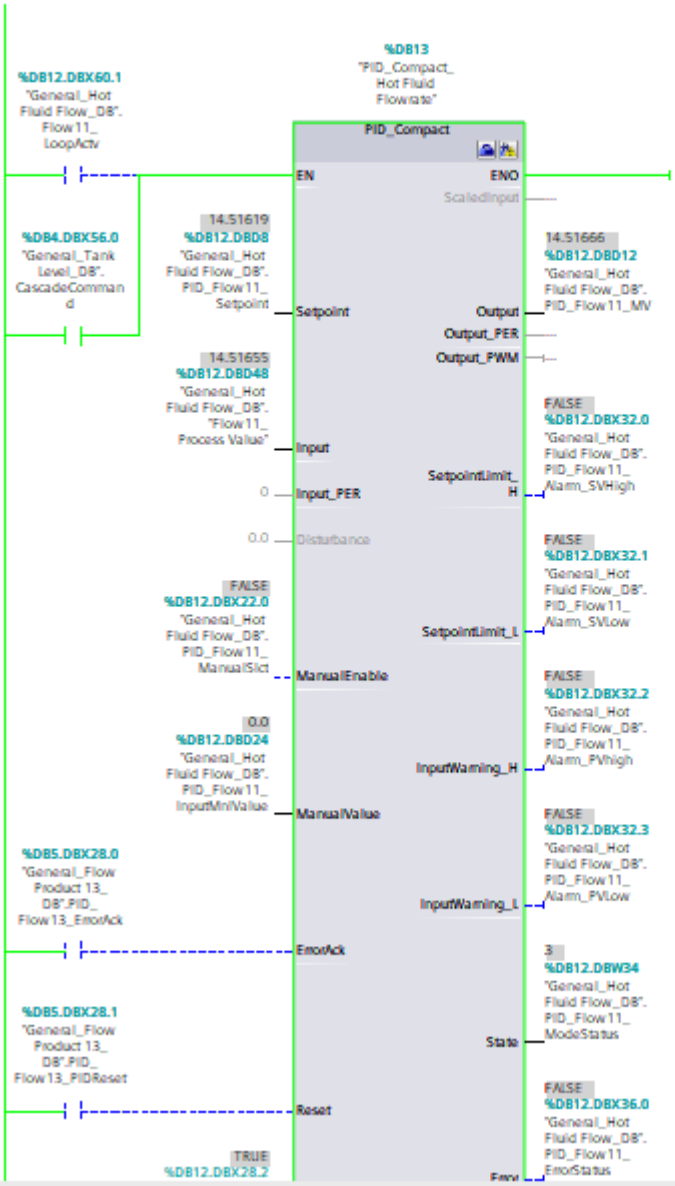
Network 1: User Setpoint

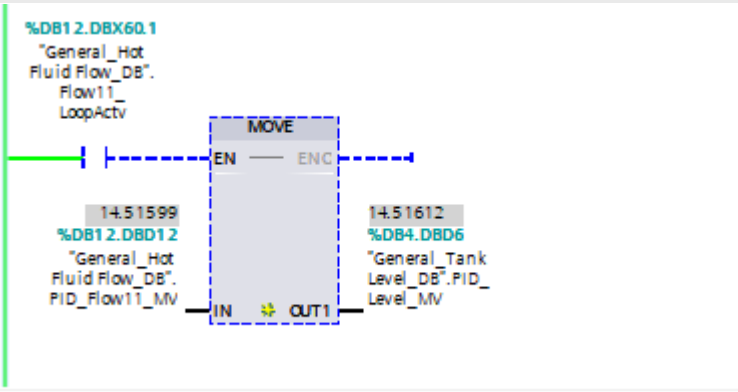
User input their Setpoint for flowrate in L/s converted into Real Number for PID Setpoint (0-100)



Network 2: Hot Fluid Flow PID Compact Block

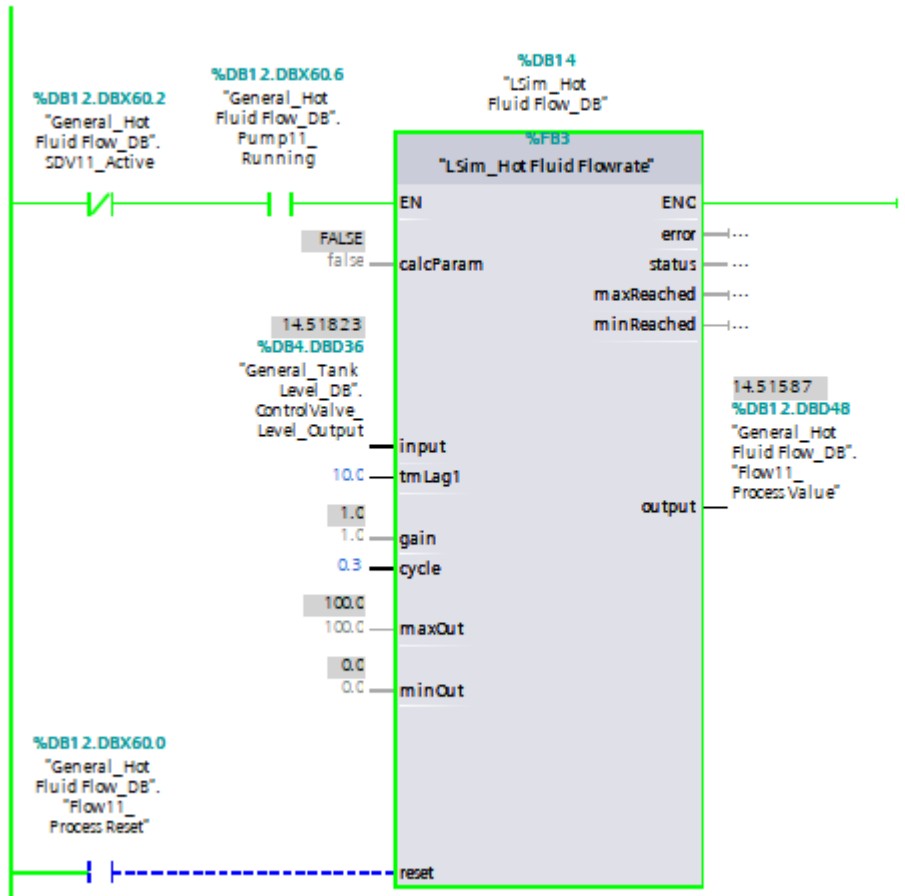
PID Algorithm for Controlling the Flowrate of the Hot Fluid





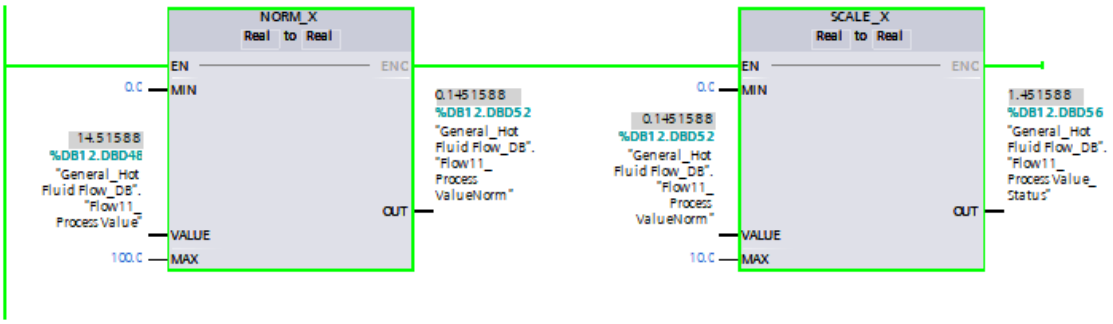
Network 3: Hot Fluid Process Control Block

Process for Flowrate as First Order System



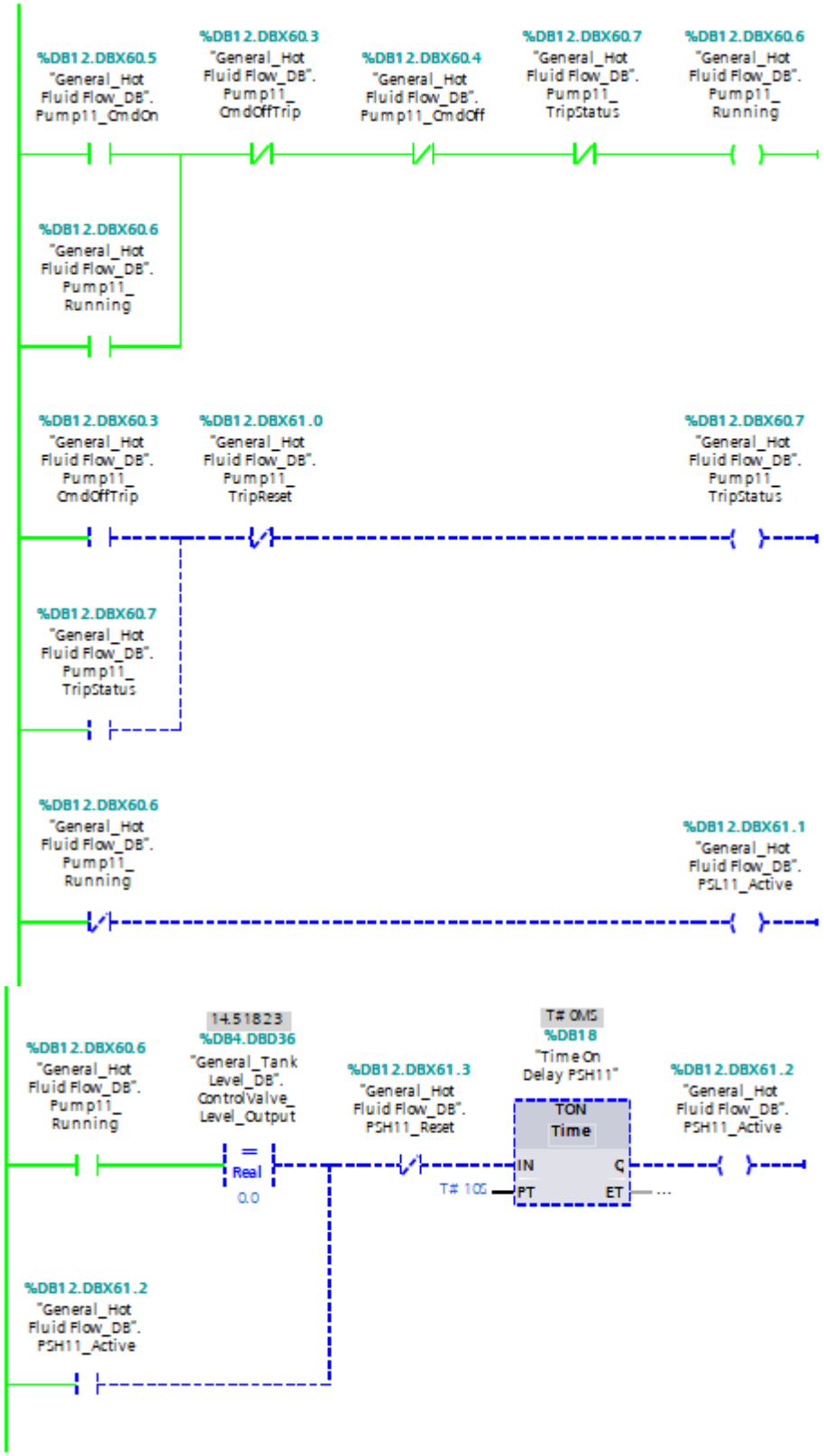
Network 4: Flowrate Process Conversion Control Block

Convert Process Flowrate from 0-100 % into 0-10 L/s



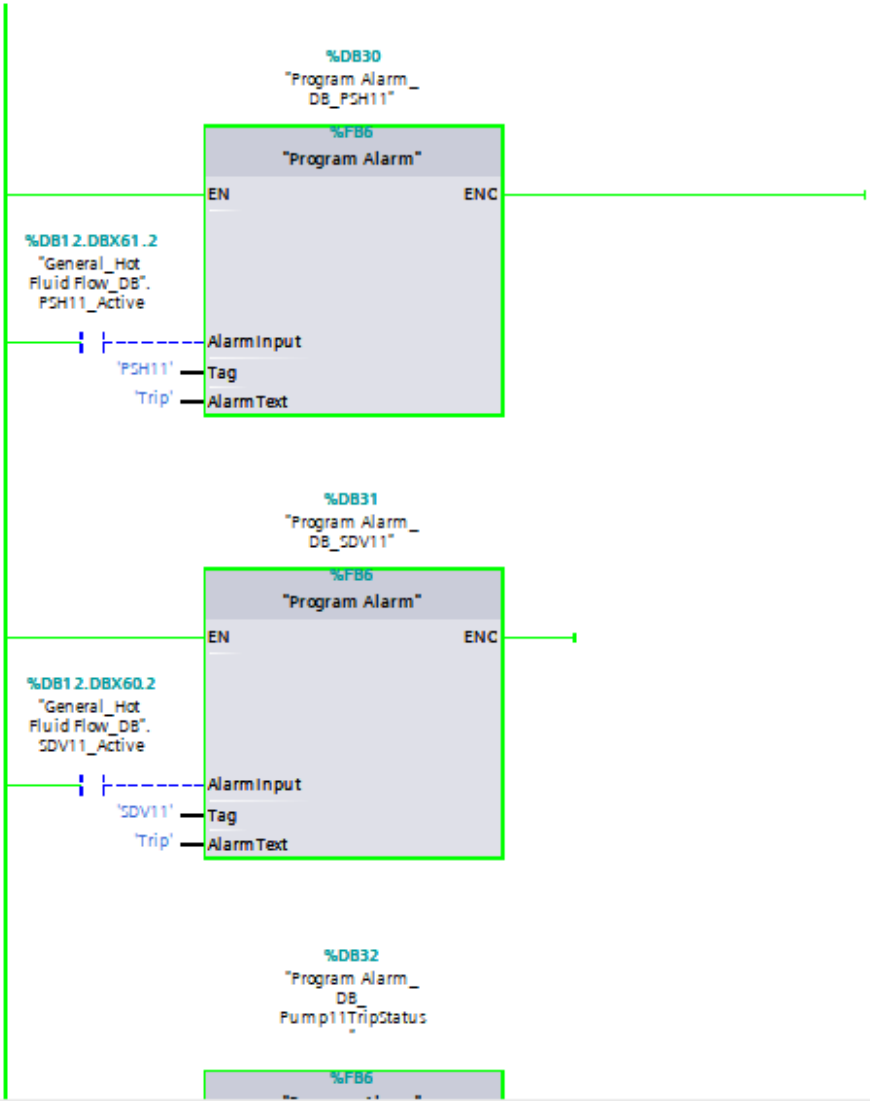
Network 5: Pump Operational Control Block

Block for Controlling On/Off of the Pump and It's Safety Operation



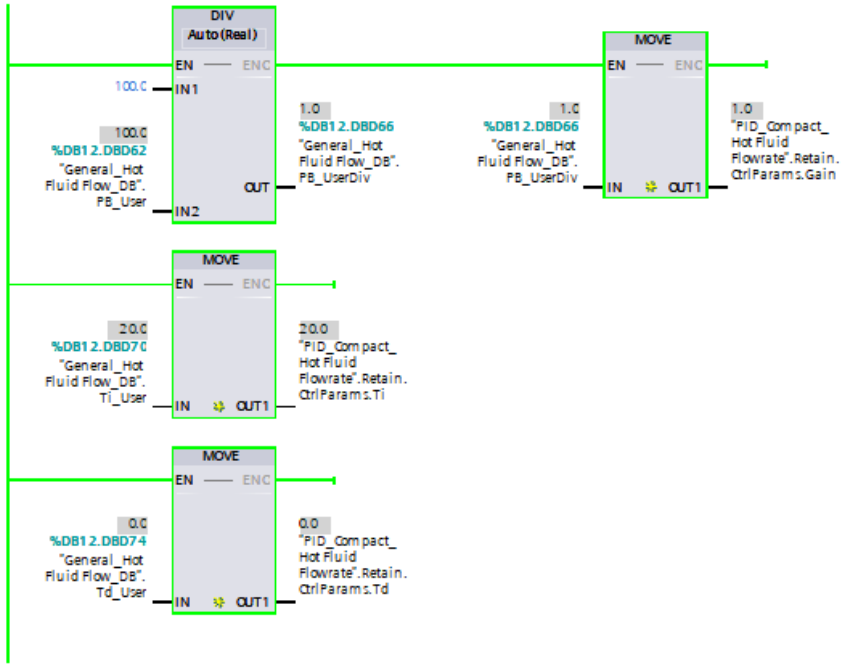
Network 6: Alarm Management Block

Control Block for Managing the Alarm Occured in the System



Network 7: User Additional Feature

Put additional feature that user can use to easier the system operation



General_Hot Fluid Flow_DB

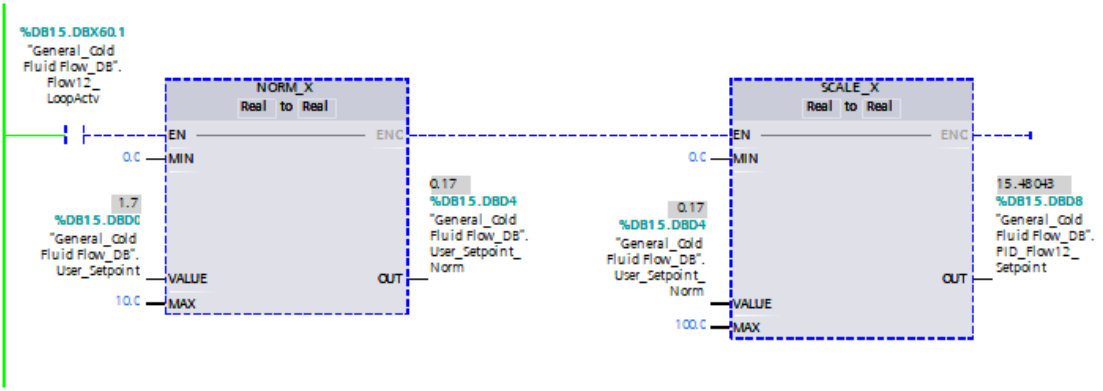
	Name	Data type	Offset	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint	Supervision	Comment
1	Static										
2	User_Setpoint	Real	0.0	2.5		☑	☑	☑	☑		Setpoint Input from User
3	User_Setpoint_Norm	Real	4.0	0.0		☑	☑	☑			Setpoint Input from User Normalized
4	PID_Flow11_Setpoint	Real	8.0	0.0		☑	☑	☑			Setpoint into PID Hot Fluid Flowrate
5	PID_Flow11_MV	Real	12.0	0.0		☑	☑	☑			Output of PIDHot Fluid Flowrate(Manipulating...
6	PID_Flow11_MVNorm	Real	16.0	0.0		☑	☑	☑			Output of PID Hot Fluid Flowrate(Manipulatin...
7	PID_Flow11_MVInt	Int	20.0	0		☑	☑	☑			Output of PID Hot Fluid Flowrate (Manipulatin...
8	PID_Flow11_ManualSlct	Bool	22.0	false		☑	☑	☑			Switch for Activate Manual Mode
9	PID_Flow11_InputMnl...	Real	24.0	0.0		☑	☑	☑			User Input Value for Manual MV
10	PID_Flow11_ErrorAck	Bool	28.0	false		☑	☑	☑			Acknowledged Button for Operator
11	PID_Flow11_PIDReset	Bool	28.1	false		☑	☑	☑			Reset Button for PID Compact
12	PID_Flow11_Modeslct...	Bool	28.2	true		☑	☑	☑			Activate Mode Selection for PID Operation
13	PID_Flow11_ModeVal...	Int	30.0	3		☑	☑	☑			Select Mode for PID Operation from 1-4
14	PID_Flow11_Alarm_S...	Bool	32.0	false		☑	☑	☑			Alarm from PID Hot Fluid Flowrate if Setpoint i...
15	PID_Flow11_Alarm_S...	Bool	32.1	false		☑	☑	☑			Alarm from PID Hot Fluid Flowrate if Setpoint i...
16	PID_Flow11_Alarm_P...	Bool	32.2	false		☑	☑	☑			Alarm from PID Hot Fluid Flowrate if Process V...
17	PID_Flow11_Alarm_P...	Bool	32.3	false		☑	☑	☑			Alarm from PID Hot Fluid Flowrate if Process V...
18	PID_Flow11_ModeSta...	Int	34.0	0		☑	☑	☑			Status Mode for PID Operation
19	PID_Flow11_ErrorStatus	Bool	36.0	false		☑	☑	☑			Error Flag if PID Block is Occured
20	PID_Flow11_ErrorBit	Real	38.0	0.0		☑	☑	☑			Error Code if PID Block is Occured
21	ControlValve_Flow11...	Real	42.0	0.0		☑	☑	☑			Output of Hot Fluid Flowrate Control Valve
22	ControlValve_Flow11...	Bool	46.0	false		☑	☑	☑			Product Hot Fluid Flowrate Control Valve Trav...
23	ControlValve_Flow11...	Bool	46.1	false		☑	☑	☑			Product Hot Fluid Flowrate Control Valve Trav...
24	Flow11_Process Value	Real	48.0	0.0		☑	☑	☑			Output from Hot Fluid Flowrate Process
25	Flow11_Process Value...	Real	52.0	0.0		☑	☑	☑			Output fromHot Fluid Flowrate Process Norm...
26	Flow11_Process Value...	Real	56.0	0.0		☑	☑	☑			Output Status from Hot Fluid Flowrate
27	Flow11_Process Reset	Bool	60.0	false		☑	☑	☑			Reset The Hot Fluid Flowrate Process
28	Flow11_LoopActv	Bool	60.1	true		☑	☑	☑			Command to activate Hot Fluid Control Loop ...
29	SDV11_Active	Bool	60.2	false		☑	☑	☑			Alarm : SDV11_Activate
30	Pump11_CmdOffTrip	Bool	60.3	false		☑	☑	☑			Turn Off the Pump1-1 as Alarm Activate
31	Pump11_CmdOff	Bool	60.4	false		☑	☑	☑			Turn off the Pump1-1
32	Pump11_CmdOn	Bool	60.5	false		☑	☑	☑			Turn On the Pump1-1
33	Pump11_Running	Bool	60.6	true		☑	☑	☑			Pump1-1 Running Status
34	Pump11_TripStatus	Bool	60.7	false		☑	☑	☑			Pump1-1 Trip Status
35	Pump11_TripReset	Bool	61.0	false		☑	☑	☑			Pump1-1 Trip Reset Command
36	PSL11_Active	Bool	61.1	false		☑	☑	☑			Alarm : PSL Activate
37	PSH11_Active	Bool	61.2	false		☑	☑	☑			Alarm : PSH Activate
38	PSH11_Reset	Bool	61.3	false		☑	☑	☑			Reset Command of PSH11
39	PB_User	Real	62.0	100.0		☑	☑	☑			User Input for Proportional Band
40	PB_UserDiv	Real	66.0	0.0		☑	☑	☑			User Input for Kp (Gain)
41	Ti_User	Real	70.0	20.0		☑	☑	☑			User Input for Integral Time
42	Td_User	Real	74.0	0.0		☑	☑	☑			User Input for Derivative Time

//Make sure to turn off optimization at the DB, so we can fill the offset address for easier addressing at OPC

D. Flow Indicating Controller 12 (FIC12) Function Block and Ladder

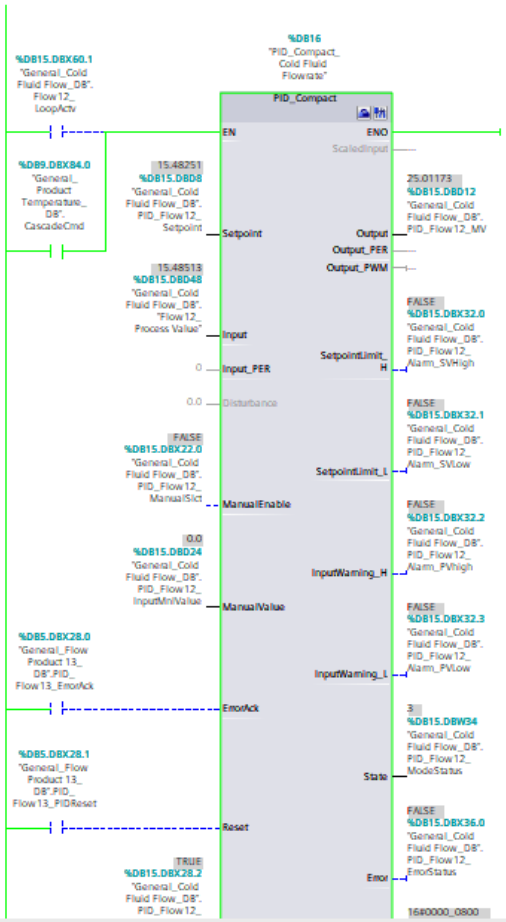
Network 1: User Setpoint

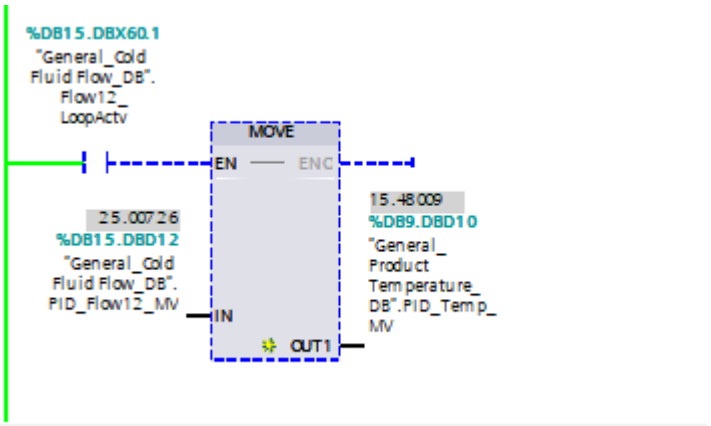
User input their Setpoint for flowrate in L/s converted into Real Number for PID Setpoint (0-100)

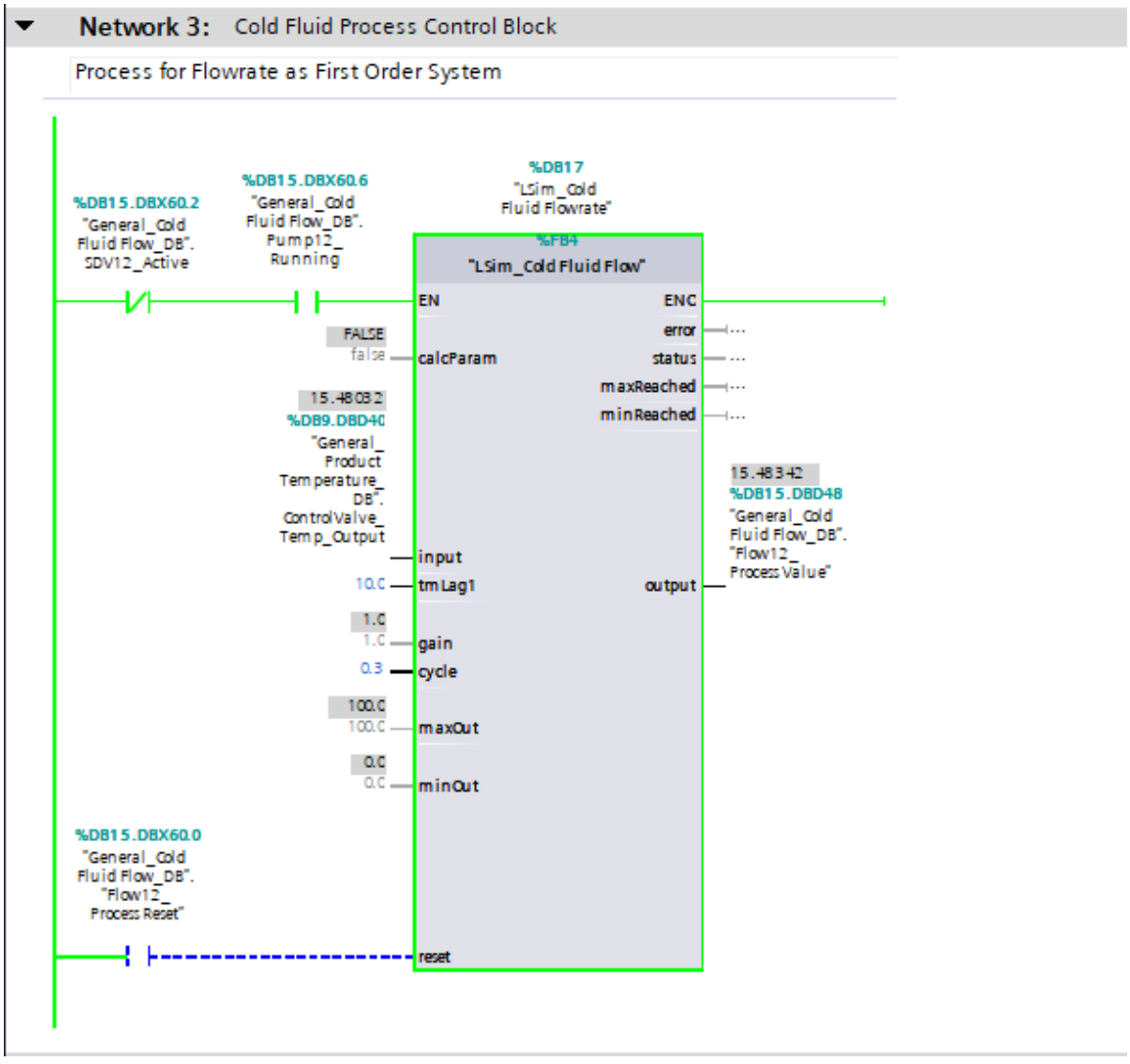


Network 2: Coldt Fluid Flow PID Compact Block

PID Algorithm for Controlling the Flowrate of the Cold Fluid

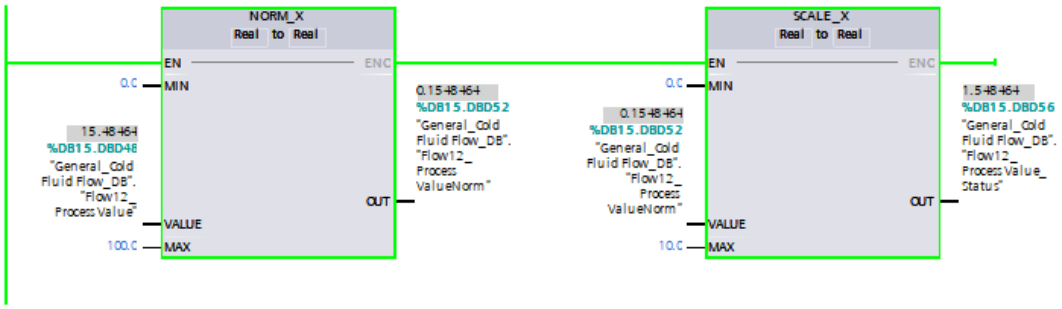



%DB15.DBX60.1
"General_Cold Fluid Flow_DB". Flow12_ LoopActv
MOVE
EN
ENO
25.00726
%DB15.DBD12
"General_Cold Fluid Flow_DB". PID_Flow12_MV
IN
OUT1
15.48009
%DB9.DBD10
"General_ Product Temperature_ DB".PID_Temp_ MV


Network 3: Cold Fluid Process Control Block
Process for Flowrate as First Order System
%DB15.DBX60.2
"General_Cold Fluid Flow_DB". SDV12_Active
%DB15.DBX60.6
"General_Cold Fluid Flow_DB". Pump12_ Running
%DB17
"LSim_Cold Fluid Flowrate"
%FB4
"LSim_Cold Fluid Flow"
EN
ENO
FALSE
false
calcParam
error
status
maxReached
minReached
15.48032
%DB9.DBD40
"General_ Product Temperature_ DB". ControlValve_ Temp_Output
input
10.0
tmLag1
output
15.48342
%DB15.DBD48
"General_Cold Fluid Flow_DB". "Flow12_ Process Value"
1.0
1.0
gain
0.3
cycle
100.0
100.0
maxOut
0.0
0.0
minOut
%DB15.DBX60.0
"General_Cold Fluid Flow_DB". "Flow12_ Process Reset"
reset

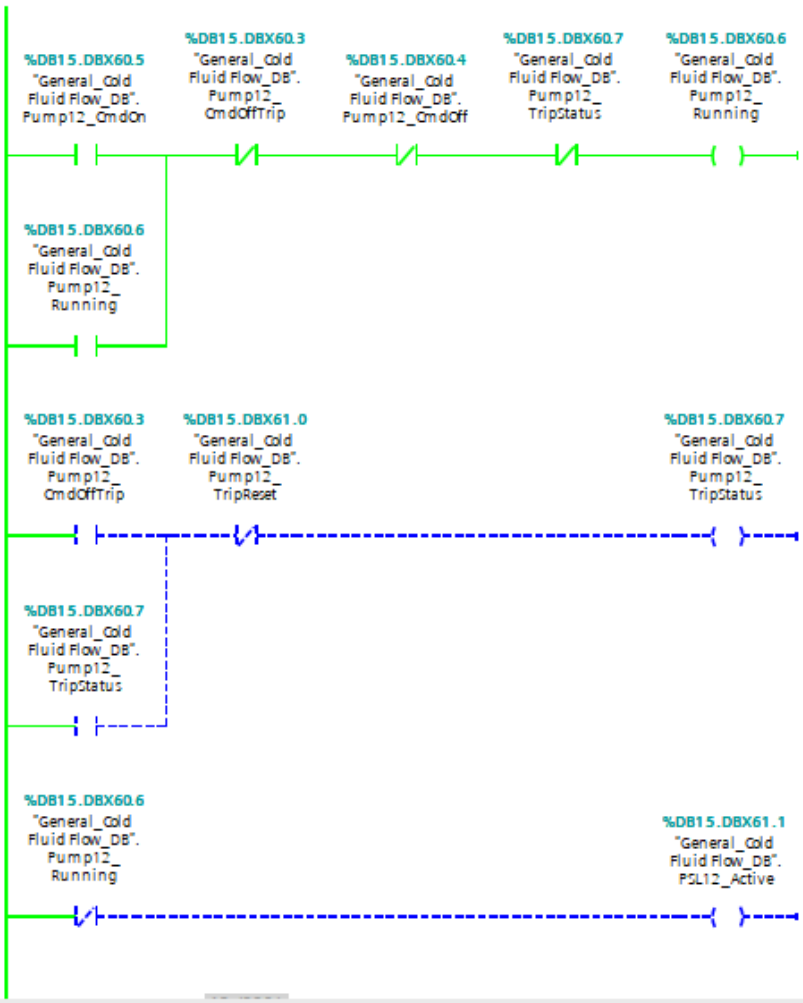
Network 4: Flowrate Process Conversion Control Block

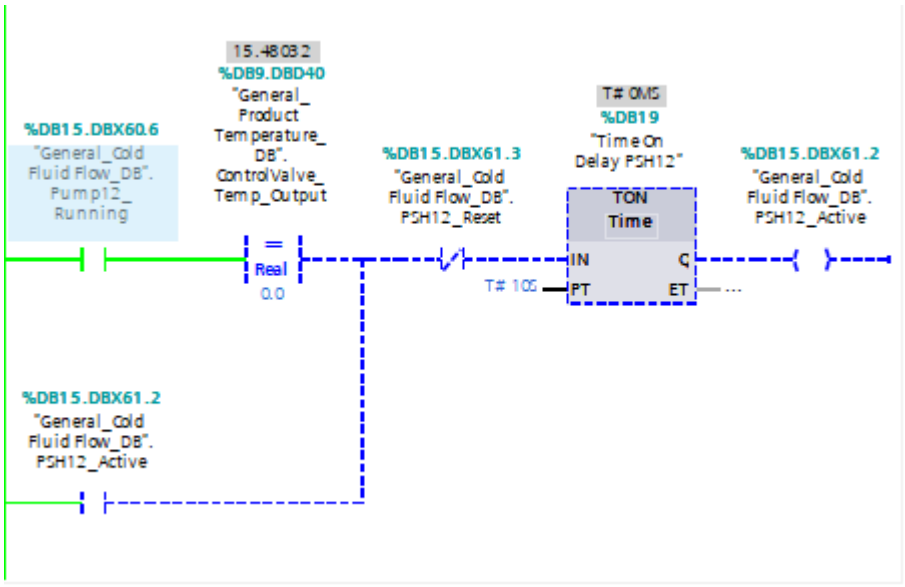
Convert Process Flowrate from 0-100 % into 0-10 L/s



Network 5: Pump Operational Control Block

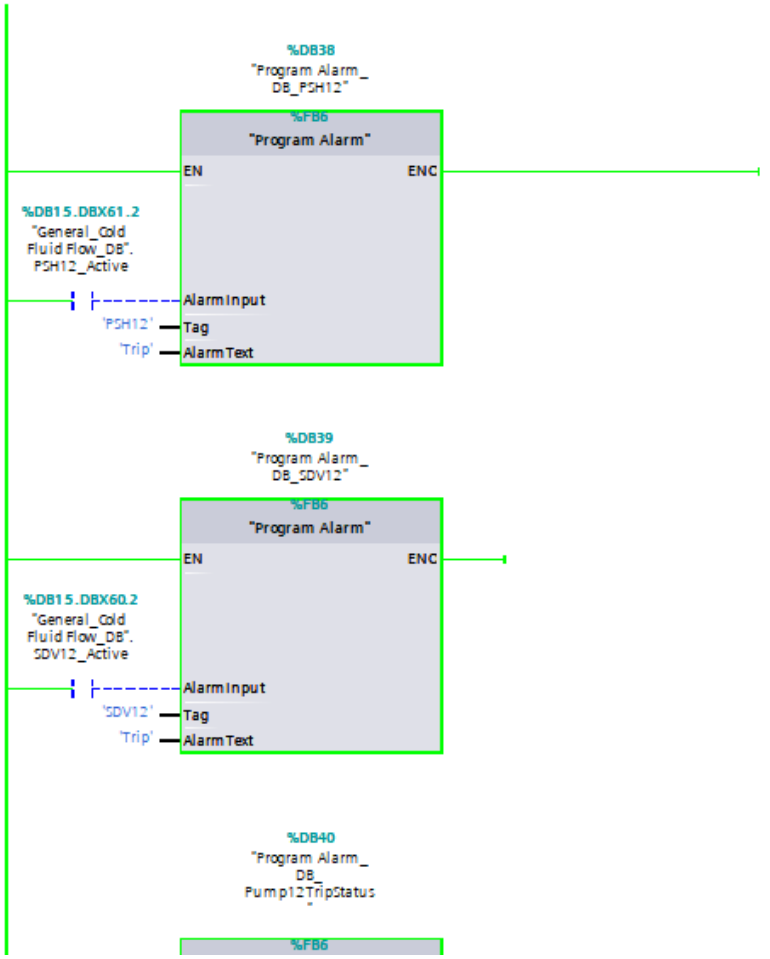
Block for Controlling On/Off of the Pump and It's Safety Operation

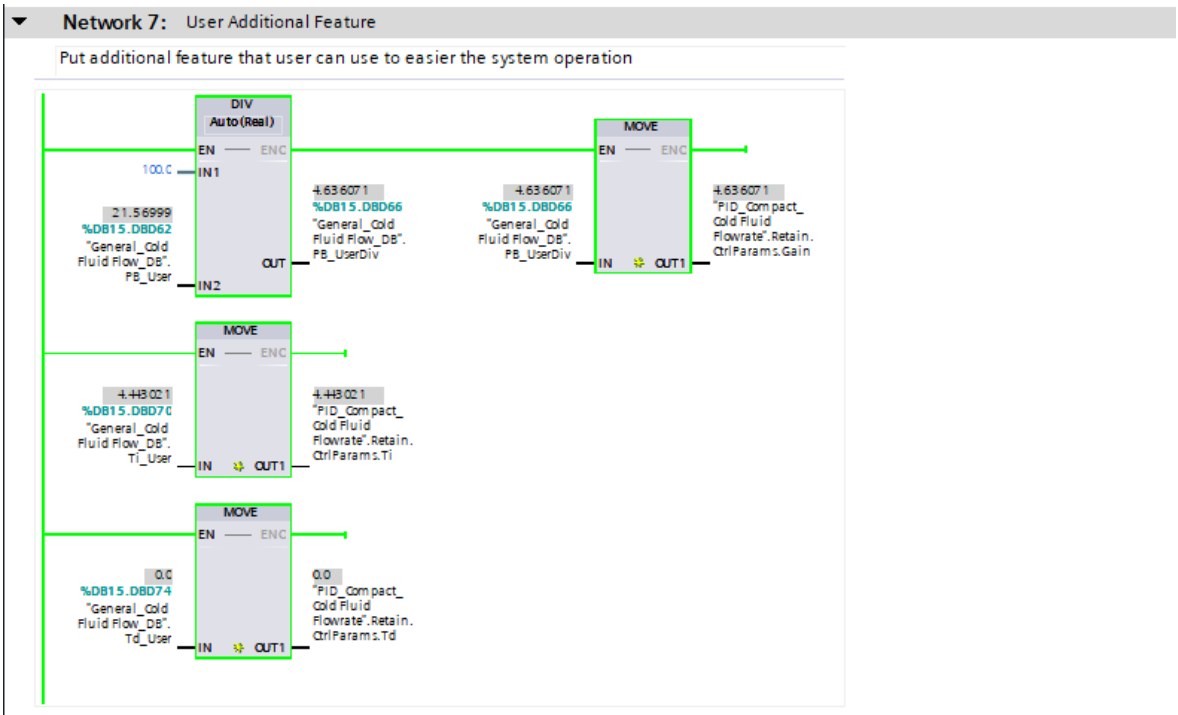




Network 6: Alarm Management Block

Control Block for Managing the Alarm Occured in the System





General_Cold Fluid Flow_DB

	Name	Data type	Offset	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint	Supervision	Comment
1	Static										
2	User_Setpoint	Real	0.0	1.7		☑	☑	☑	☑		Setpoint Input from User
3	User_Setpoint_Norm	Real	4.0	0.0		☑	☑	☑			Setpoint Input from User Normalized
4	PID_Flow12_Setpoint	Real	8.0	0.0		☑	☑	☑			Setpoint into PID Cold Fluid Flowrate
5	PID_Flow12_MV	Real	12.0	0.0		☑	☑	☑			Output of PID Cold Fluid Flowrate(Manipulati...
6	PID_Flow12_MVNorm	Real	16.0	0.0		☑	☑	☑			Output of PID Cold Fluid Flowrate(Manipulati...
7	PID_Flow12_MVInt	Int	20.0	0		☑	☑	☑			Output of PID Cold Fluid Flowrate (Manipulati...
8	PID_Flow12_ManualSlct	Bool	22.0	false		☑	☑	☑			Switch for Activate Manual Mode
9	PID_Flow12_InputMnl...	Real	24.0	0.0		☑	☑	☑			User Input Value for Manual MV
10	PID_Flow12_ErrorAck	Bool	28.0	false		☑	☑	☑			Acknowledged Button for Operator
11	PID_Flow12_PIDReset	Bool	28.1	false		☑	☑	☑			Reset Button for PID Compact
12	PID_Flow12_ModeSlct...	Bool	28.2	true		☑	☑	☑			Activate Mode Selection for PID Operation
13	PID_Flow12_ModeVal...	Int	30.0	3		☑	☑	☑			Select Mode for PID Operation from 1-4
14	PID_Flow12_Alarm_S...	Bool	32.0	false		☑	☑	☑			Alarm from PID Cold Fluid Flowrate if Setpoint...
15	PID_Flow12_Alarm_S...	Bool	32.1	false		☑	☑	☑			Alarm from PID Cold Fluid Flowrate if Setpoint...
16	PID_Flow12_Alarm_P...	Bool	32.2	false		☑	☑	☑			Alarm from PID ColdFluid Flowrate if Process ...
17	PID_Flow12_Alarm_P...	Bool	32.3	false		☑	☑	☑			Alarm from PID Cold Fluid Flowrate if Process ...
18	PID_Flow12_ModeSta...	Int	34.0	0		☑	☑	☑			Status Mode for PID Operation
19	PID_Flow12_ErrorStatus	Bool	36.0	false		☑	☑	☑			Error Flag if PID Block is Occured
20	PID_Flow12_ErrorBit	Real	38.0	0.0		☑	☑	☑			Error Code if PID Block is Occured
21	ControlValve_Flow12...	Real	42.0	0.0		☑	☑	☑			Output of Cold Fluid Flowrate Control Valve
22	ControlValve_Flow12...	Bool	46.0	false		☑	☑	☑			Product Cold Fluid Flowrate Control Valve Tra...
23	ControlValve_Flow12...	Bool	46.1	false		☑	☑	☑			Product Cold Fluid Flowrate Control Valve Tra...
24	Flow12_Process Value	Real	48.0	0.0		☑	☑	☑			Output from Cold Fluid Flowrate Process
25	Flow12_Process Value...	Real	52.0	0.0		☑	☑	☑			Output from Cold Fluid Flowrate Process Nor...
26	Flow12_Process Value...	Real	56.0	0.0		☑	☑	☑			Output Status from Cold Fluid Flowrate
27	Flow12_Process Reset	Bool	60.0	false		☑	☑	☑			Reset The Cold Fluid Flowrate Process
28	Flow12_LoopActv	Bool	60.1	true		☑	☑	☑			Activate the Cold Fluid Control Loop Only
29	SDV12_Active	Bool	60.2	false		☑	☑	☑			Alarm : SDV12 activate
30	Pump12_CmdOffTrip	Bool	60.3	false		☑	☑	☑			Turn Off the Pump1-2 as Alarm Occured
31	Pump12_CmdOff	Bool	60.4	false		☑	☑	☑			Turn off the Pump1-2
32	Pump12_CmdOn	Bool	60.5	false		☑	☑	☑			Turn On the Pump1-2
33	Pump12_Running	Bool	60.6	true		☑	☑	☑			Pump1-2 Running Status
34	Pump12_TripStatus	Bool	60.7	false		☑	☑	☑			Pump1-2 Trip Status
35	Pump12_TripReset	Bool	61.0	false		☑	☑	☑			Pump1-2 Trip Reset Command
36	PSL12_Active	Bool	61.1	false		☑	☑	☑			Alarm : PSL Activate
37	PSH12_Active	Bool	61.2	false		☑	☑	☑			Alarm : PSH Activate
38	PSH12_Reset	Bool	61.3	false		☑	☑	☑			Reset Command of PSH12
39	PB_User	Real	62.0	21.56999		☑	☑	☑			User Input for Proportional Band
40	PB_UserDiv	Real	66.0	0.0		☑	☑	☑			User Input for Kp (Gain)
41	Ti_User	Real	70.0	4.443021		☑	☑	☑			User Input for Integral Time
42	Td_User	Real	74.0	0.0		☑	☑	☑			User Input for Derivative Time

//Make sure to turn off optimization at the DB, so we can fill the offset address for easier addressing at OPC

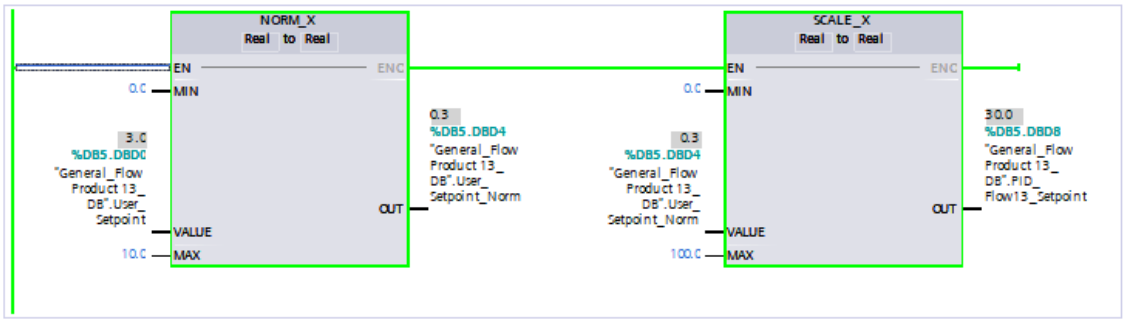
E. Flow Indicating Controller 13 (FIC13) Function Block and Ladder

Block title: Flow Indicator Controller 13 (Product)

Ladder and Block Program to control flowrate of Product (Tank Output)

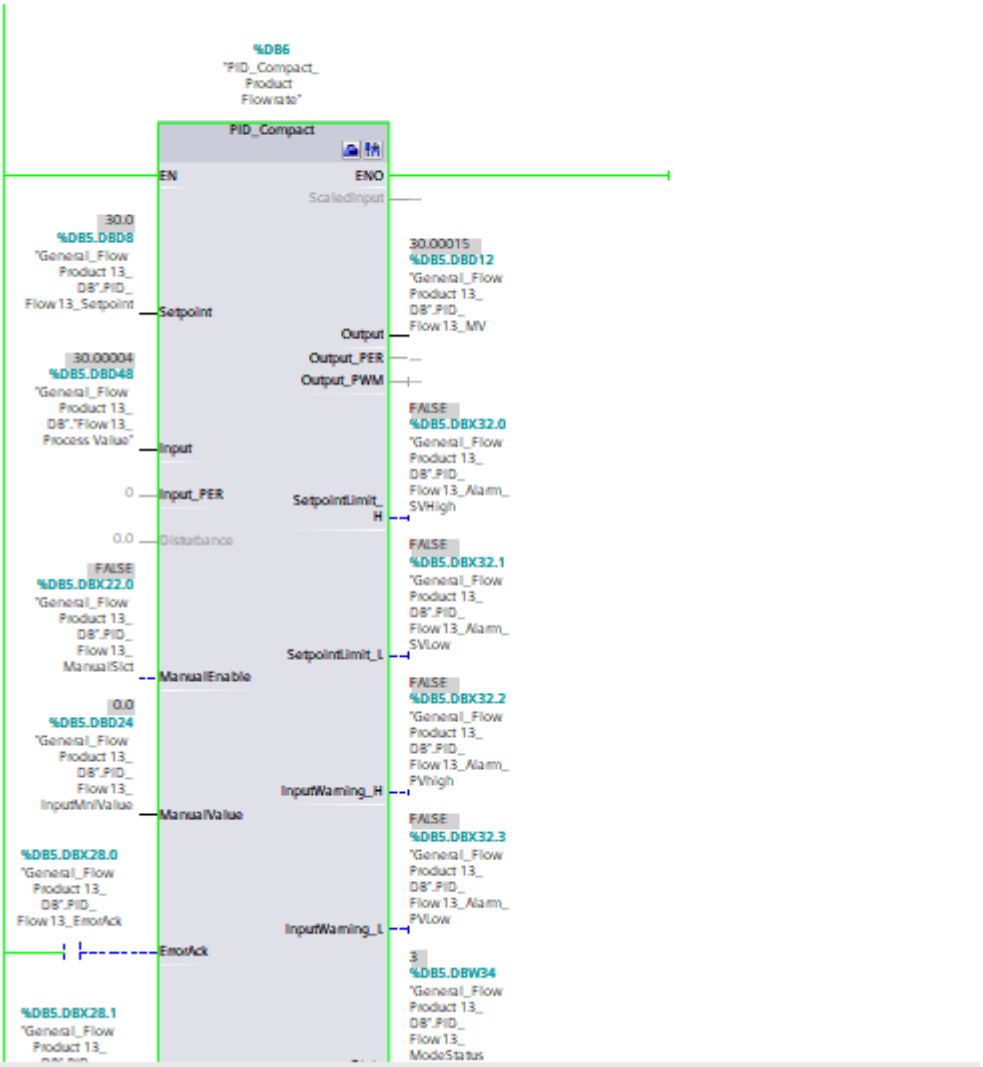
Network 1: User Setpoint

User input their Setpoint for flowrate in L/s converted into Real Number for PID Setpoint (0-100)



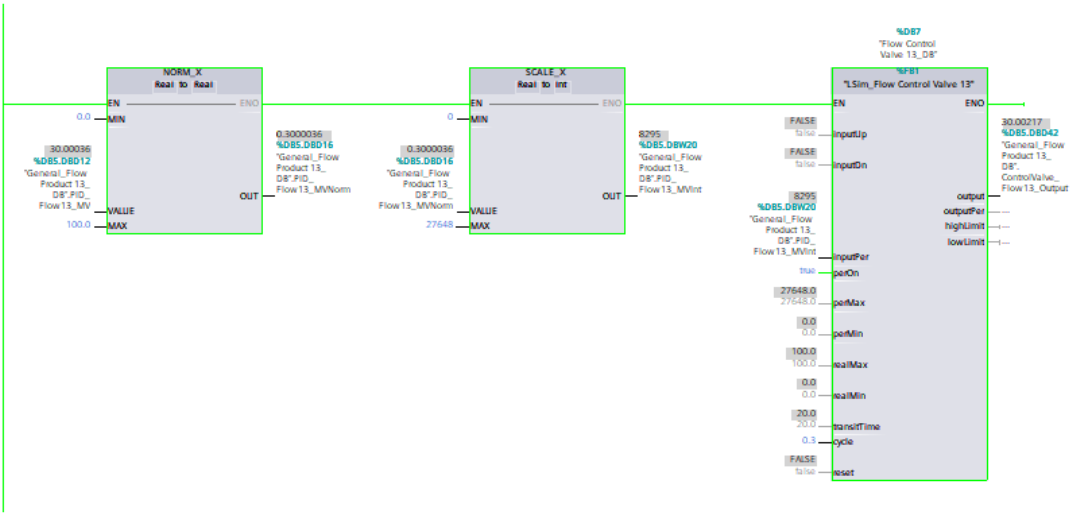
Network 2: Product Flow PID Compact Block

PID Algorithm for Controlling the Flowrate of the Product



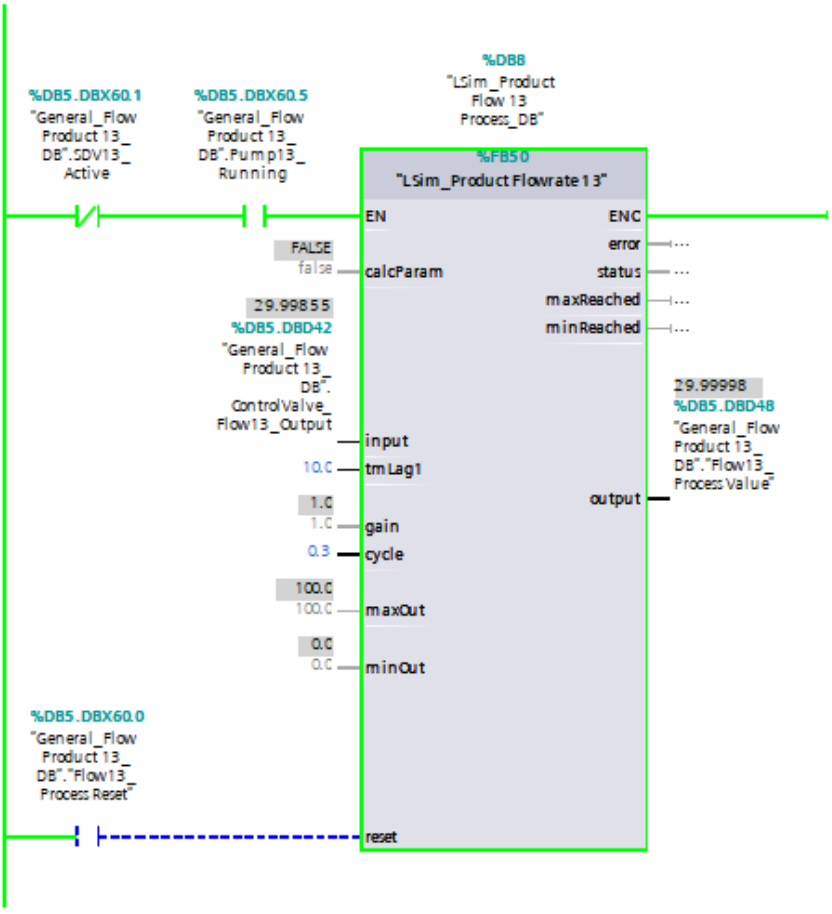
Network 3: Flow Control Valve 13 Control Block

Control Valve Process to Control the Product Flowrate



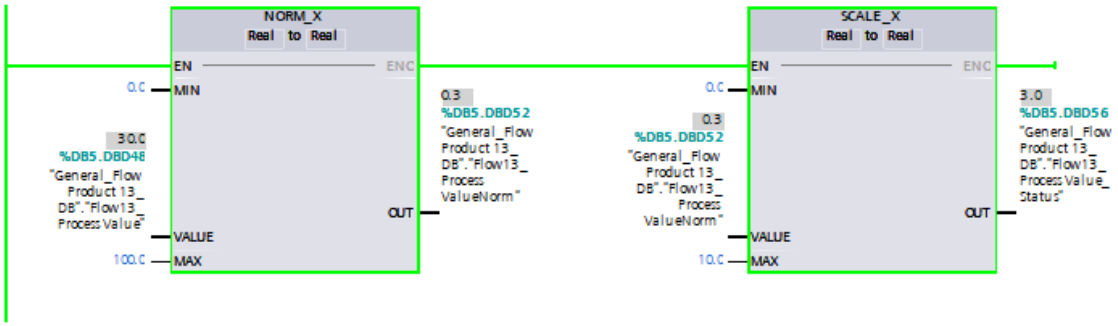
Network 4: Product Flow 13 Process Control Block

Process for Flowrate as First Order System



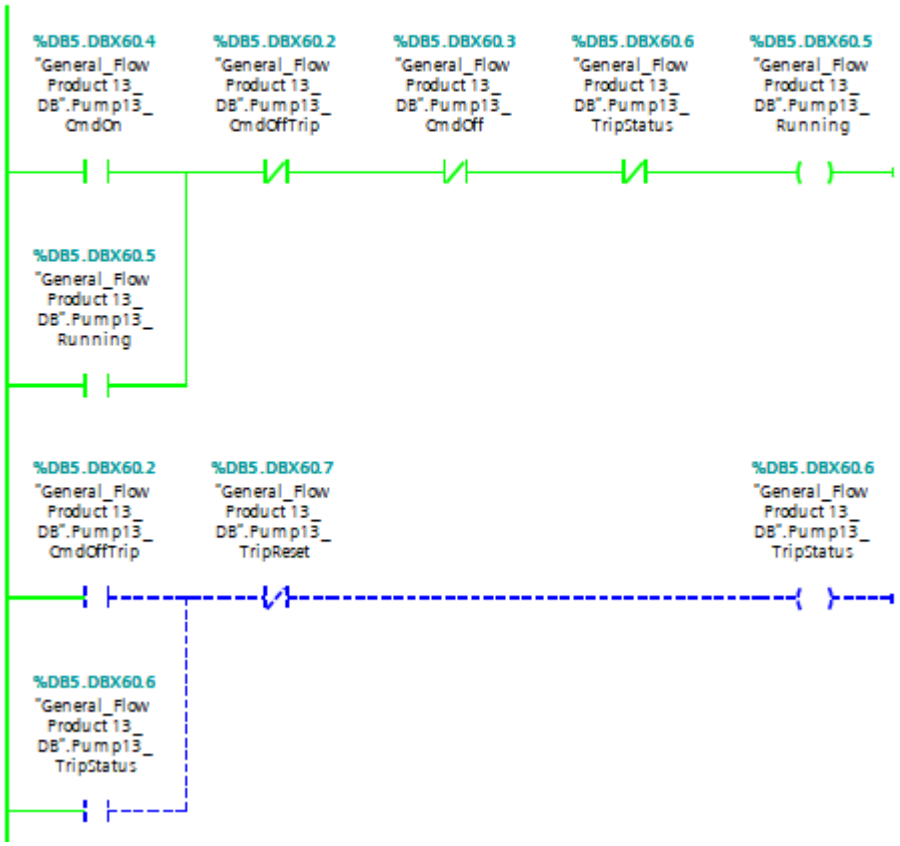
Network 5: Flowrate Process Conversion Control Block

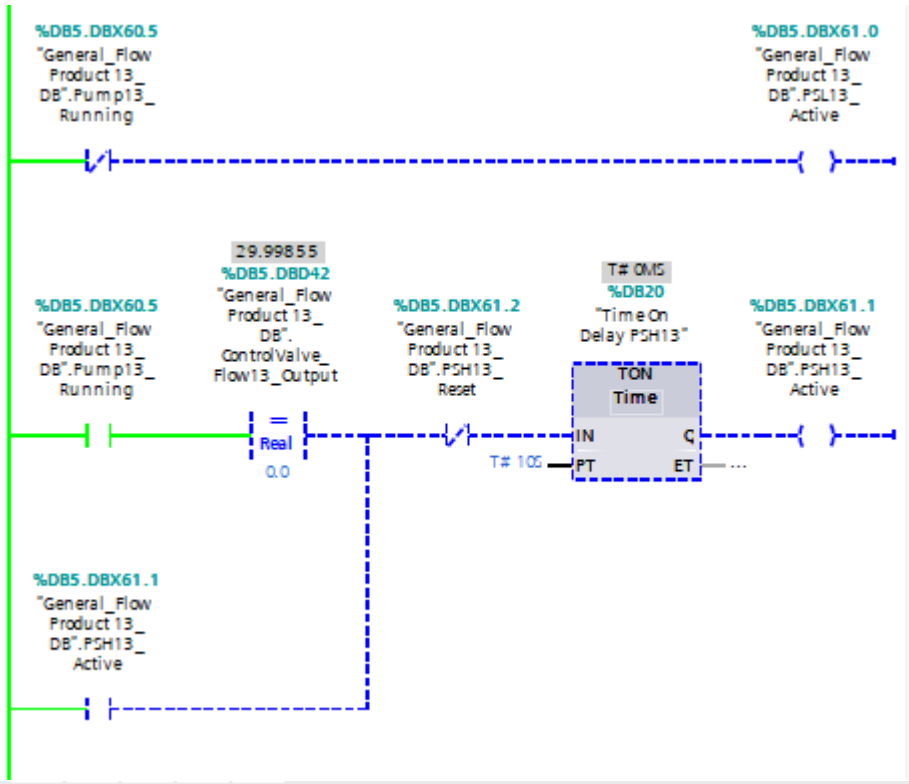
Convert Process Flowrate from 0-100 % into 0-10 L/s



Network 6: Pump Operational Control Block

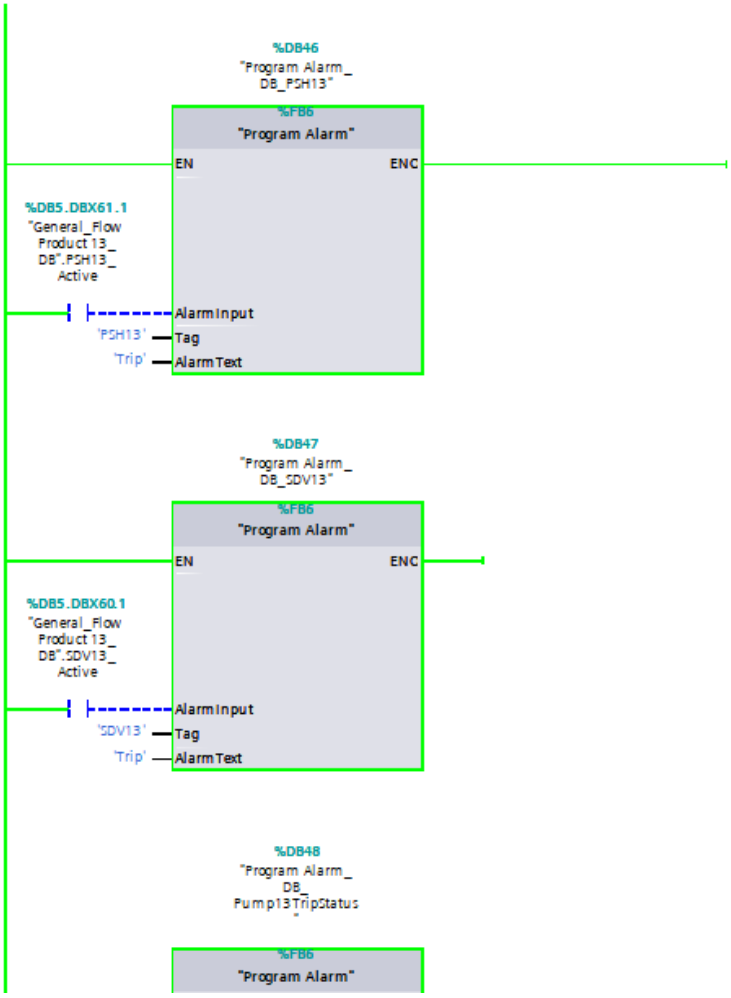
Block for Controlling On/Off of the Pump and It's Safety Operation

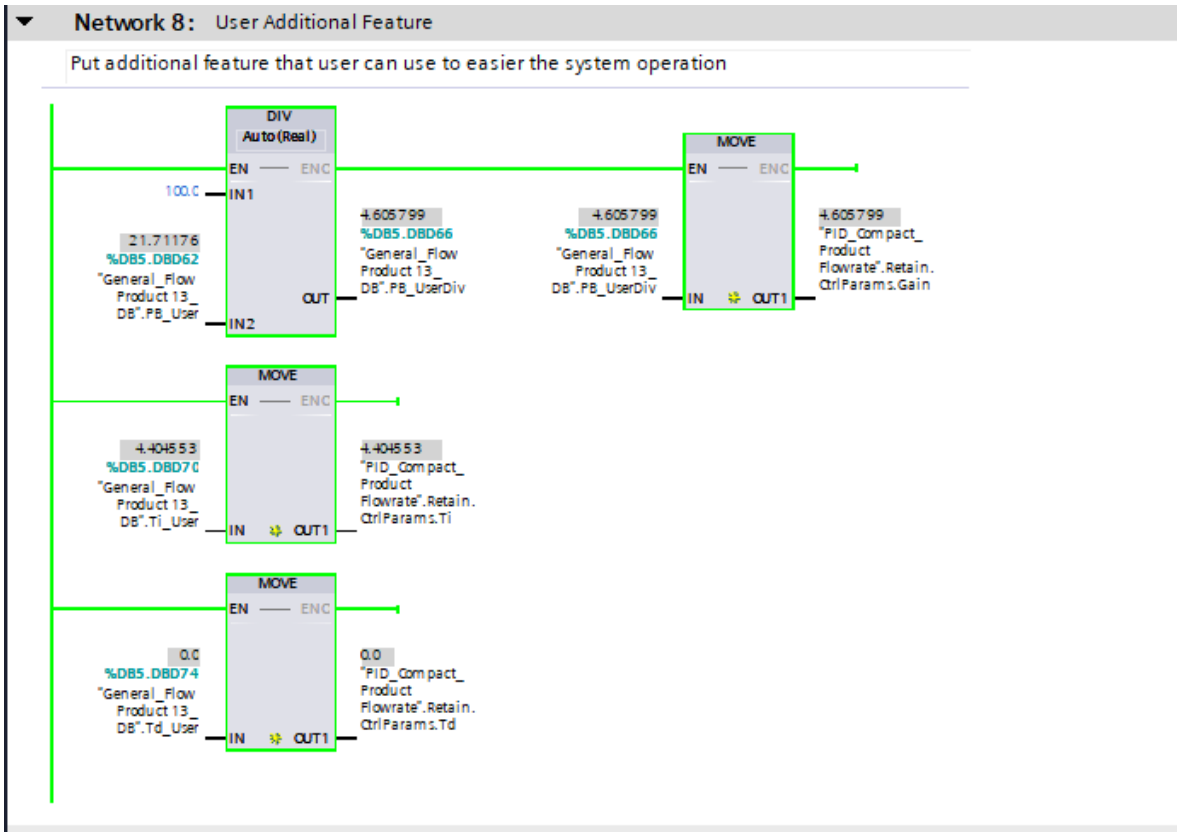




Network 7: Alarm Management Block

Control Block for Managing the Alarm Occured in the System





General_Flow Product 13_DB

	Name	Data type	Offset	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint	Supervision	Comment
1	Static										
2	User_Setpoint	Real	0.0	2.0							Setpoint Input from User
3	User_Setpoint_Norm	Real	4.0	0.0							Setpoint Input from User Normalized
4	PID_Flow13_Setpoint	Real	8.0	0.0							Setpoint into PID Product Flowrate 13
5	PID_Flow13_MV	Real	12.0	0.0							Output of PID Product Flowrate 13(Manipulati...
6	PID_Flow13_MVNorm	Real	16.0	0.0							Output of PID Product Flowrate 13(Manipulati...
7	PID_Flow13_MVInt	Int	20.0	0							Output of PID Product Flowrate 13 (Manipulat...
8	PID_Flow13_ManualSlct	Bool	22.0	false							Switch for Activate Manual Mode
9	PID_Flow13_InputMnl...	Real	24.0	0.0							User Input Value for Manual MV
10	PID_Flow13_ErrorAck	Bool	28.0	false							Acknowledged Button for Operator
11	PID_Flow13_PIDReset	Bool	28.1	false							Reset Button for PID Compact
12	PID_Flow13_ModeSlct...	Bool	28.2	true							Activate Mode Selection for PID Operation
13	PID_Flow13_ModeVal...	Int	30.0	3							Select Mode for PID Operation from 1-4
14	PID_Flow13_Alarm_S...	Bool	32.0	false							Alarm from PID Product Flowrate 13 if Setpoin...
15	PID_Flow13_Alarm_S...	Bool	32.1	false							Alarm from PID Product Flowrate 13 if Setpoin...
16	PID_Flow13_Alarm_P...	Bool	32.2	false							Alarm from PID Product Flowrate 13 if Process...
17	PID_Flow13_Alarm_P...	Bool	32.3	false							Alarm from PID Product Flowrate 13 if Process...
18	PID_Flow13_ModeSta...	Int	34.0	0							Status Mode for PID Operation
19	PID_Flow13_ErrorStatus	Bool	36.0	false							Error Flag if PID Block is Occured
20	PID_Flow13_ErrorBit	Real	38.0	0.0							Error Code if PID Block is Occured
21	ControlValve_Flow13...	Real	42.0	0.0							Output of Product Flowrate 13 Control Valve
22	ControlValve_Flow13...	Bool	46.0	false							Product Flowrate 13 Control Valve Travel Max
23	ControlValve_Flow13...	Bool	46.1	false							Product Flowrate 13 Control Valve Travel Min
24	Flow13_Process Value	Real	48.0	0.0							Output from Product Flowrate 13 Process
25	Flow13_Process Value...	Real	52.0	0.0							Output fromProduct Flowrate 13 Process Nor...
26	Flow13_Process Value...	Real	56.0	0.0							Output Status from Product Flowrate
27	Flow13_Process Reset	Bool	60.0	false							Reset The Product Flowrate 13Process
28	SDV13_Active	Bool	60.1	false							Alarm : SDV13 Activate
29	Pump13_CmdOffTrip	Bool	60.2	false							Turn off the Pump1-3 as Alarm Occured
30	Pump13_CmdOff	Bool	60.3	false							Turn off the Pump1-3
31	Pump13_CmdOn	Bool	60.4	false							Turn On the Pump1-3
32	Pump13_Running	Bool	60.5	true							Pump1-3 Running Status
33	Pump13_TripStatus	Bool	60.6	false							Pump1-3 Trip Status
34	Pump13_TripReset	Bool	60.7	false							Pump1-3 Trip Reset Command
35	PSL13_Active	Bool	61.0	false							Alarm : PSL Activate
36	PSH13_Active	Bool	61.1	false							Alarm : PSH Activate
37	PSH13_Reset	Bool	61.2	false							Reset Command of PSH13
38	PB_User	Real	62.0	21.71176							User Input for Proportional Band
39	PB_UserDiv	Real	66.0	0.0							User Input for Kp (Gain)
40	Ti_User	Real	70.0	4.404553							User Input for Integral Time
41	Td_User	Real	74.0	0.0							User Input for Derivative Time

//Make sure to turn off optimization at the DB, so we can fill the offset address for easier addressing at OPC

//PID Block need to be commissioned first in their Commissioning menu, before it can work.

//Make sure you already import / open the LSIM Library from Siemens. I'll try to attached it in this project. Otherwise, you can download it from Siemens Website for free

//Alarm Management Block is optional if you want to develop it or not

5- Operation & Control Narative

After doing the soft commissioning of the system, the System will always be booting the Process Value from 0. So, it will cause the Level Low Alarm Trip early and system can't boot.

That's why we turn off the Feedback system at start, and using Flow Control system both at Input and Output Instead.

1. When Controller Start, monitor the Tank Level minimum until 10%

2. After that, Turn Off the Flow Loop Command both at Level Control and Temperature Control.

3. So the system with condition:
   - Hot Fluid Flowrate : 2,5 L/s
   - Cold Fluid Flowrate : 1,7 L/s
   - Product Flowrate : 2 L/s

We already input the PID Parameter in Soft Commissioning, but if you have better parameter, please do it by yourself 😊

Also, if you want to change the Process Value, please to change to cascade for more robust control after the control bump is finished.

Also, feedforward mode only can be activated if cascade control is active, because the control bump is very high when feedforward is active.

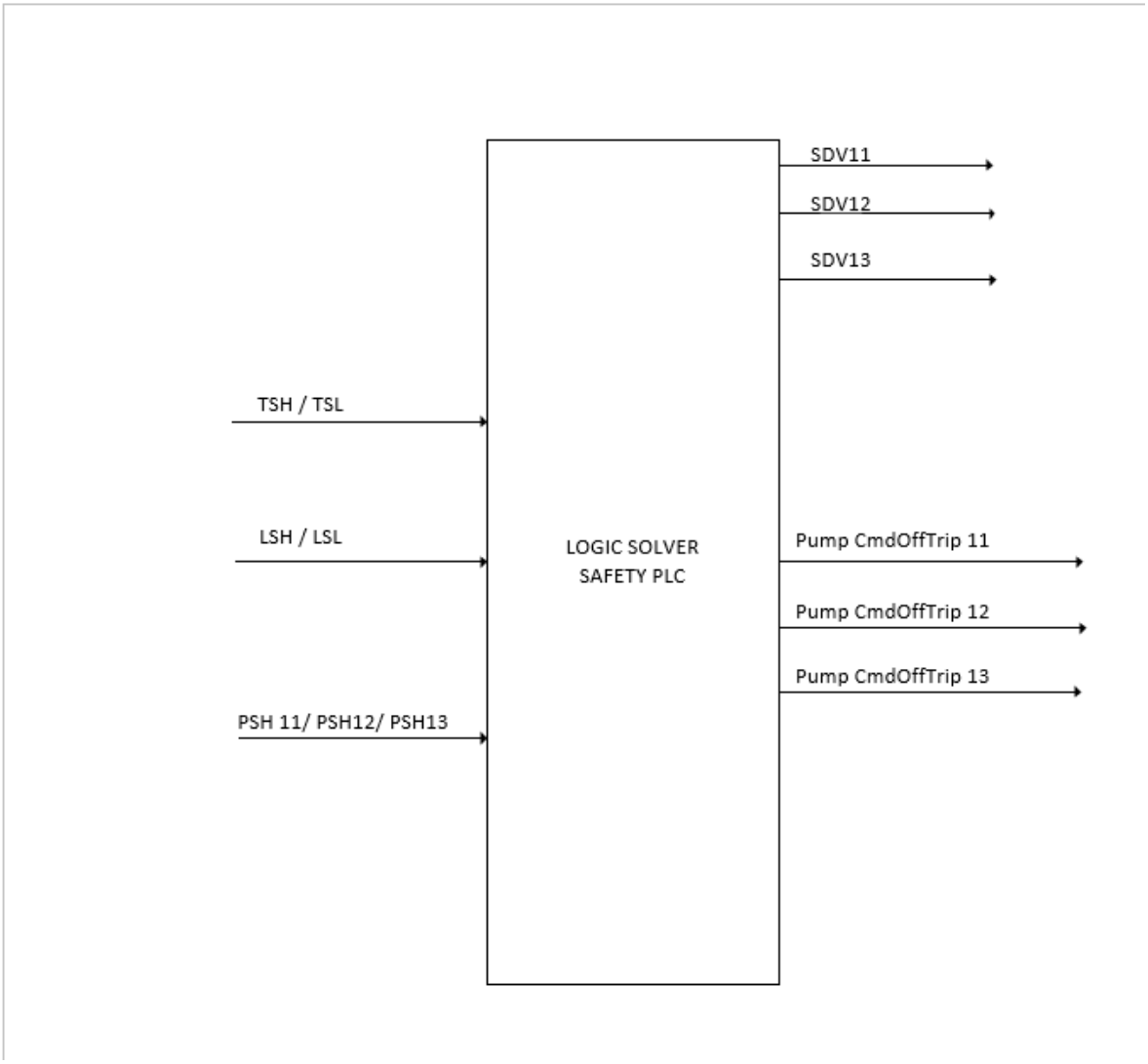
6- Safety Control Narrative

Safety Automation need to be considered after the basic control system scheme already established. The safety hazard in this system need to be defined first :

Equipment	Potential Hazard	Action Taken
Product Temperature	High Temperature	Maximize Cold Water Flow
		Minimize Hot Water Flow
	Low Temperature	Minimize Cold Water Flow
		Maximize Hot Water

		Flow
Atmospheric Tank	Overspill	Turn Off Cold Water Flow
		Turn Off Hot Water Flow
		Maximize Product Flowrate
	Under level	Maximize Hot Water Flow
		Turn Off Product Water Flow
Pipeline	High Pressure	Turn Off flowrate in pipeline
		Turn Off Pump

After Hazard analysis is defined, then the logic block diagram is needed to make a simple algorithm how the safety system works.



After the logic diagram had been made, it clearly shows what equipment and

device that need to be operated. The details can be tabulated in the SAFE Chart to be more precise.

Link to SAFE Chart
// For Github, refer to the repository itself

We try to just shutdown all the whole plant system if any of the safety system is turned on. The safety system scale is defined :

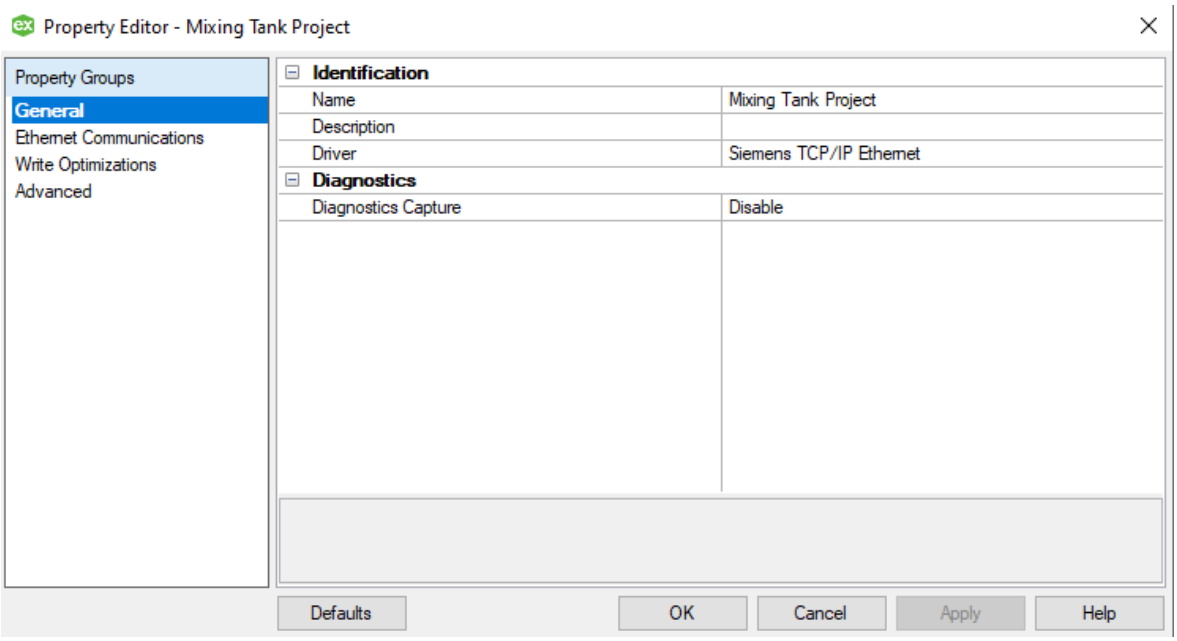
Hazard Status	Hazard Range	Delay Activation
Level High Trip	>= 95%	10 sec
Level High Warning	80-95%	-
Level Low Trip	<5 %	10 sec
Level Low Warning	5-20 %	-
Temp High Trip	> 85°C	10 sec
Temp High Warning	70-85 °C	-
Temp Low Trip	<= 20 °C	10 sec
Temp Low Warning	20-30 °C	-

Also, PSH Alarm would be occurred if the pump is on but the control valve in OFF Position for 10 sec.

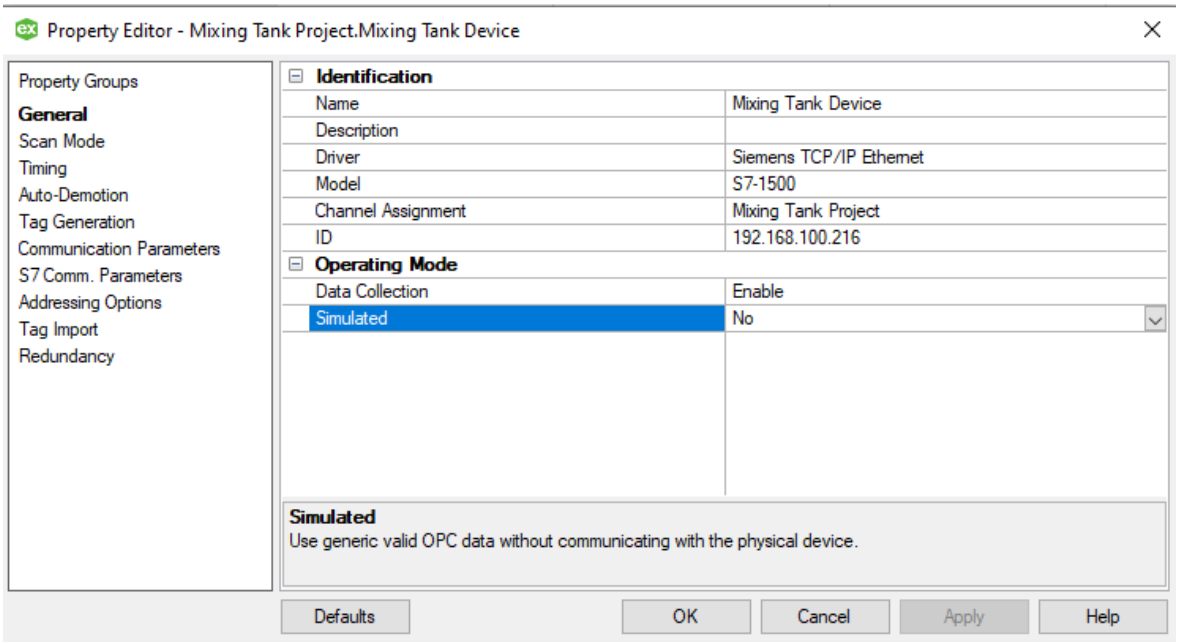
For information, the device used for safety is already following the recommendation practice from API RP14 C Safety system for offshore production, 6 ed.

7- Server Configuration

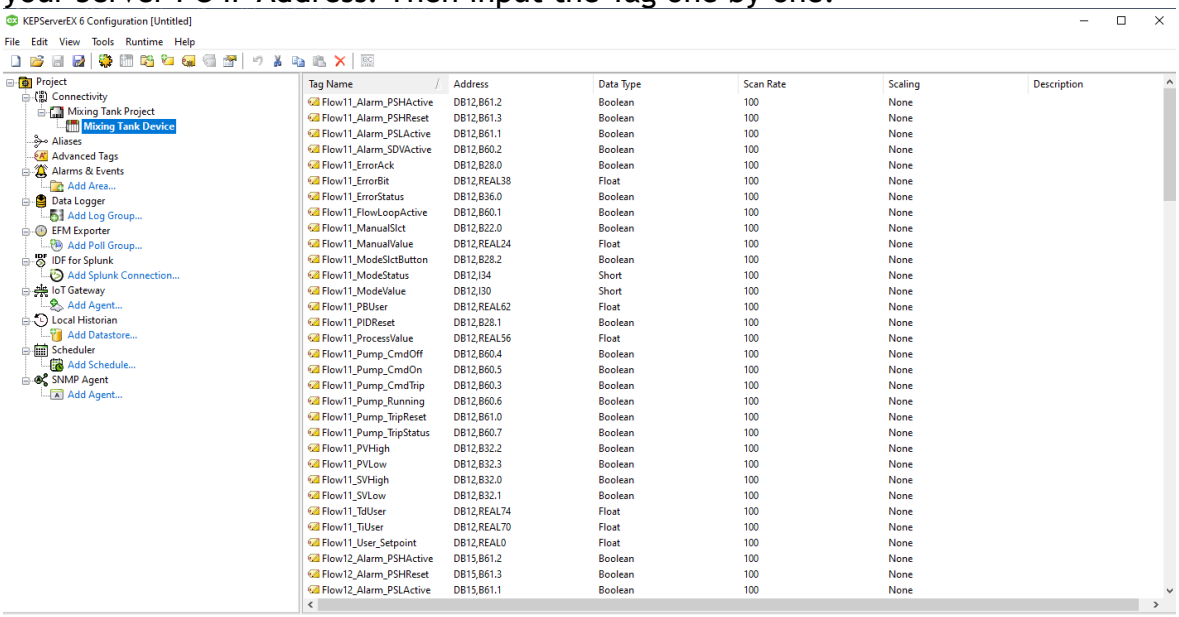
Server used is using KepserverEX 6. For using it, you need to configure the Project at Connectivity tabs as shown:

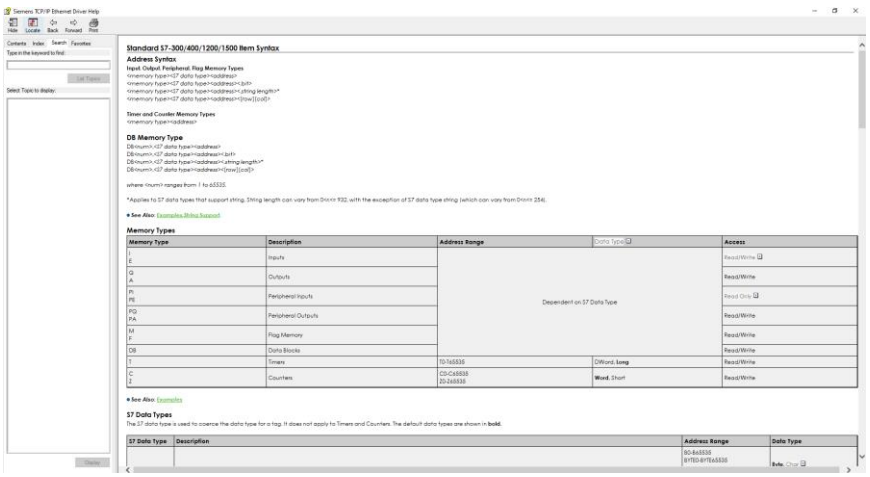


Then, you need to configure the device in the project tab as shown:



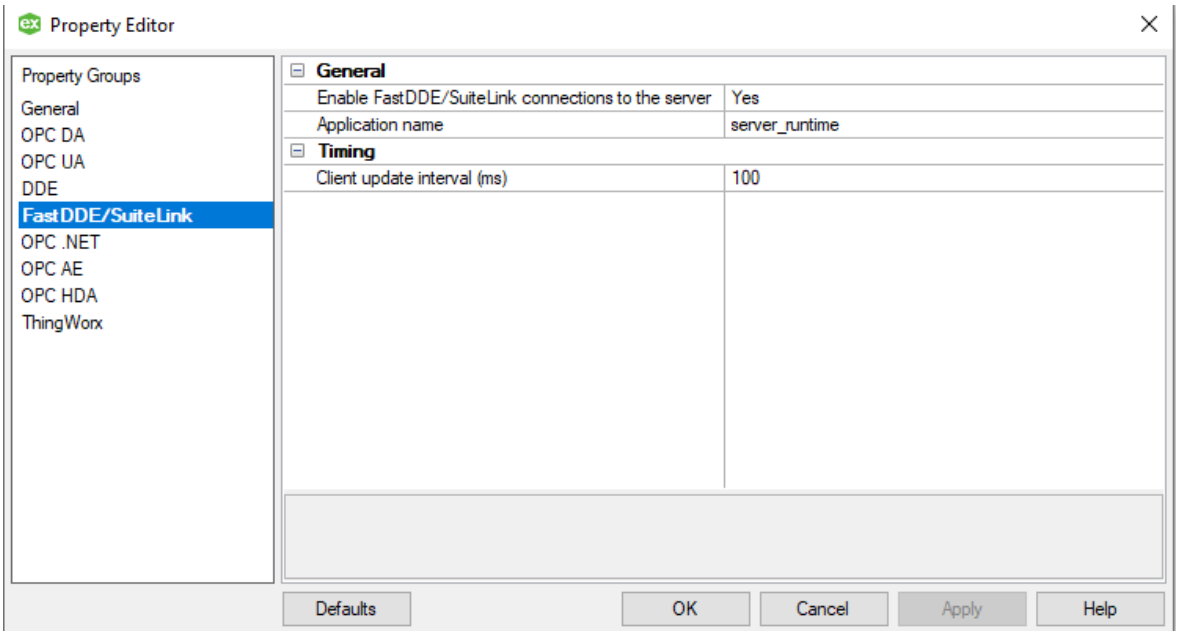
Choose your controller driver (in here I use Siemens TCP/IP Ethernet) and input your Server PC IP Address. Then input the Tag one by one:





// Open Help in KepserverEX for detailing syntax + make sure offset in DB is OK.

Also make sure you already installed the Wonderware Intouch in the Server PC also, so the KepserverEX can recognized and automatically installed the Suitelink Protocol.

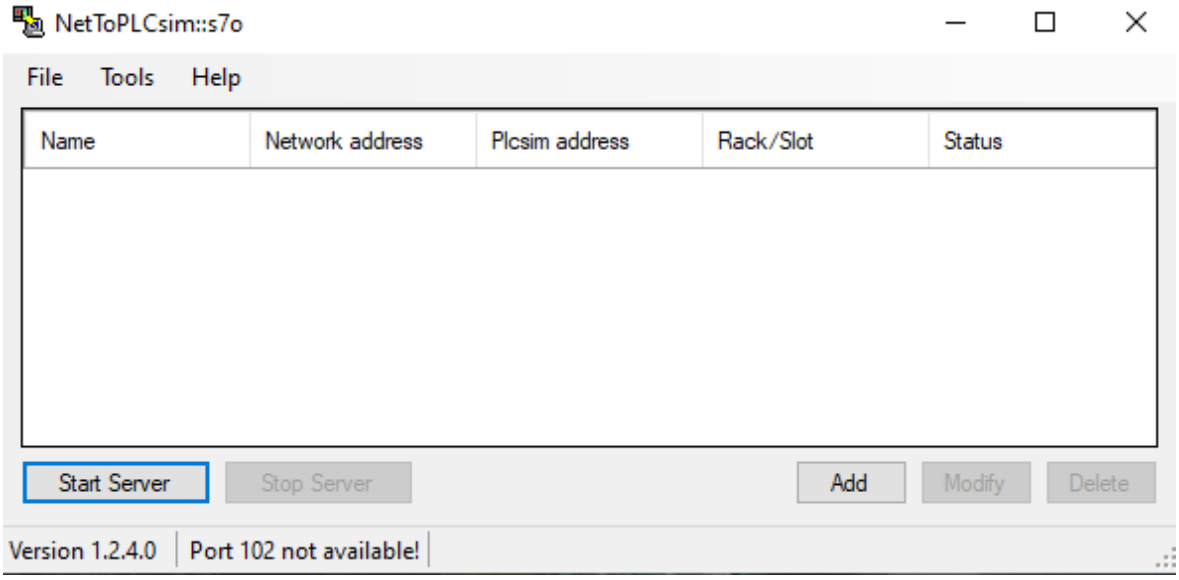


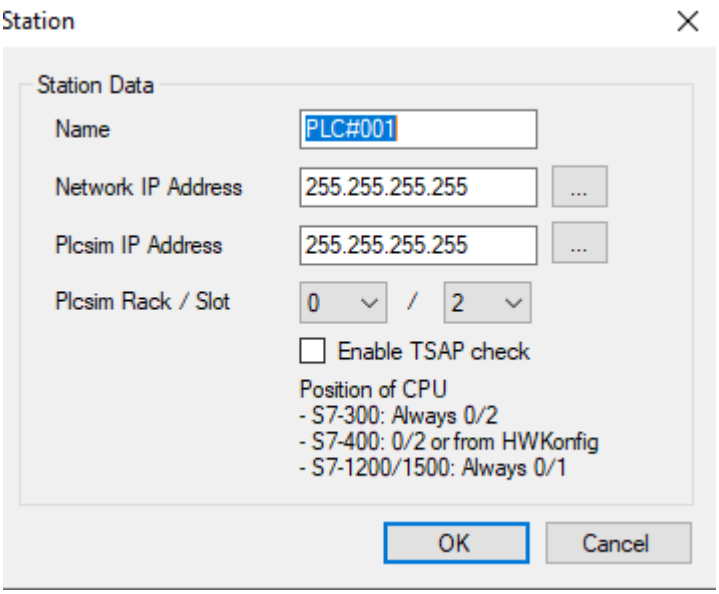
Rename the application name in the property editor window as you wish (default: server_runtime).

If you import the OPC Tags from me, the password is : DzakwanafifPLCS

//Complete with Alarm DB Log, DB Logger, and OPC UA After Siemens HMI Finished

After that, how to make your PLC Simulator virtual IP can be used as physical IP Address? you need to use NettoPLCSim. This item can make the virtual PLC IP Address to became the server PC IP Address (Open the software with Run with Administrator)



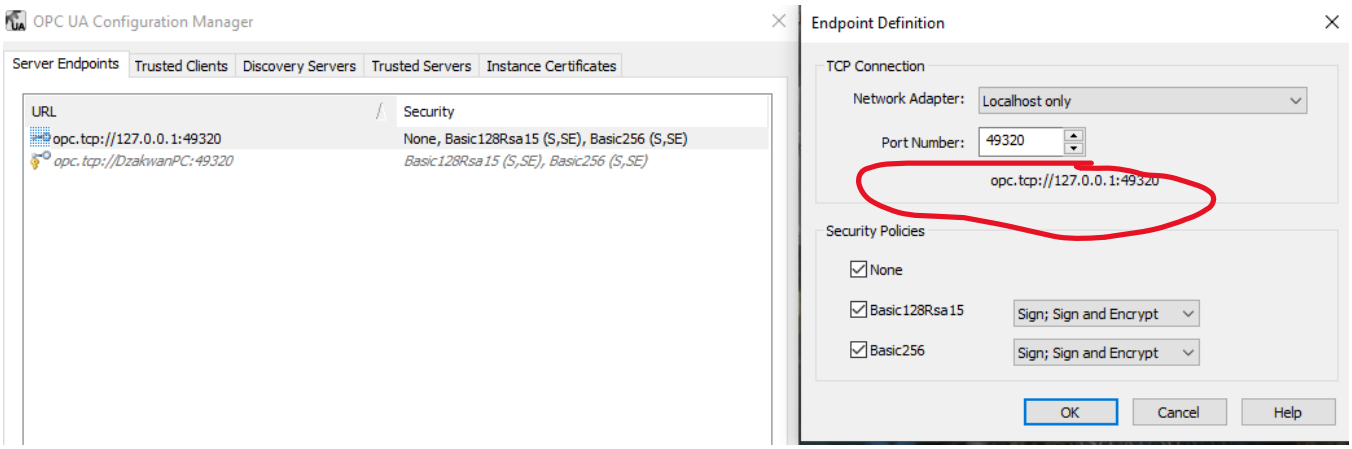


Input your PLC Name, choose your Network IP (Server PC IP Address), then your PLC IP Address, then choose your CPU Rack Number (I use 0/1 since I use S7-1500 CPU). After that click Start Server.

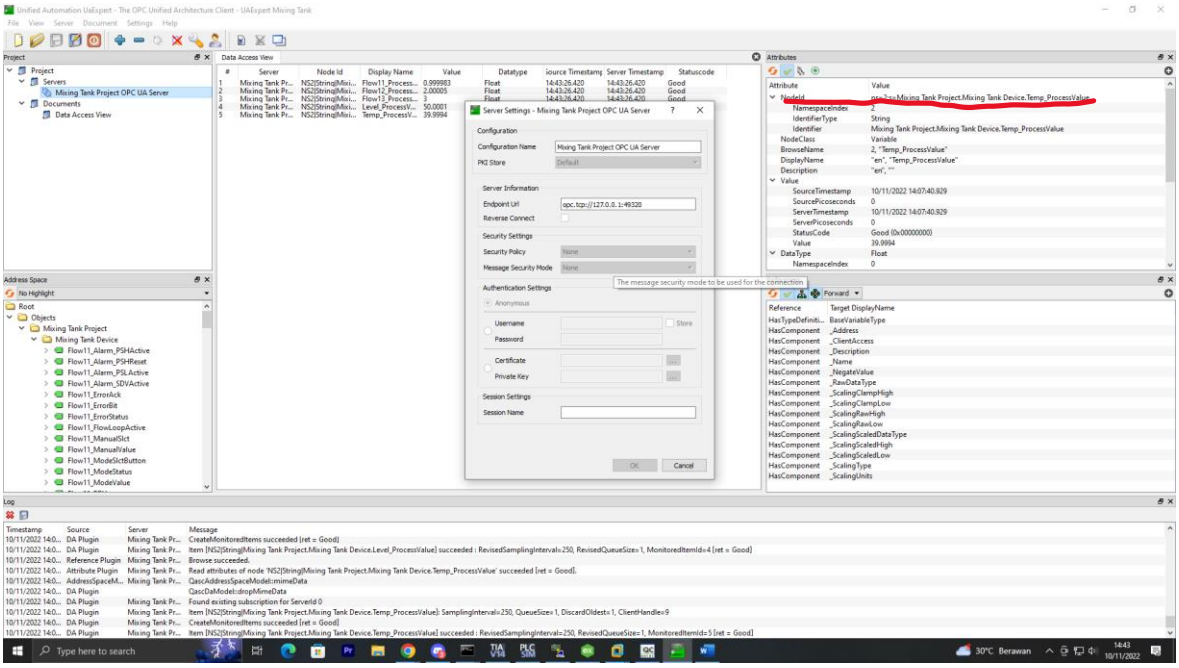
Communication between Server and Cloud is using Node-red as low programming tools developed by IBM, so it's open source and the library is always updated by billion of another user. The pre-requisite is :

1. Install Node-JS at your server PC
2. Install Node-red
3.Install Kep-server Library module

For communicating between OPC Server and Cloud we use OPC UA as Protocol. Check OPC UA Configuration to check your OPC UA host address provided by the server.

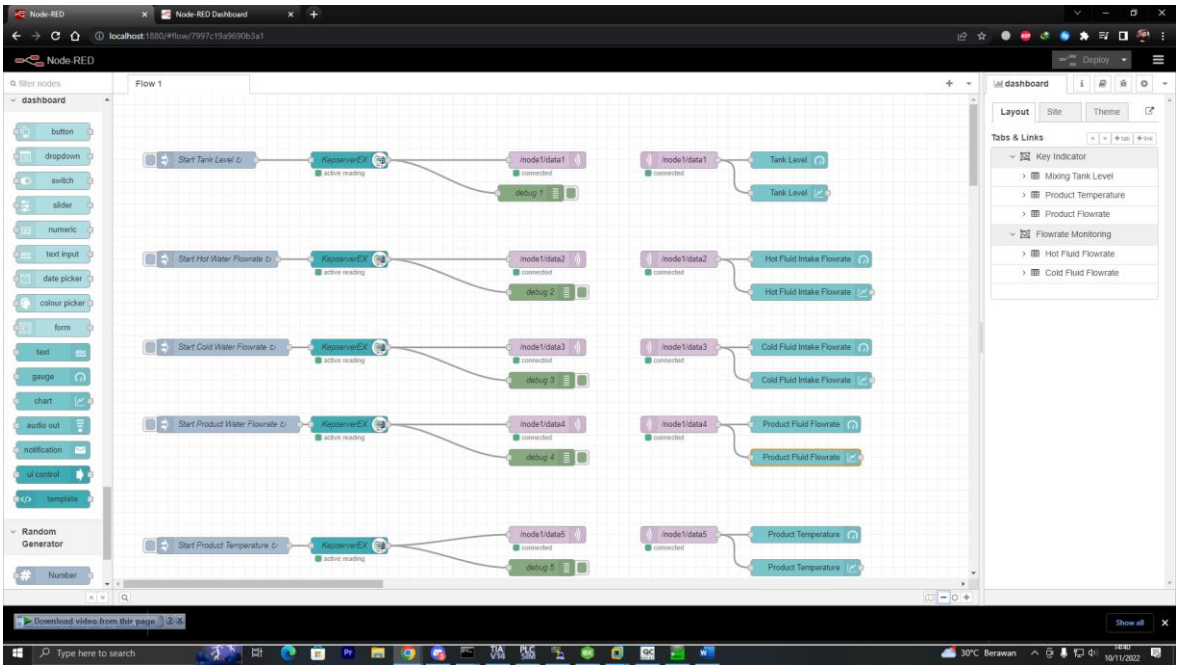


After that, download and use UA Expert (Free software) so you know every node address of every tag name we define at the server.

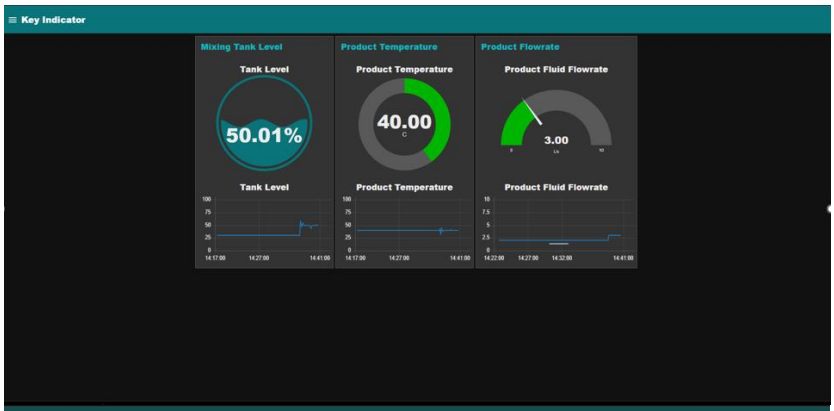


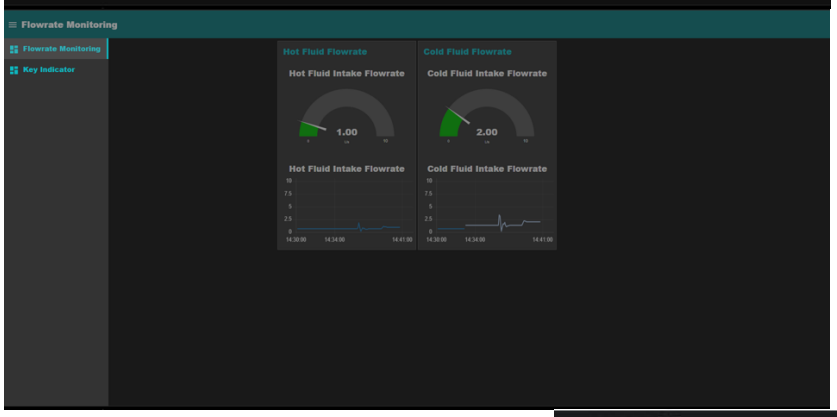
Then, develop the node red. It's flow-based programming so it's script less and easy to use. Input the Inject node, KepserverEX node, UI Node, and MQTT Publish/Subscribe Node. Input the NodeID at Inject node and OPC UA Server ID at KepserverEX node.

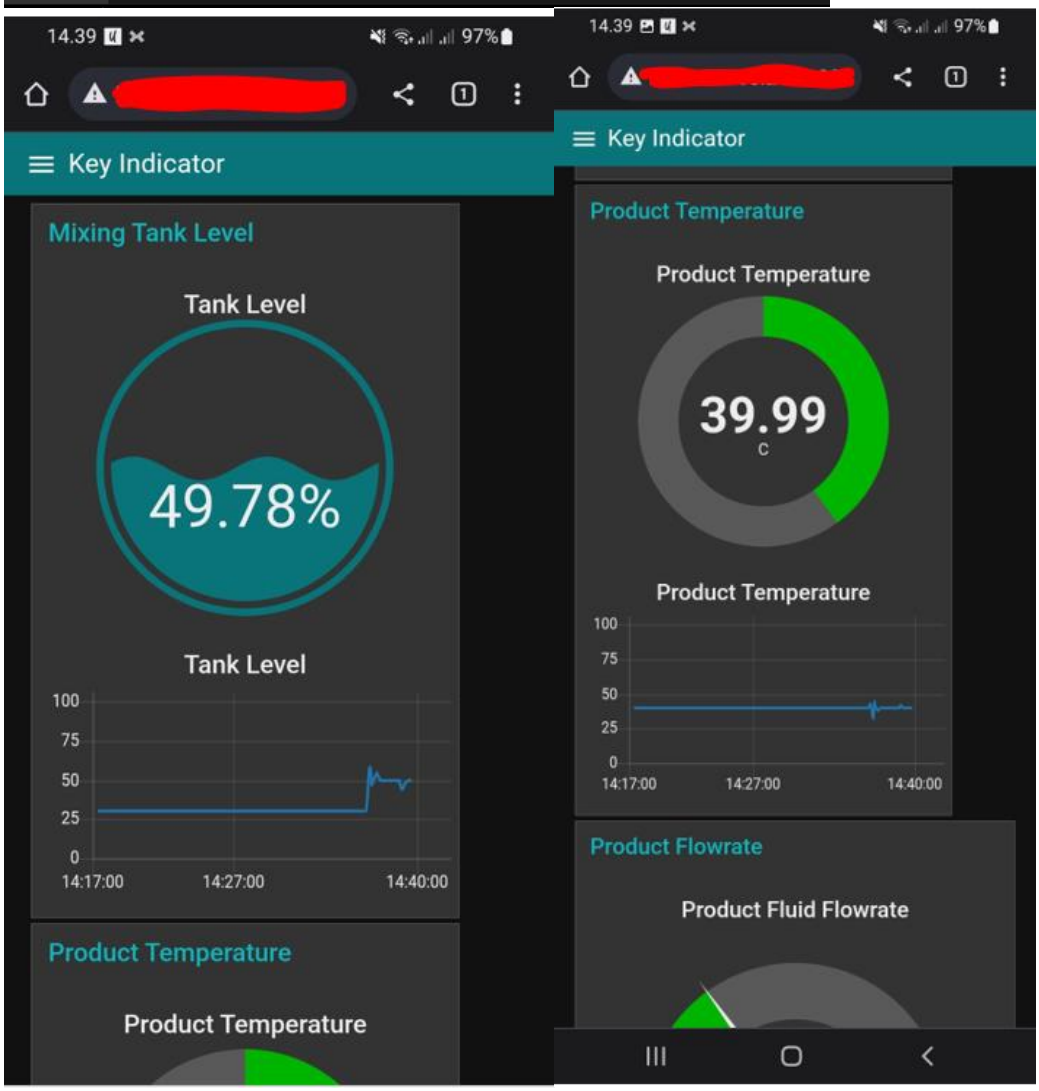
//I also provide MQTT publish node so another IoT or another Cloud Platform could subs the Data trough MQTT Protocol.



Finally, develop the UI and open the node-red UI for seeing the dashboard after you deploy the flow. If success, you can monitor using your smartphone also as long connected into the same network as the server.


Key Indicator
Mixing Tank Level
Tank Level
50.01%
Tank Level
Product Temperature
Product Temperature
40.00
C
Product Temperature
Product Flowrate
Product Fluid Flowrate
3.00
Product Fluid Flowrate


Flowrate Monitoring
Flowrate Monitoring
Key Indicator
Hot Fluid Flowrate
Hot Fluid Intake Flowrate
1.00
Hot Fluid Intake Flowrate
Cold Fluid Flowrate
Cold Fluid Intake Flowrate
2.00
Cold Fluid Intake Flowrate


14.39
97%
Key Indicator
Mixing Tank Level
Tank Level
49.78%
Tank Level
100
75
50
25
0
14:17:00
14:27:00
14:40:00
Product Temperature
Product Temperature

14.39
97%
Key Indicator
Product Temperature
Product Temperature
39.99
C
Product Temperature
100
75
50
25
0
14:17:00
14:27:00
14:40:00
Product Flowrate
Product Fluid Flowrate

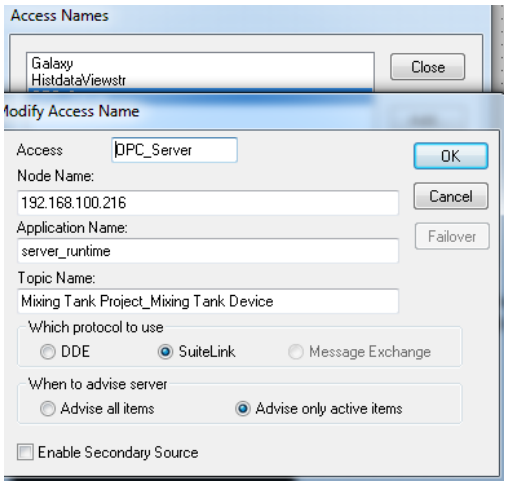
8- HMI Client Configuration

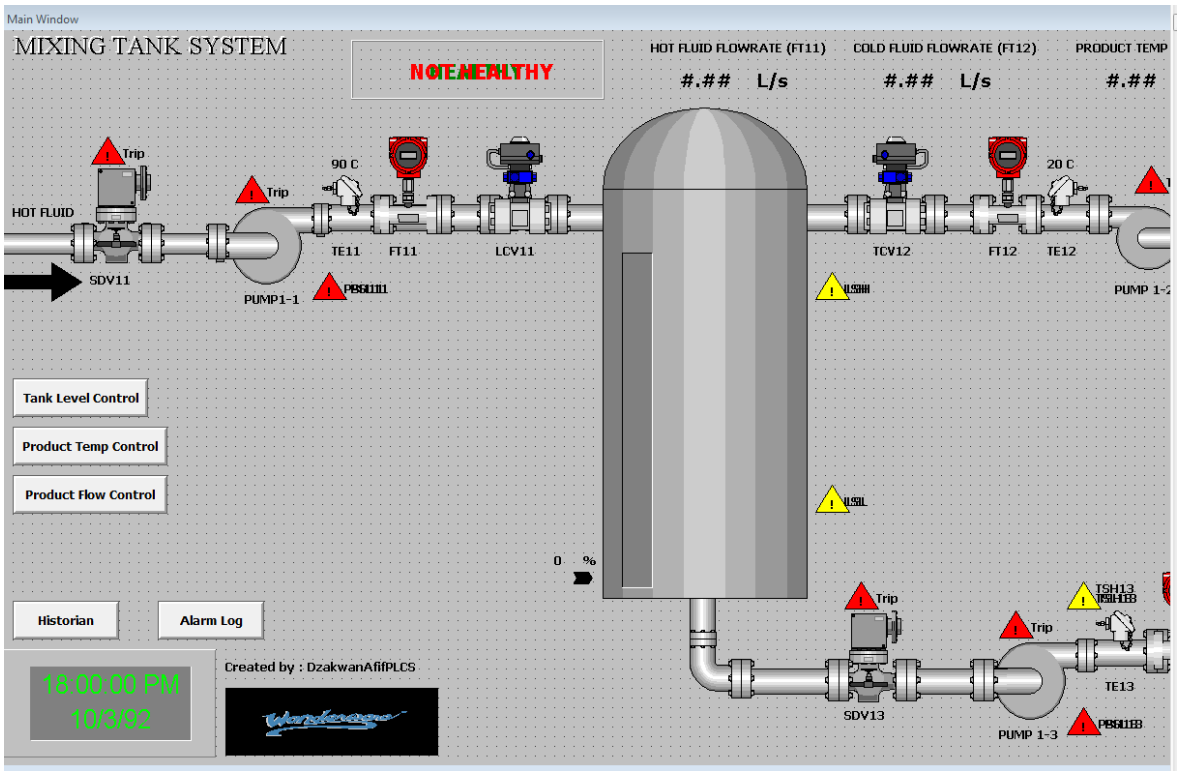
To make sure the OPC Server – HMI can communicate we need to established the Access Names if HMI. Input as below :

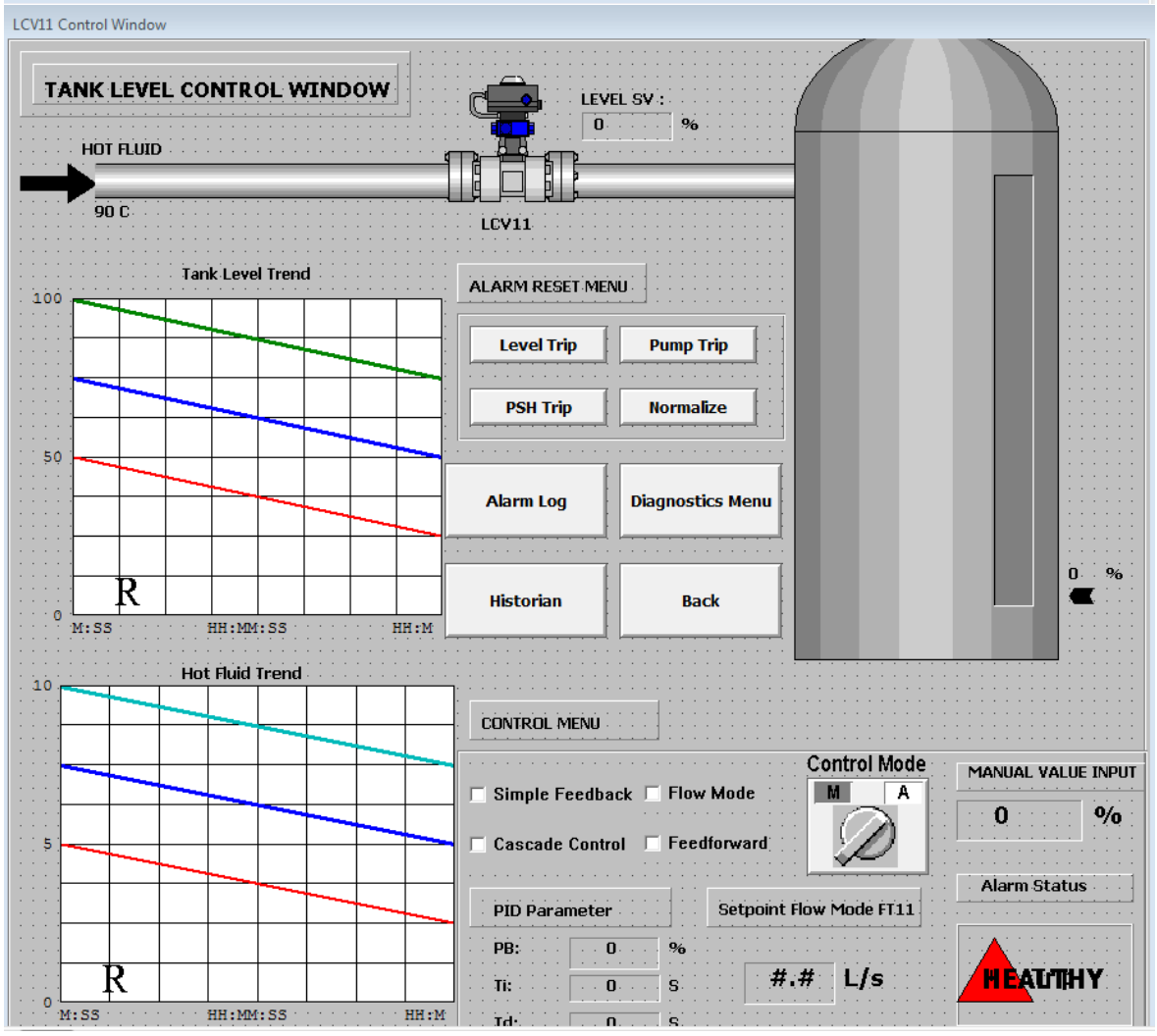
Node Name : IP Address of Server PC
Application name : Application name inputted at OPC Server
Topic Name : ChannelName_DeviceName

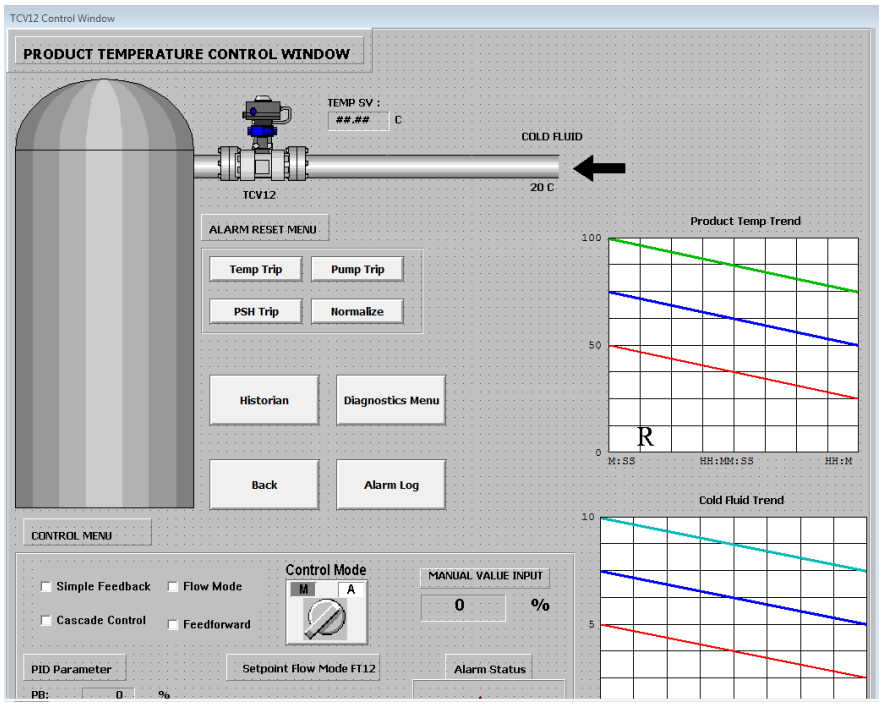
Choose suitelink protocol since it's already built to made comms between OPC and Wonderware InTouch directly.

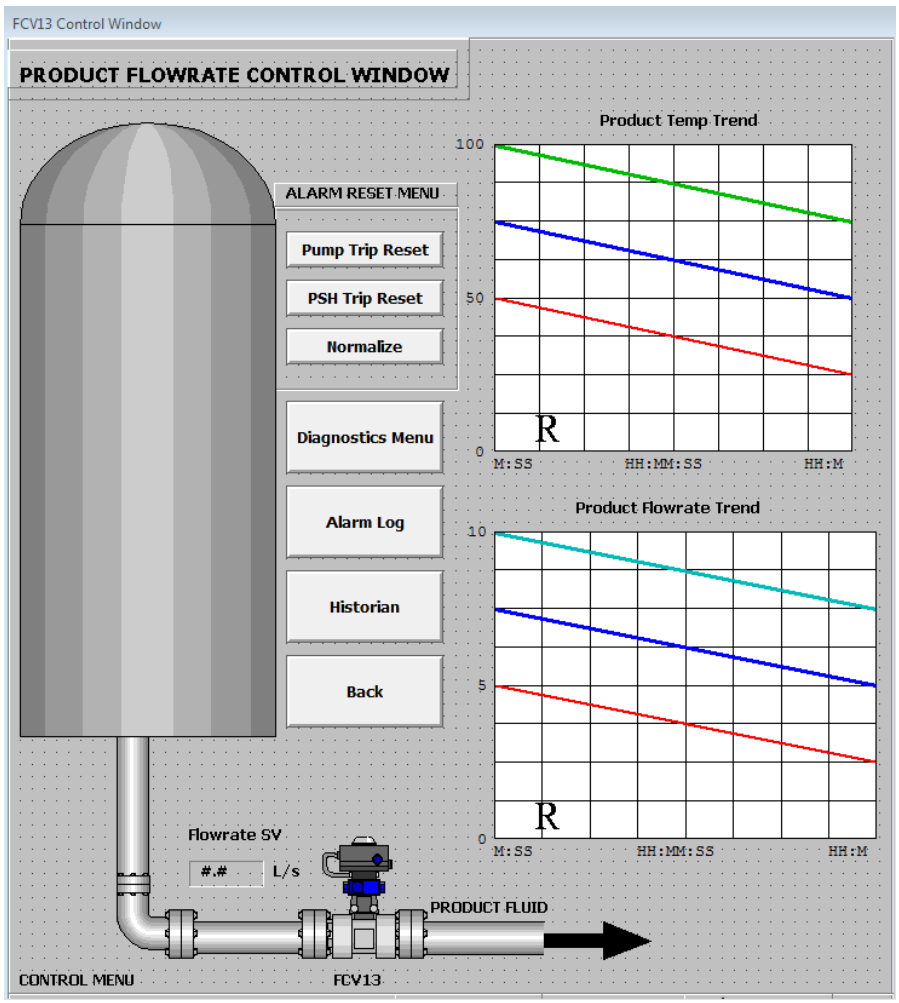
//Make sure you install wonderware intouch also at server pc to make sure the Suitelink installed also at Server PC

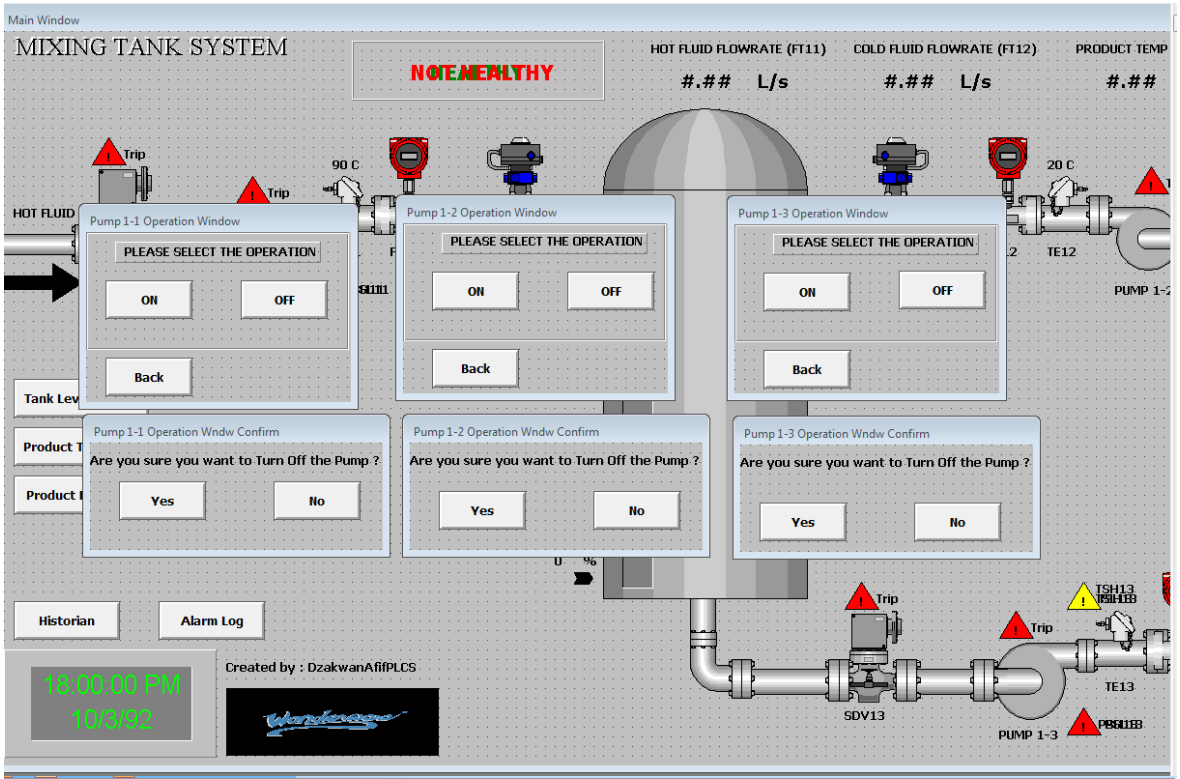


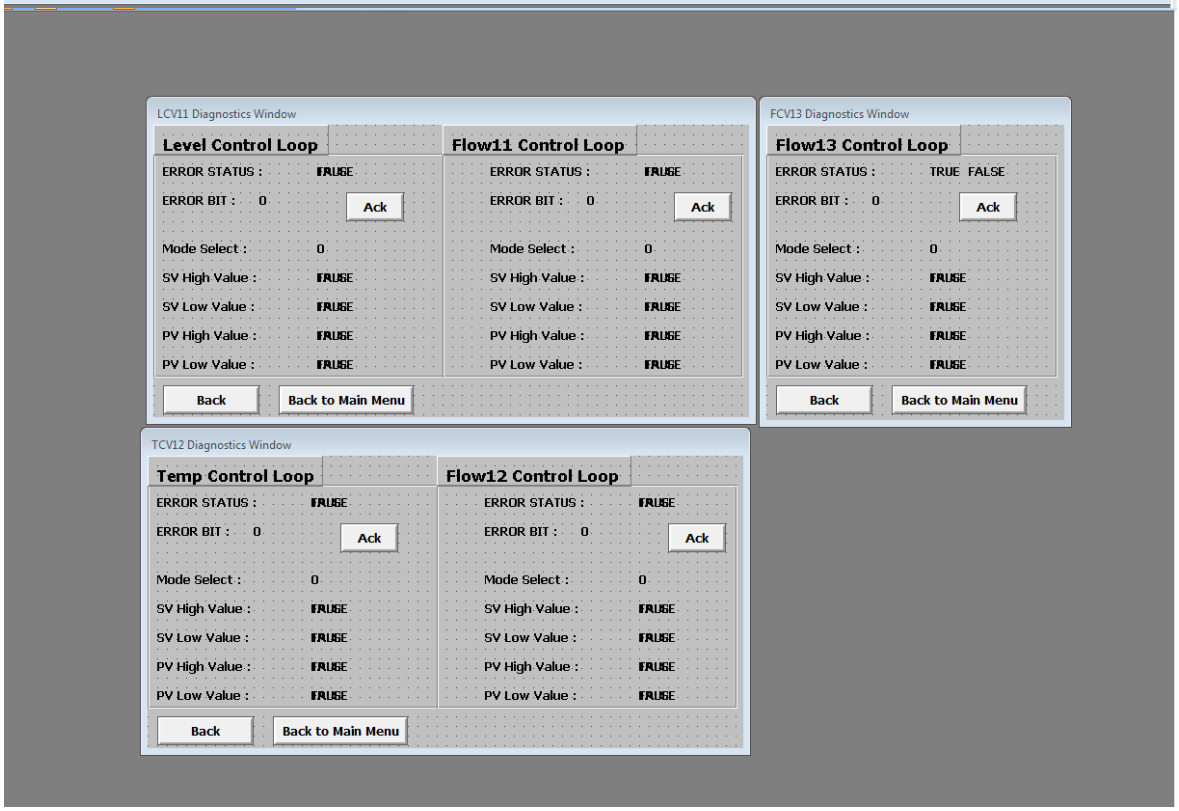

Main Window
MIXING TANK SYSTEM
NOT HEALTHY
HOT FLUID FLOWRATE (FT11)
#.## L/s
COLD FLUID FLOWRATE (FT12)
#.## L/s
PRODUCT TEMP
#.##
HOT FLUID
Trip
SDV11
PUMP1-1
90 C
TE11
FT11
LCV11
TCV12
FT12
TE12
20 C
PUMP 1-2
Tank Level Control
Product Temp Control
Product Flow Control
Historian
Alarm Log
0 %
SDV13
PUMP 1-3
TE13
15:00:00 PM
10/3/02
Created by : DzakwanAfifPLCS

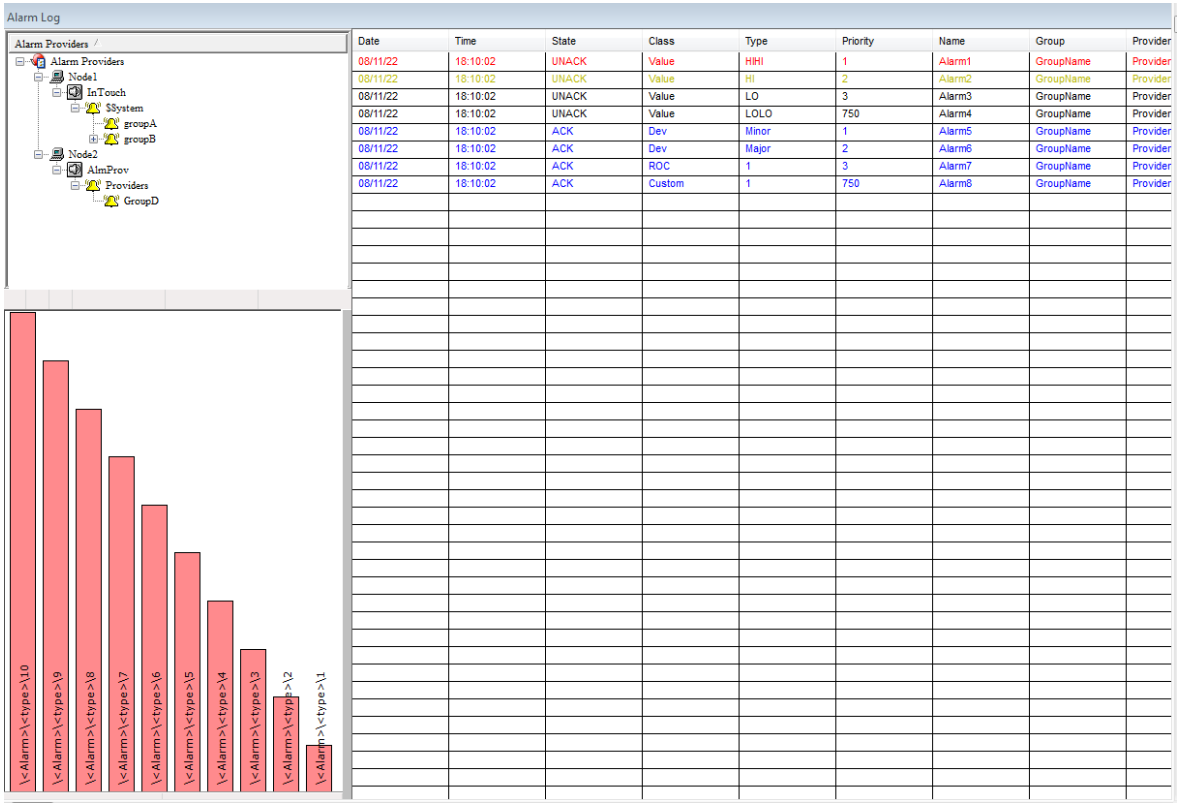

LCV11 Control Window
TANK LEVEL CONTROL WINDOW
LEVEL SV :
0 %
HOT FLUID
90 C
LCV11
Tank Level Trend
100
50
0
M:SS
HH:MM:SS
HH:M
ALARM RESET MENU
Level Trip
Pump Trip
PSH Trip
Normalize
Alarm Log
Diagnostics Menu
Historian
Back
0 %
Hot Fluid Trend
10
5
0
CONTROL MENU
Control Mode
M
A
Simple Feedback
Flow Mode
Cascade Control
Feedforward
MANUAL VALUE INPUT
0 %
Alarm Status
PID Parameter
Setpoint Flow Mode FT11
PB: 0 %
Ti: 0 S
Td: 0 S
#.# L/s
HEALTHY

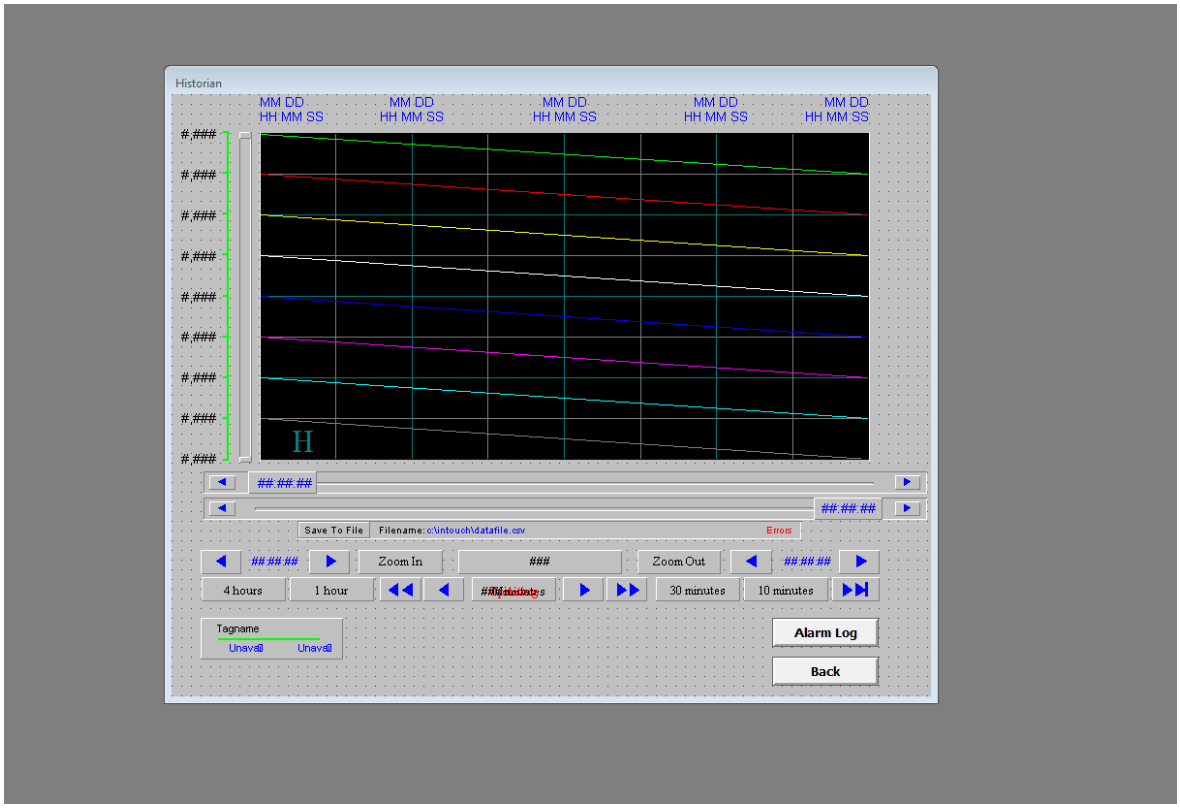

TCV12 Control Window
PRODUCT TEMPERATURE CONTROL WINDOW
TEMP SV :
##.##
C
COLD FLUID
20 C
TCV12
ALARM RESET MENU
Temp Trip
Pump Trip
PSH Trip
Normalize
Historian
Diagnostics Menu
Back
Alarm Log
CONTROL MENU
Simple Feedback
Flow Mode
Cascade Control
Feedforward
Control Mode
M
A
MANUAL VALUE INPUT
0
%
PID Parameter
Setpoint Flow Mode FT12
Alarm Status
PB:
0
%
Product Temp Trend
100
50
0
R
M:SS
HH:MM:SS
HH:M
Cold Fluid Trend
10
5


FCV13 Control Window
PRODUCT FLOWRATE CONTROL WINDOW
ALARM RESET MENU
Pump Trip Reset
PSH Trip Reset
Normalize
Diagnostics Menu
Alarm Log
Historian
Back
Product Temp Trend
100
50
0
R
M:SS
HH:MM:SS
HH:M
Product Flowrate Trend
10
5
0
R
M:SS
HH:MM:SS
HH:M
Flowrate SV
#.#
L/s
PRODUCT FLUID
CONTROL MENU
FCV13


Main Window
MIXING TANK SYSTEM
NOT HEALTHY
HOT FLUID FLOWRATE (FT11)
#.## L/s
COLD FLUID FLOWRATE (FT12)
#.## L/s
PRODUCT TEMP
#.##
Trip
90 C
20 C
HOT FLUID
TE12
PUMP 1-2
Pump 1-1 Operation Window
PLEASE SELECT THE OPERATION
ON
OFF
Back
Pump 1-2 Operation Window
PLEASE SELECT THE OPERATION
ON
OFF
Back
Pump 1-3 Operation Window
PLEASE SELECT THE OPERATION
ON
OFF
Back
Tank Lev
Product T
Product I
Pump 1-1 Operation Wndw Confirm
Are you sure you want to Turn Off the Pump ?
Yes
No
Pump 1-2 Operation Wndw Confirm
Are you sure you want to Turn Off the Pump ?
Yes
No
Pump 1-3 Operation Wndw Confirm
Are you sure you want to Turn Off the Pump ?
Yes
No
Historian
Alarm Log
18:00:00 PM
10/3/82
Created by : DzakwanAfifPLCS
Trip
TSH13
TE13
SDV13
PUMP 1-3


LCV11 Diagnostics Window
Level Control Loop
ERROR STATUS : FALSE
ERROR BIT : 0
Ack
Mode Select : 0
SV High Value : FALSE
SV Low Value : FALSE
PV High Value : FALSE
PV Low Value : FALSE
Flow11 Control Loop
ERROR STATUS : FALSE
ERROR BIT : 0
Ack
Mode Select : 0
SV High Value : FALSE
SV Low Value : FALSE
PV High Value : FALSE
PV Low Value : FALSE
Back
Back to Main Menu
FCV13 Diagnostics Window
Flow13 Control Loop
ERROR STATUS : TRUE FALSE
ERROR BIT : 0
Ack
Mode Select : 0
SV High Value : FALSE
SV Low Value : FALSE
PV High Value : FALSE
PV Low Value : FALSE
Back
Back to Main Menu
TCV12 Diagnostics Window
Temp Control Loop
ERROR STATUS : FALSE
ERROR BIT : 0
Ack
Mode Select : 0
SV High Value : FALSE
SV Low Value : FALSE
PV High Value : FALSE
PV Low Value : FALSE
Flow12 Control Loop
ERROR STATUS : FALSE
ERROR BIT : 0
Ack
Mode Select : 0
SV High Value : FALSE
SV Low Value : FALSE
PV High Value : FALSE
PV Low Value : FALSE
Back
Back to Main Menu



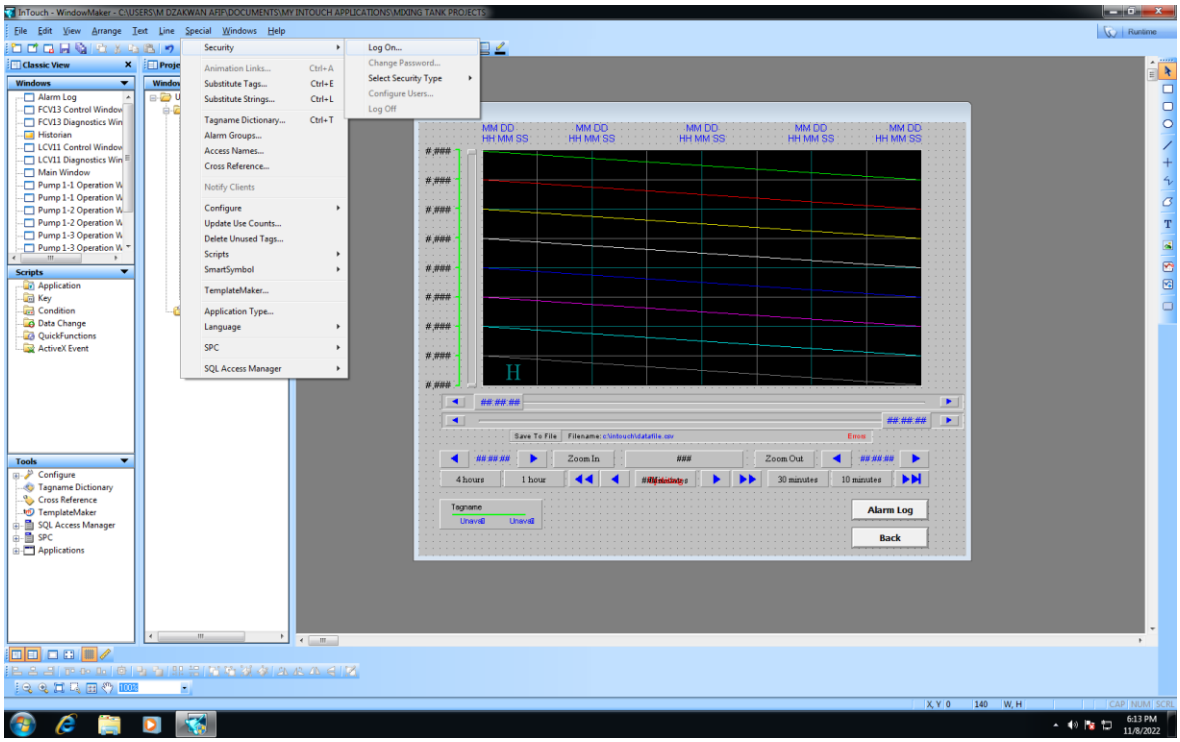


In this HMI, we input some alarm management system and Historian to see and log any critical event or alarm that occurred to make sure the troubleshooting easier as the alarm logged sequentially.

Then, operator need to input security logon to have the access into alarm reset

or management, control parameter changement, and diagnostic window.

Username : Supervisor
Pass : Supervisor



Pustaka:
1- ANSI / ISA-5.1-1984 (R1992) Instrumentation Symbols and Identification

2- ANSI / ISA-5.5-1985 Graphics Symbols for Process Display

3- API MPMS Chapter-5 Metering

4- API RP554 1995 Process Instrumentation and Control

5- API RP14 C Safety system for offshore production, 6 ed

6- Bela G Liptak : Instrumentation Engineer's Handbook; Process Software and Digital Networks Vol 3-2

7- Lesson in Industrial Instrumentation, R Kuphaldt