

2024583

by Harri Jones

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Figure 1: SFC Diagram 6

1. Research

1.1 IEC Languages for PLCs

The most popular programming languages are Sequential Function Chart (SFC), Instructions List (IL): (STL in Siemens), Function Block Diagram (FBD), Ladder (LD) and Structured Text (ST). Choosing which language to use can depend on the type of program being made.

1.2 Structured Text

Structured text (ST) = SCL in Siemens

Structured text is a text-based programming language. Comparing to the other languages structured text is easier to read and understand. Structured text takes up less space for example an input or output can be one line of code. (Peter, 2015). ST is a lot closer to the programming languages like Python, C++, C and Java than ladder logic, making it easier for software engineers who are learning PLC programming to understand. Some flows and routines can be implemented easier in ST than ladder logic making it the suitable option for certain tasks. Other programming languages can be implemented in to ST. ST can be used to write the functions within the function blocks. (Romanov, 2021)

Structured Text is a High-level language which is used for the development of complex algorithms. The code is made up from a combination of instructions and expressions for example (THEN), (ELSE), (IF). (Beckhoff, 2021)

(See Appendices 8.1.1 for an example of Structured Text)

1.3 Instruction List

Instruction list (IL) = STL in Siemens

Instruction Lists (IL) is similar to assembly language, the program consists of a series of instructions. Some of the common operations within the Instruction list are mathematical for example, subtracting, dividing and multiplying. (Budimir, 2017) IL was one of the first languages used for programming PLCs. It's considered as a low-level language, each instruction/command is on a new line so that the commands are all stacked. IL is not as common as the other language as it is seen as out-dated and has a limited use. (Collins, 2019) IL is good for applications which need code that is time critical and compact. (Dixon, 2018)

(See Appendices 8.1.2 for an example of an Instruction List)

1.4 Sequential Function Chart (SFC)

SFC is a graphical language meaning that it is not text based. There are steps and transitions. The steps are the functions inside the overall system and the transition is the change from step/state to another. SFC can also include logical techniques for example feedback loops and branching. State diagrams can also be used to design SFCs. (Budimir, 2017) SFCs are mainly used in scenarios with many states of operations. An example would be the operation of a washing machine. When a button is pressed the steps come one after another. When one step/state is over the next one will automatically start. States/steps are represented by boxes and the lines connect each step. (Devasia, 2020) Correctly cited

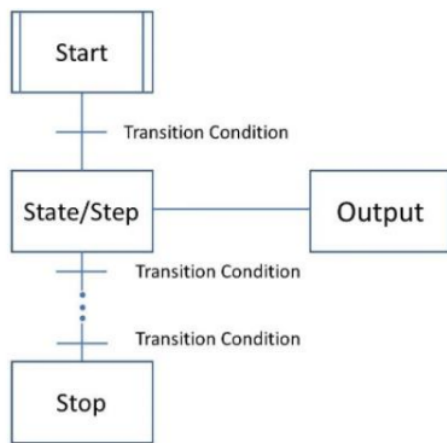


Figure 1: SFC Diagram

Figure 1 shows a general SFC diagram. The first box is the start of the operation. Two states are connected with a line. The horizontal lines are the transition conditions. After a step has been done the process continues forward to the next state only when the transition condition is satisfied. Each states has a corresponding output. (Devasia, 2020) Correctly cited

1.5 Function Block Diagram

Function Block Diagram or FBD is a very used programming language. FBD is a graphical way to program functions together in a program. With FBD all the functions are placed in function blocks. These function blocks have one or more inputs/outputs. Graphically the function block is a box, within the box is a text or symbol which represents the function. The output of a function block can be connected to the input of a function block. (Peter, 2018) Correctly cited FBDs can replace hundreds/thousands of lines from a program written in text. Technicians can find it easier to troubleshoot a machine when it is in FBD as it can be easier to understand. (Cope, 2019) Correctly cited

Appendices 8.1.3 **Function Block Diagram** shows an OR function block, it has 2 inputs and 1 output. The symbol for OR is ≥ 1 . If the sum of both inputs is larger or equal to 1 then the output becomes true.

1.6 Ladder Logic

Ladder logic is similar to relay circuits, which makes it easier for technicians to understand. Ladder Logic is a graphical programming language which shows logic operations as symbolic notation. It consists of rungs logic which looks like a ladder. The programming is carried out by combining different graphic elements (symbols). (Peter, 2017) Rungs are laid out between two bars which acts as the system power. The rungs contain coils and contacts the coils behave as outputs and the inputs represent push buttons/switches.

Appendices 8.1.4 Ladder Logic shows an example of Ladder Logic. The example contains 3 rungs. The first rung has 2 inputs, for the output to energize both inputs must be closed. Rung 2 shows 2 inputs in parallel (OR condition). The output can be energized if any of the inputs are true. In rung 3 the output can only be true if the input connected to it is open.

1.7 Programming Languages Comparison Table

Language	Advantage	Disadvantage
Structured Text	• Very organized • Able To cover more instructions than other languages	• Difficult to debug • Difficult to edit online
Instruction List	• Good for applications which require compact and time critical coding	• Errors can be difficult to resolve
Sequential Function Chart	• Can be broken down easier, making troubleshooting faster • Easier to see faults	• Does not always fit every applications
Function Block Diagram	• Good for motion controls • Many lines of programming can be placed in to one or several function blocks	• Can be disorganized as the function blocks can be placed anywhere on the page
Ladder Logic	• Easy to follow and organized • Comments can be added	• Difficult to program motion control or batching

Table information was gathered from (Dixon, 2018) , (Peter, 2018) & (St.Michael, 2019)

2. Hardware Design

2.1.1 I/O Table

This is supposed to be an IO list not a tag table, columns 2 and 4 are not necessary at this point

Name	Data Type	Address	Device Comment
Start Button	Bool	%I0.0	Begins sequence when activated
Reset Button	Bool	%I0.2	Resets the sequence when activated
Stop Button	Bool	%I0.1	Stops the sequence when activated
Factory IO Running DI	Bool	%I0.3	System will only run when this is true
Level Meter AI Real	Real	%ID30	Reads the Level
Flow Meter AI Real	Real	%ID34	Reads the Flow
Set point Potentiometer	Real	%ID38	Adjusts the set point
Start Light	Bool	%Q0.0	Toggles when start button is activated
Reset Light	Bool	%Q0.1	Toggles when reset button is activated
Stop Light	Bool	%Q0.2	Toggled when stop button is activated
Fill Valve AQ Real	Real	%QD30	Fills the tank at a selected rate
Drain Valve AQ Real	Real	%QD34	Drains the tank at a selected rate
Set Point Panel Meter	Dint	%QD38	Displays the set point value
Process Variable Panel Meter	Dint	%QD42	Displays the variable

2.1.2 PLC

The PLC chosen is a S7-1214 DC/DC/DC. The PLC has 14 digital inputs, 10 digital outputs, 2 analogue inputs.

See appendices 8.2.1 – I/O

An expansion module was used for the analogue values. The module has 4 configurable analogue inputs (0-10VDC). The 10VDC is supplied by the voltage regulator which is fed from the 24VDC supply.

See appendices 8.2.2 – Analogue

3. Program Design and Explanation

3.1.1 PLC Tag List

The PLC tag list was produced using the I/O table created in the hardware design

See appendices 8.3.1 – Tag List

3.1.2 HMI

See appendices 8.3.2/8.3.3 for HMI screens.

The HMI contains an Auto, Semi Auto and Manual control for filling the tank.

Auto – The Start and stop can be activated for the level control – Contains a lamp to show that it is operating

Semi Auto – The Program contains PID and an on/off control which controls the level.

Manual – The Fill Valve can be manually opened or closed.

A number from 0-100% can be placed in the valve

The Fill Valve HMI contains a Level Control graph which displays the flowrate m³/pm.

The level is 0-300cm

The HMI for the discharge/drain has the same buttons besides the semi auto control. It can be drained automatically by pressing start and deactivated by pressing stop

The HMI also contains the Manual drain valve which can be used to manually open and close the valve.

The graph shows 0-100%

3.1.3 Program

The program was all written in Ladder as it was the most suitable language to use

7 Networks were used for the Flow Control Program

See appendices 8.3.4 For Flow Control

11 Networks were used for the Level Control Program

See appendices 8.3.5 For Level Control

4 Networks were used for the Main Program.

See appendices 8.3.6 For Main.

3.1.4 User Requirements

1. Manual Controls for emptying and filling the tank with indicators of the current status.

See appendices 8.5.1

2. Semi Auto Controls with ON/OFF and PID control. Selectable Set point and dead band.

See appendices 8.4.4 and 8.4.5

3. Semi Auto Control of flow and engineer can choose tuning values for PID

See appendices 8.4.4 and 8.4.5

4. Provide Full automatic mode.

Automatic mode was not completed therefor it is not working on the simulation

5. HMI Screens provide data and trend graphs to help engineer. Auto Mode start and Stop

The HMI's contain graphs which are fully operational and assist the engineer. Auto sequence was not created therefor Start and Stop are not functional in Auto Mode.

4. System Testing

A testing table was produced to cover the user/customer requirements.

Description of Test	Expected Results	Actual Results	Pass or Fail Decision	Reference to evidence in appendix
Manual Controls for filling and emptying the tank with indicators of the current status of the devices	When the tank is filling or emptying the indicators on the HMI should show the status	Manual controls working for both filling and indicators of status working.	Pass	Appendices 8.4.1 and 8.4.2
Semi Auto mode, control of level with On/Off and PID control methods with set point for level.	Semi Auto Mode working. On/Off and PID working correctly.	Expected Results Achieved	Pass	Appendices 8.4.3 and 8.4.4
Engineer can choose dead-band. Engineer can choose the tuning valves	Dead-band and the tuning valves can be chosen	Dead band and tuning valves can be selected	Pass	Appendices 8.4.5 and 8.4.6
Full automatic mode when initiated, the tank should fill up to a fixed level and flow control should begin and run to set point rate. When stopped the tank should drain.	When Auto is initiated the tank fills up to a fixed level and flow runs to set point rate. When stopped the tank drains.	Automatic mode, unsuccessful – Tank would not fill up to a fixed level and would not run to set point rate.	Fail	Appendices 8.4.7
HMI screens providing data and trend graphs. Operator screen Auto-mode start and stop buttons	HMI screens updating according to data provided. Start and stop working in auto mode	HMI Screens provide data from graphs – Start and Stop in auto mode unsuccessful	Pass/Fail	Appendices 8.4.5/6/7

The actual results obtained were very similar to the expected however for the Auto mode.

The auto mode was not implemented into the program therefore it did not work. The auto button was kept on the HMI in case it was to be later added in the program. The fifth test was a pass/fail as the HMI did produce data however the auto mode was non-functional.

5. Meeting the Customer Needs and Team Working

5.1 Testing

Due to COVID the practical was not able to be carried out within college, therefore a simulated scenario of the Level and Flow Control system was carried out online. We were placed in groups on Google meet and we discussed each other's work, giving feedback of improvements and recommendations. A member of the group shared their program, showing their program, HMI screens and the simulation.

The program was well organized and structured neatly. Both HMI's were clear and self-explanatory to use as they were all labelled. The buttons for Auto, Semi and Manual were all colour coordinated which made it easier to understand and easier for operation.

The simulation had one error with the start button however the tag was re-labelled in the program and after compiling it was working smoothly. We went through the customer/user requirements in order and all 5 tasks were carried out successfully.

5.2 Recommendations

The comments on the code were briefly explained however some were very brief and could have had more information to make it easier to understand. One or two of the codes did not have any information.

The HMI was setup neatly however perhaps a status light could have been added to indicate the state of the system. Another thing on the HMI is that the graph could have perhaps been larger as the text was too small. Titles for the axis could have been added to the graph to make it easier to understand.

6. Conclusions and Recommendations

The aim was to develop a system for an industrial process involving level and flow control. This aim was successfully met, an I/O list was created and further developed into the program. Electrical drawings of the PLC and analogue modules were made. Two HMIs were created for the operator and engineer. All the buttons on the HMI were operational besides the Auto Mode. The HMI contained manual controls for filling and emptying the tank with a lamp to show the status of the system. The HMI also contained a semi-automatic control of level with an ON/OFF and PID control methods. The setpoint for the level and the dead-band can be altered on the HMI. The engineer can choose the tuning of the values for PID control. The HMI's contained a graph of the flow level and drain which updated as the tank was in operation.

Five tests were carried out for the system testing. Four out of the five tests were successful. The only one to fail was the Auto Mode which was not implemented into the program. Screenshots were all taken to provide evidence for the simulation. One of the tests was a pass/fail as the HMI did produce data/graphs however the auto mode did not work. Once fully tested the program was then shared with a small group. Feedback and recommendations were provided to each other and some changes were made, for example I was recommended to change my HMI buttons so that they were all colour co-ordinated to make it easier for the engineer/operator.

An automatic mode could be implemented next time, it was not implemented in this program due to complications with the program. To avoid confusion with the operator/engineer the Auto mode on the HMI could have been removed as it was non-functional. Another recommendation would be to include axis titles to the HMI graphs, this would make it easier to understand and read.

7. Citation List

Beckhoff, 2021. *Structured Text (ST), Extended Structured Text (ExST)*, s.l.: Beckhoff.

Budimir, M., 2017. *MotionControlTips*. [Online]

Available at: <https://www.motioncontroltips.com/sequential-function-charts-sfcs-plcs/>
[Accessed 18 May 2021].

Budimir, M., 2017. *What are Instruction Lists (ILs) for PLC programming?*, s.l.: MotionControlTips.

Collins, D., 2019. *Motion Control Tips*. [Online]

Available at: <https://www.motioncontroltips.com/why-is-the-instruction-list-il-language-for-plcs-falling-out-of-favor/>
[Accessed 18 May 2021].

Collins, D., 2019. *Why is the instruction list (IL) language for PLCs falling out of favor?*, s.l.: MotionControlTips.

Cope, K., 2019. *Ladder Logic Vs Function Block Diagrams*. [Online]

Available at: <https://realpars.com/ladder-logic-vs-function-block-diagrams/>
[Accessed 19 May 2021].

Devasia, A., 2020. *Control Automation*. [Online]

Available at: <https://control.com/technical-articles/an-overview-of-sequential-function-chart-sfc-programming/>
[Accessed 18 May 2021].

Dixon, M., 2018. *RealPars*. [Online]

Available at: <https://realpars.com/plc-programming-languages/>
[Accessed 18 May 2021].

Peter, 2015. *Structured Text Tutorial to Expand Your PLC Programming Skills*, s.l.: Plcacademy.

Peter, 2017. *PLC Ladder Logic Programming Tutorial (Basics)*. [Online]

Available at: <https://www.plcacademy.com/ladder-logic-tutorial/>
[Accessed 19 May 2021].

Peter, 2018. *Function Block Diagram (FBD) Programming Tutorial*. [Online]
Available at: <https://www.plcacademy.com/function-block-diagram-programming/>
[Accessed 19 May 2021].

Peter, 2018. *PLCAcademy*. [Online]
Available at: <https://www.plcacademy.com/function-block-diagram-programming/>
[Accessed 18 May 2021].

Romanov, V., 2021. *Introduction to Structured Text Programming in RSLogix and Studio 5000 Allen Bradley*, s.l.: SolisPLC.

St.Michael, S., 2019. *Ladder Logic in Programmable Logic Controllers (PLCs)*. [Online]
Available at: <https://control.com/technical-articles/ladder-logic-in-programmable-logic-controllers-plcs/>
[Accessed 19 May 2021].

8. Appendix

8.1 Research

8.1.1 Structured Text

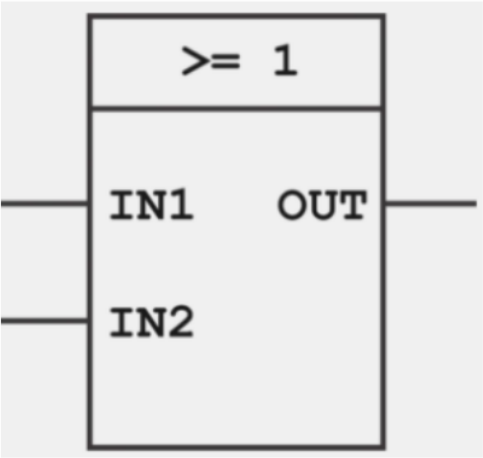
```
x: BOOL;  
P_STEP: INT;  
END_VAR  
P_STEP := 3;  
CASE PROGRAM_STEP OF  
1: P_STEP := P_STEP+1;  
2: P_STEP := P_STEP+2;  
3: P_STEP := P_STEP+3;  
ELSE  
PROGRAM_STEP := PROGRAM_STEP+10;  
END_CASE;  
LIMIT_SWITCH1 := TRUE;  
LIMIT_SWITCH2 := FALSE;  
IF LIMIT_SWITCH1 OR LIMIT_SWITCH2 THEN  
OUTPUT5 := FALSE;  
P_TRIGGER := TRUE;  
END_IF;
```

ST
IEC 61131-3

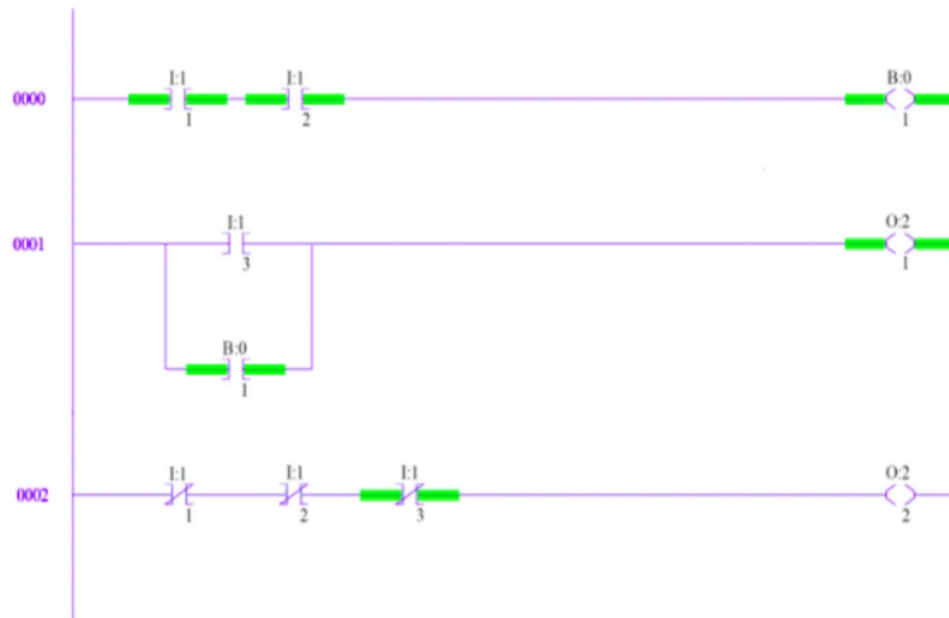
8.1.2 Instruction List

```
0001 LD      start
0002 AND     Process1
0003 OR      Manual_stir
0004 ANDN    crvr_complete
0005 ST      Stix
0006
0007 JMPCN   en_temp0
0008
0009 LD      147
0010 MOVE   Process_code
0011 ST
0012
0013 en_temp0:
0014 LD      start
0015 AND     Process2
0016 OR      Manual_clean
0017 ST     CIP_P1
0018
0019 JMPCN   en_temp1
0020
0021 LD      247
0022 MOVE   Process_code
0023 ST
0024
0025 en_temp1:
0026 LD      start
0027 AND     Process3
0028 OR      Manual_drain
0029 ANDN    tank_empty
0030 ST     Drain
0031
0032 JMPCN   en_temp2
0033
0034 LD      347
0035 MOVE   Process_code
0036 ST
0037
0038 en_temp2:
0039
```

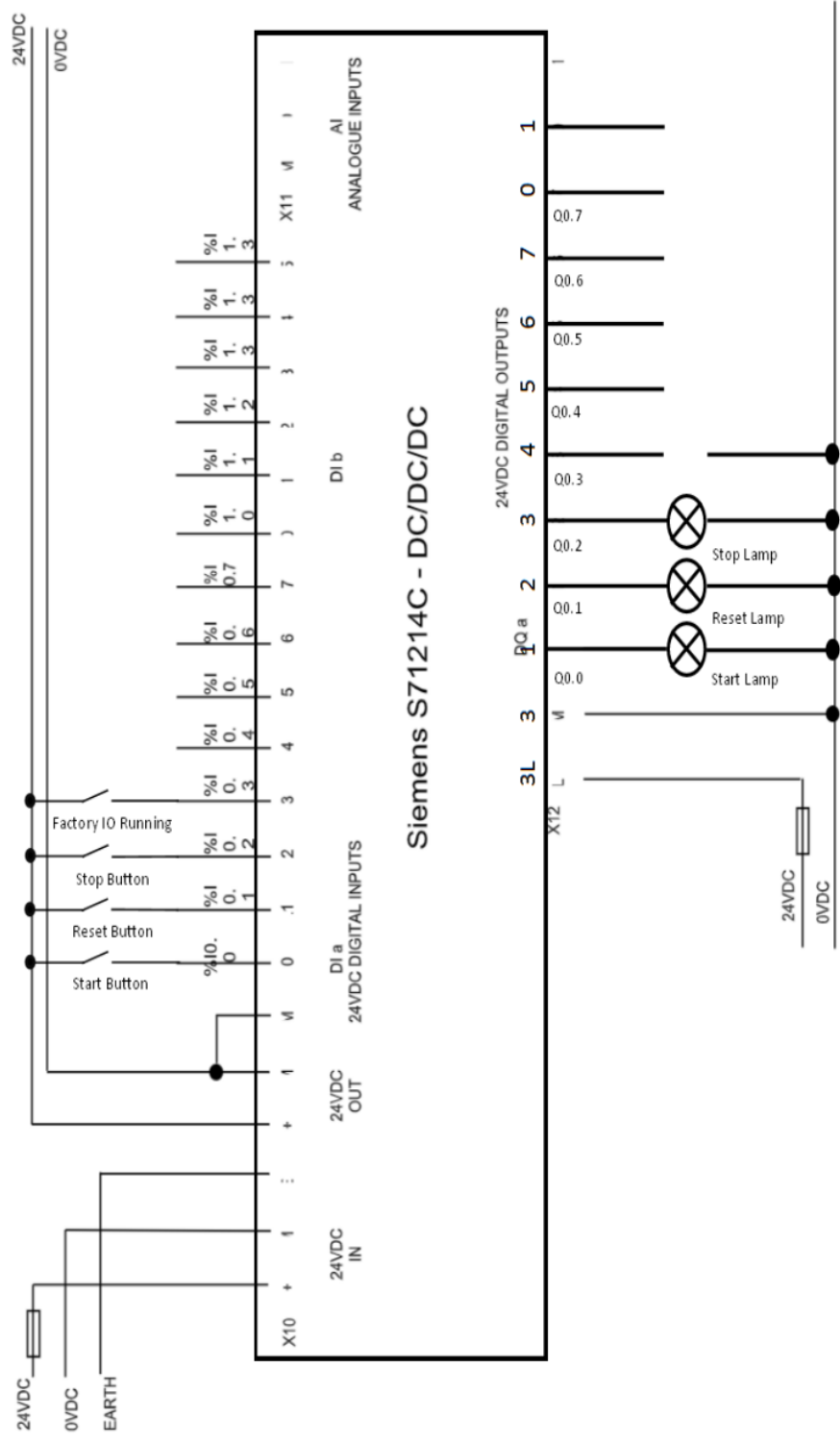
8.1.3 Function Block Diagram



8.1.4 Ladder Logic

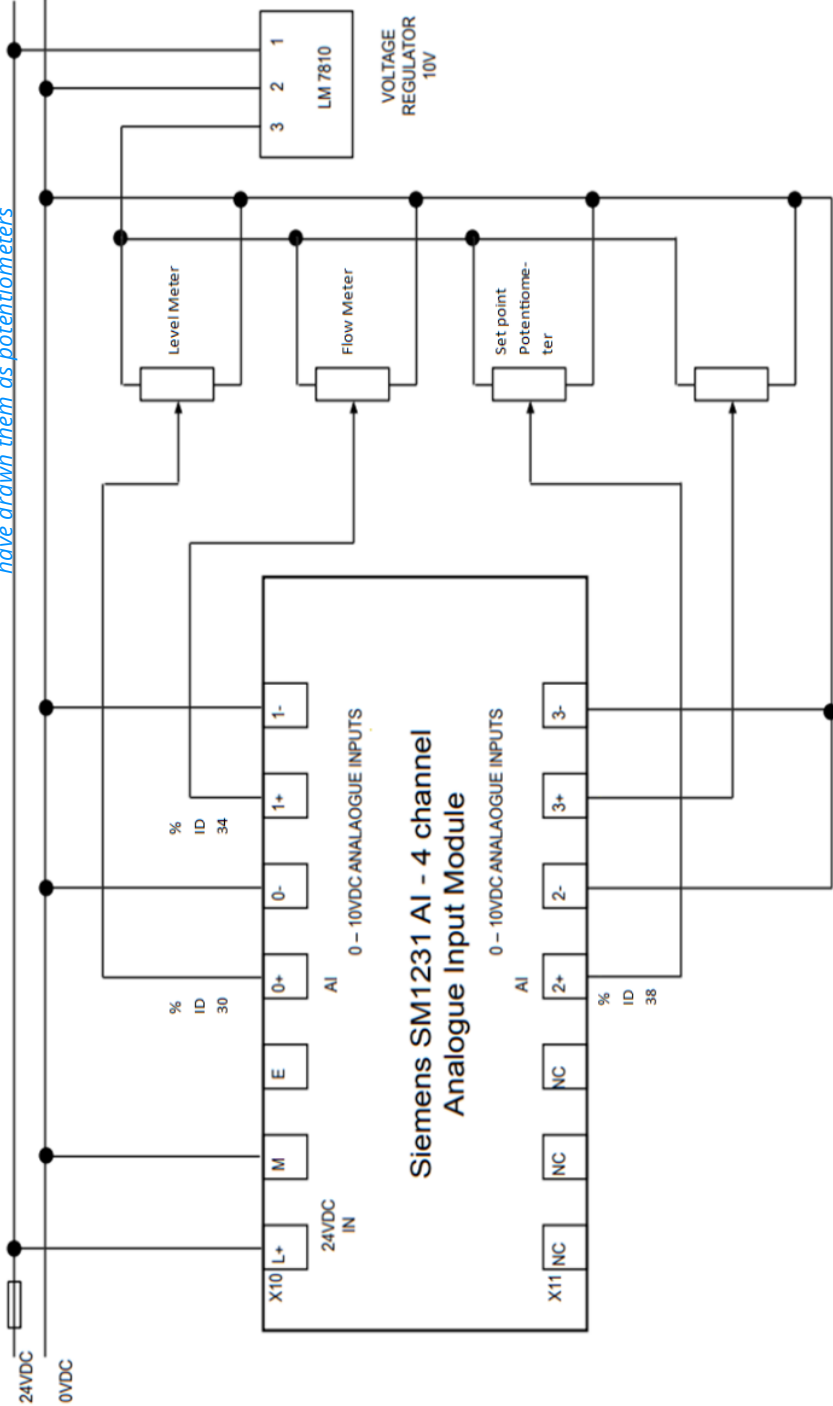


8.2.1 PLC I/O



8.2.2 PLC Analogue

the two sensors for level and flow should have their own symbols but you have drawn them as potentiometers



There should be an analogue output module also

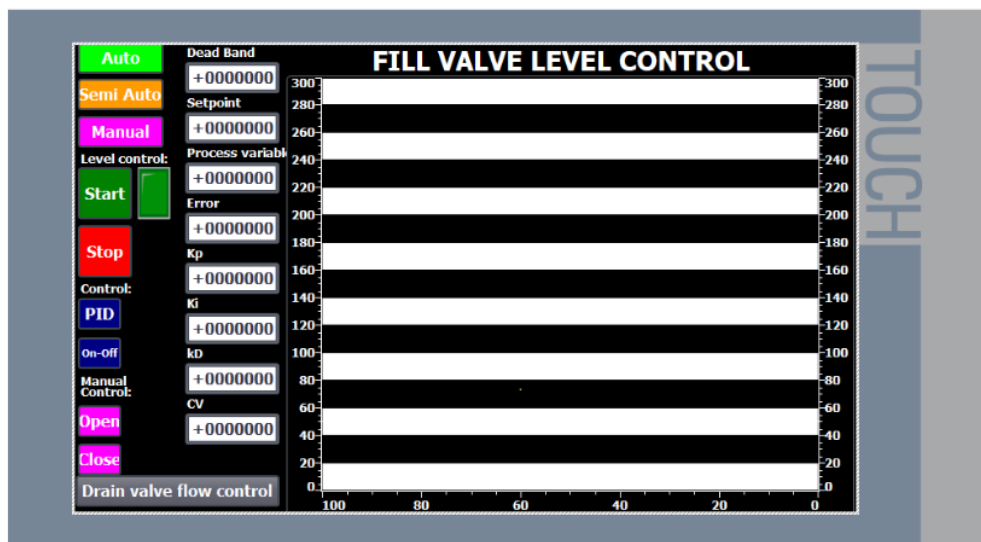
8.3.1 PLC Tag list

	LEVEL CONTROLL RUN	MY tags	Bool	%M2500.0
	LEVEL PID CONTROL	MY tags	Bool	%M2500.1
	Level ON-OFF control	MY tags	Bool	%M2500.2
	HMI Start Level Control	MY tags	Bool	%M2500.3
	HMI Stop Level Control	MY tags	Bool	%M2500.4
	HMI Manual Open Fill Valve	MY tags	Bool	%M2500.5
	HMI Manual Close Fill Valve	MY tags	Bool	%M2500.6
	HMI Manual Open Fill Valve Pulse	MY tags	Bool	%M2500.7
	HMI Manual Close Fill Valve Pulse	MY tags	Bool	%M2501.0
	Auto Mode	MY tags	Bool	%M2501.1
	Semi Auto Mode	MY tags	Bool	%M2501.2
	Manual Mode	MY tags	Bool	%M2501.3
	Flow Control RUN	MY tags	Bool	%M2501.4
	HMI start Flow Control	MY tags	Bool	%M2501.5
	HMI stop Flow Control	MY tags	Bool	%M2501.6
	HMI Manual Open Drain Valve	MY tags	Bool	%M2501.7
	HMI Manual Close Drain Valve	MY tags	Bool	%M2502.0
	HMI Manual Open Drain Valve ...	MY tags	Bool	%M2502.1
	HMI Manual Close Drain Valve P..	MY tags	Bool	%M2502.2

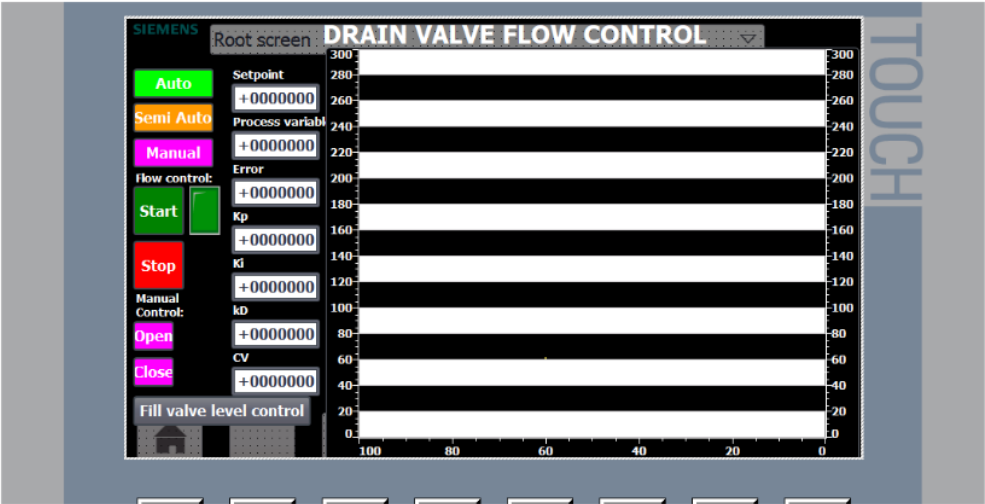
	Level Process Variable	MY tags	Real	%MD3000
	Level Error	MY tags	Real	%MD3004
	Level KP	MY tags	Real	%MD3012
	Level CV	MY tags	Real	%MD3016
	Level Setpoint	MY tags	Real	%MD3020
	Level P part	MY tags	Real	%MD3024
	Level Ki	MY tags	Real	%MD3028
	Level Integral Accumulator	MY tags	Real	%MD3032
	Level I part	MY tags	Real	%MD3036
	Level Old Error	MY tags	Real	%MD3040
	Level Kd	MY tags	Real	%MD3044
	Level Difference	MY tags	Real	%MD3048
	Level D part	MY tags	Real	%MD3052
	Level Deadband	MY tags	Real	%MD3056
	Level Maximum Deadband	MY tags	Real	%MD3060
	Level Minimum Deadband	MY tags	Real	%MD3064
	Fill Valve Position	MY tags	Real	%MD3068

Flow Setpoint	MY tags	Real	%MD3072
Flow Process Variable	MY tags	Real	%MD3076
Flow Error	MY tags	Real	%MD3080
Flow Kp	MY tags	Real	%MD3084
Flow Kd	MY tags	Real	%MD3088
Flow Old Error	MY tags	Real	%MD3092
Flow Integral Accumulator	MY tags	Real	%MD3096
Flow Difference	MY tags	Real	%MD3100
Flow P part	MY tags	Real	%MD3104
Flow I part	MY tags	Real	%MD3108
Flow D part	MY tags	Real	%MD3112
Flow CV	MY tags	Real	%MD3116
Drain Valve Position	MY tags	Real	%MD3120
Flow KI	MY tags	Real	%MD3124

8.3.2 – Fill Valve Level Control HMI

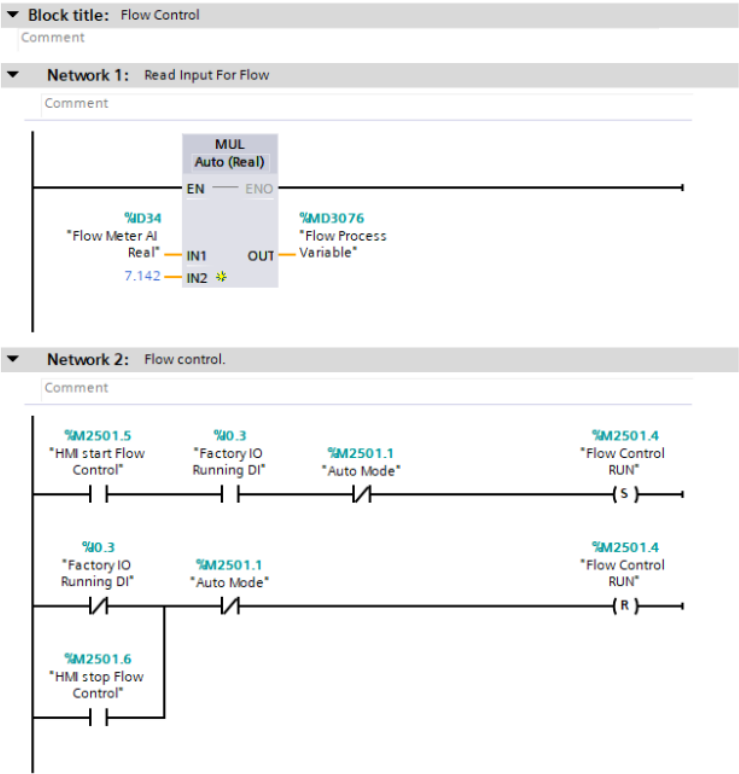


8.3.3 – Drain Valve Flow Control HMI



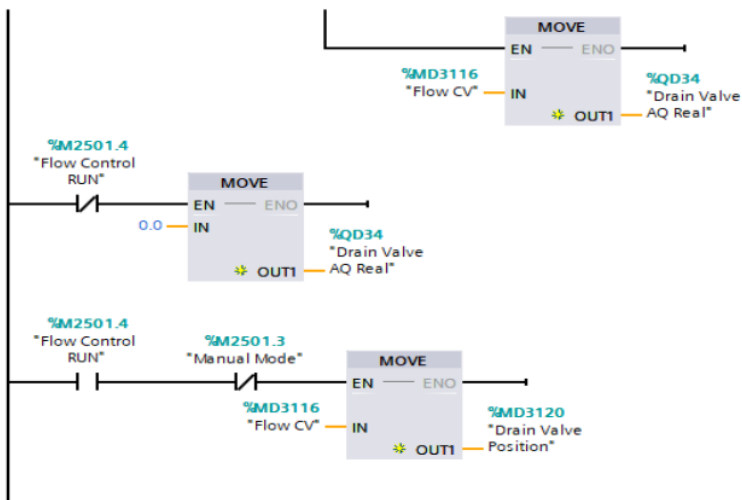
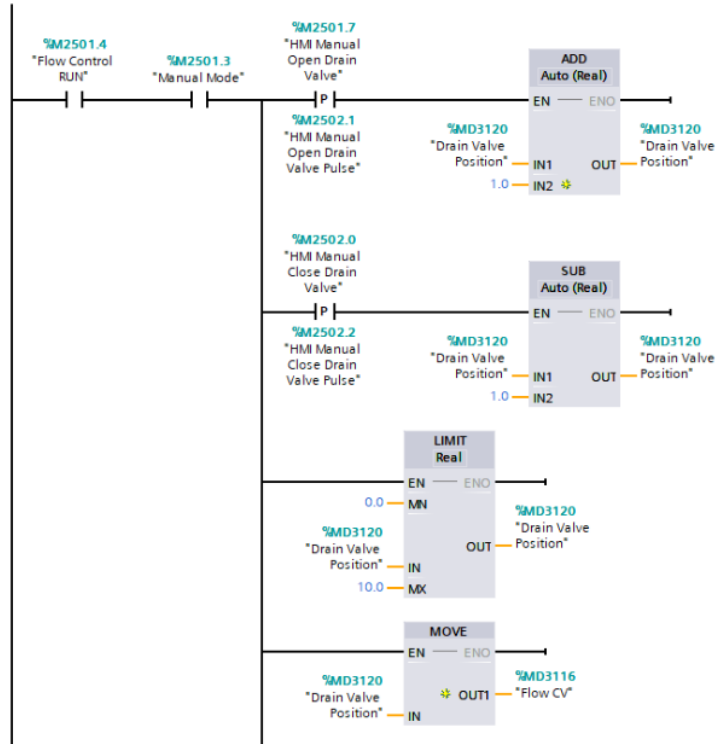
8.3.4 Flow Control

There are no comments to show understanding



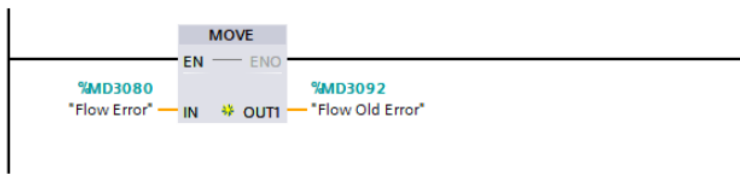
Network 3: Flow Drain Manual

Comment



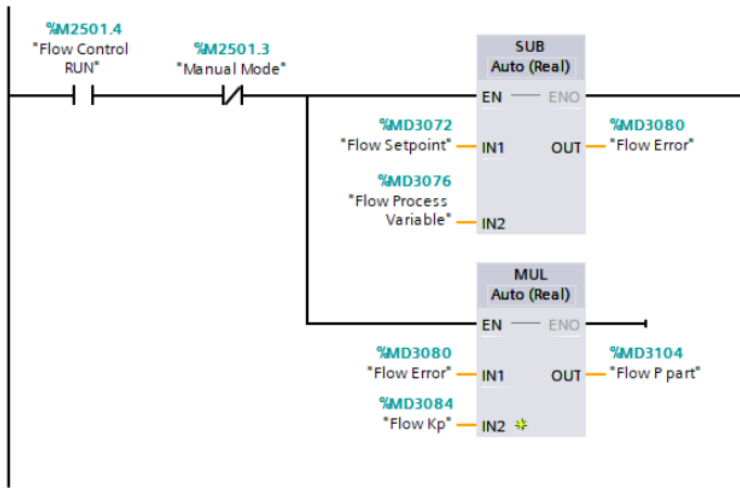
▼ **Network 4:** Stores the old error to calculate the D part for the PID control.

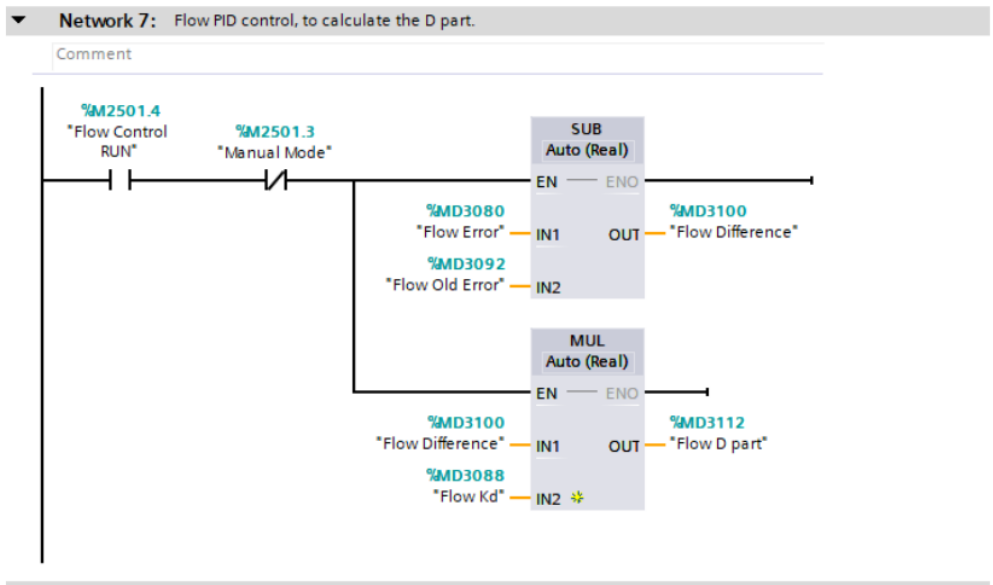
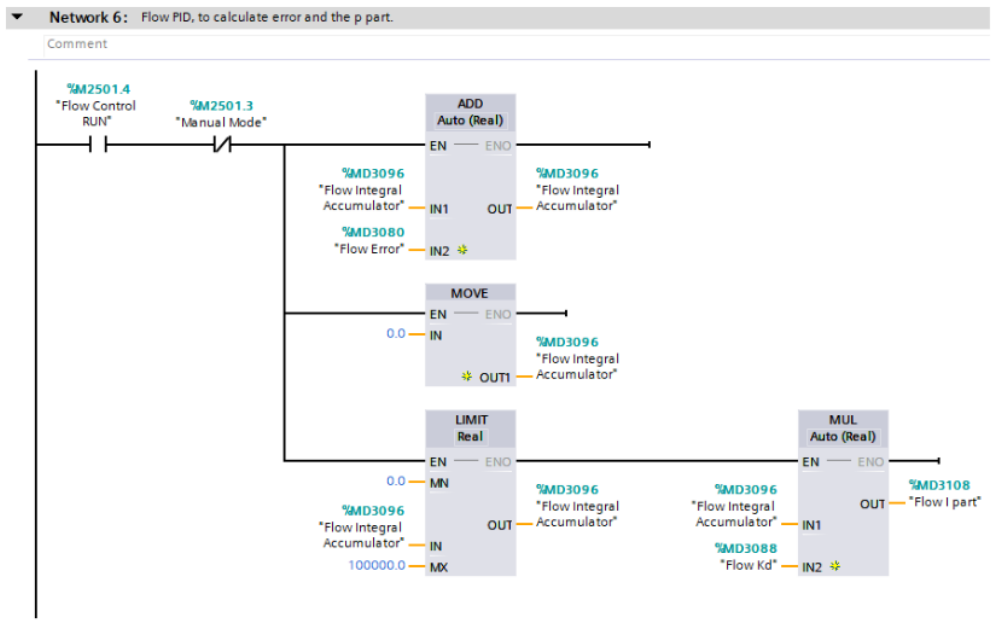
Comment



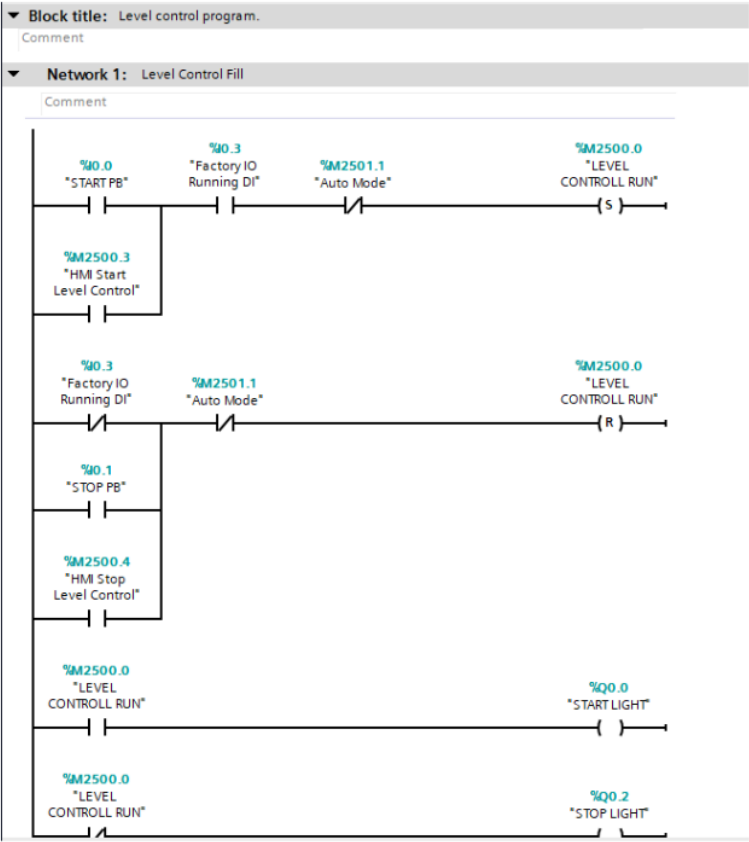
▼ **Network 5:** Flow PID control, to calculate the error and the p part.

Comment



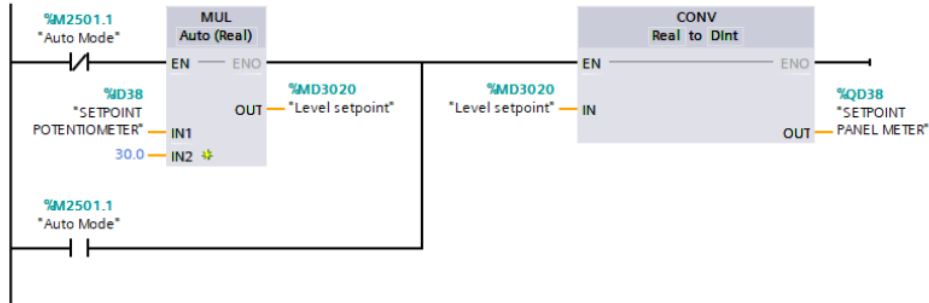


8.3.5 Level Control



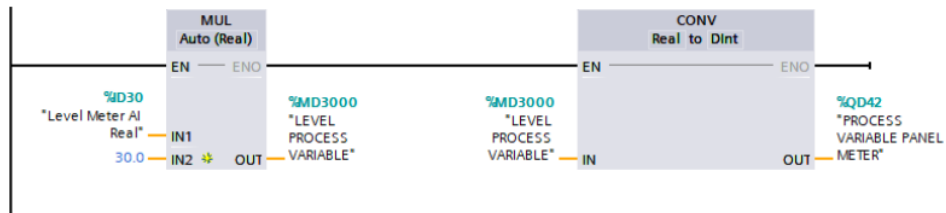
Network 2: Scale Level Setpoint

Scaling the analogue input for the level setpoint from volts into millimeters by multiplying 30 so at 10v the tank would be equal to 300cm.



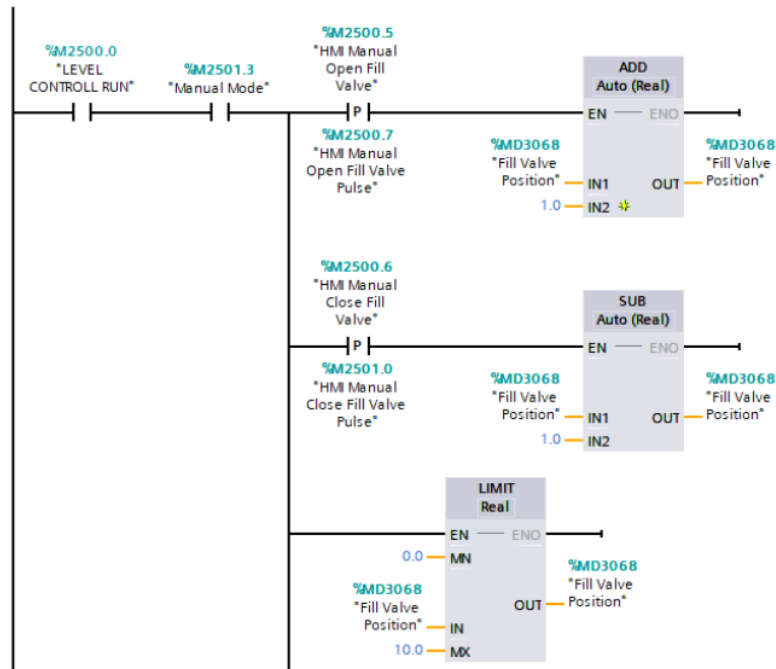
Network 3: Scale level, process variable and display.

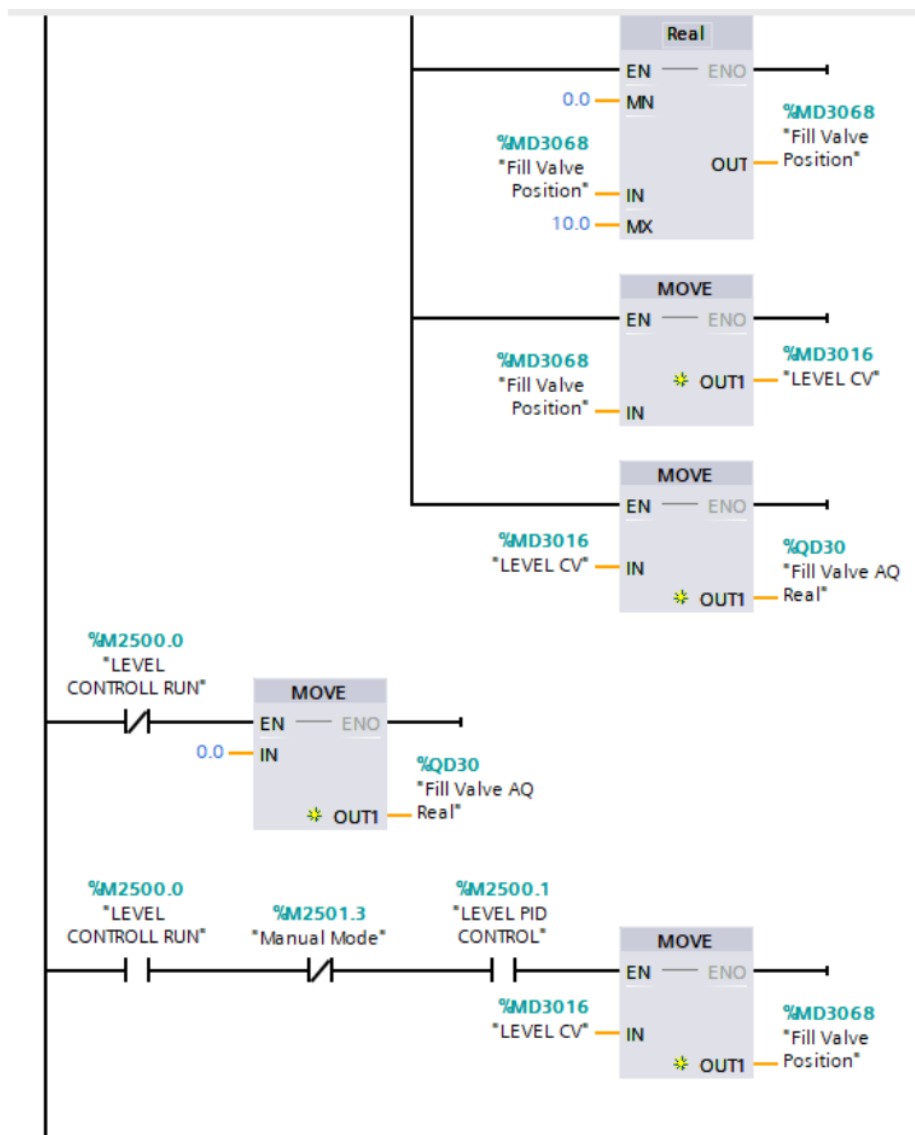
Comment



Network 4: Manual Control Fill Valve

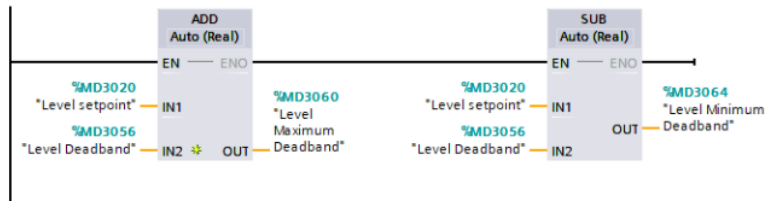
Comment





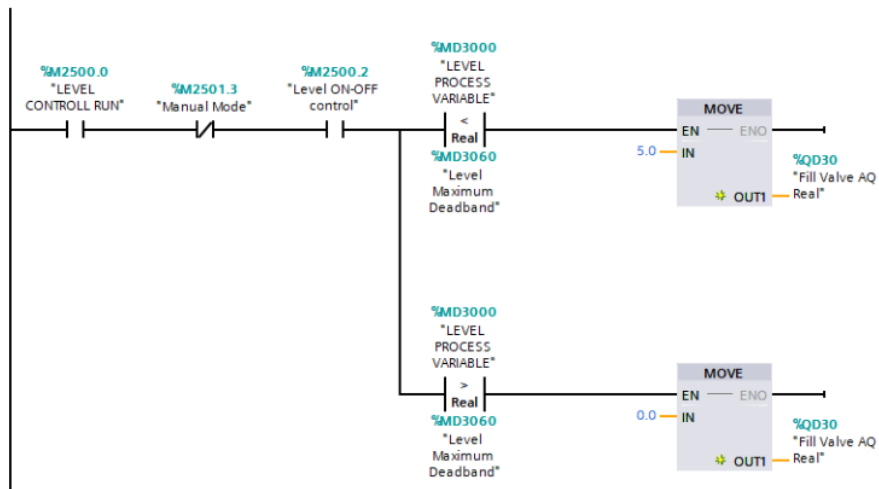
▼ **Network 5:** ON/OFF deadband control.

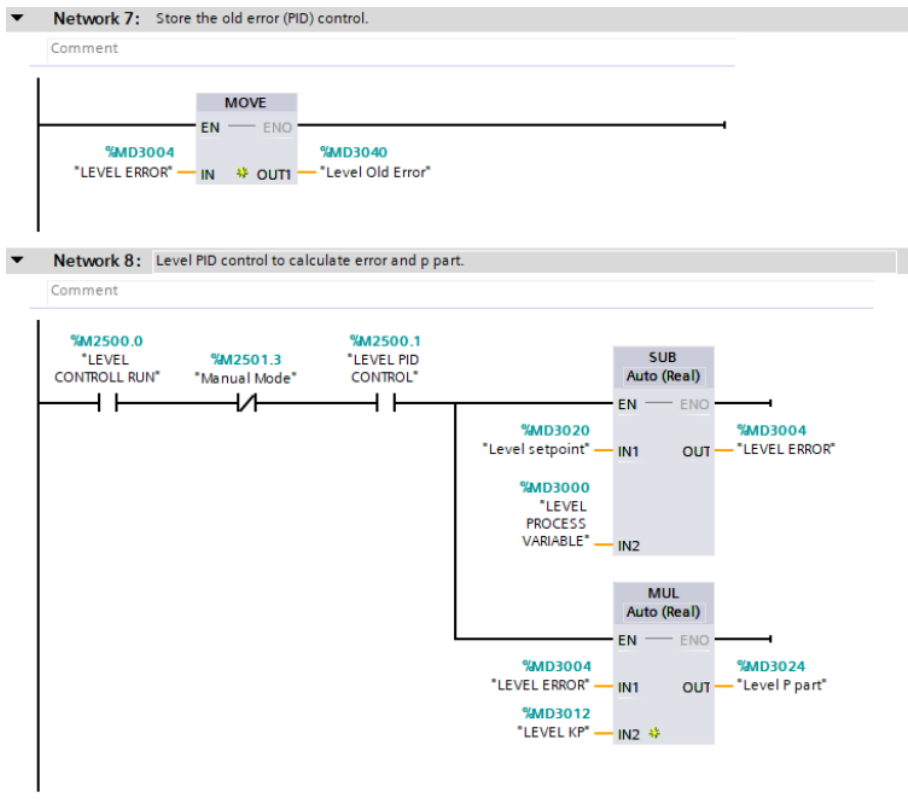
Comment



▼ **Network 6:** level ON/OFF deadband control.

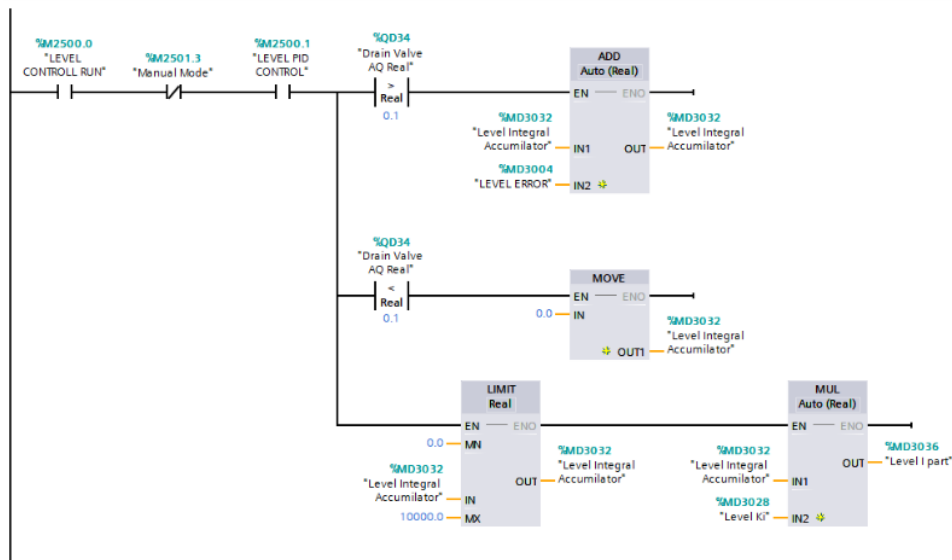
Comment





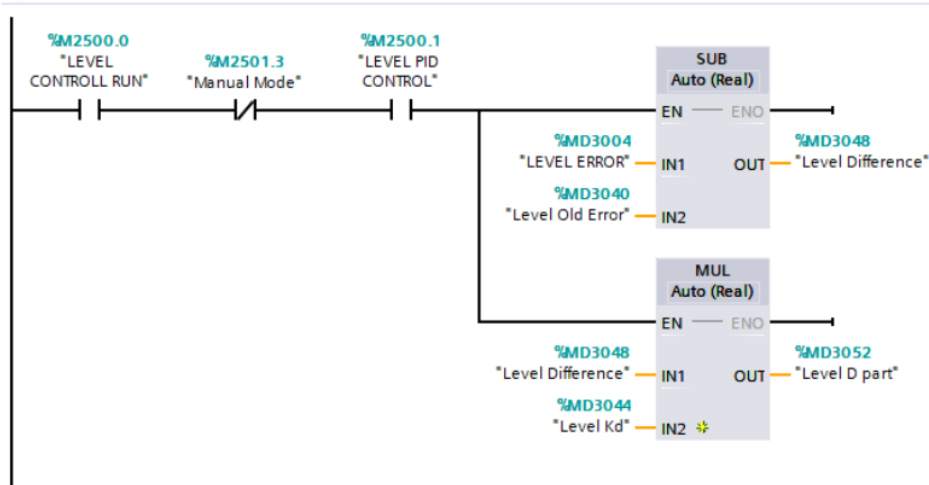
▼ **Network 9:** Level PID control in order to calculate i part.

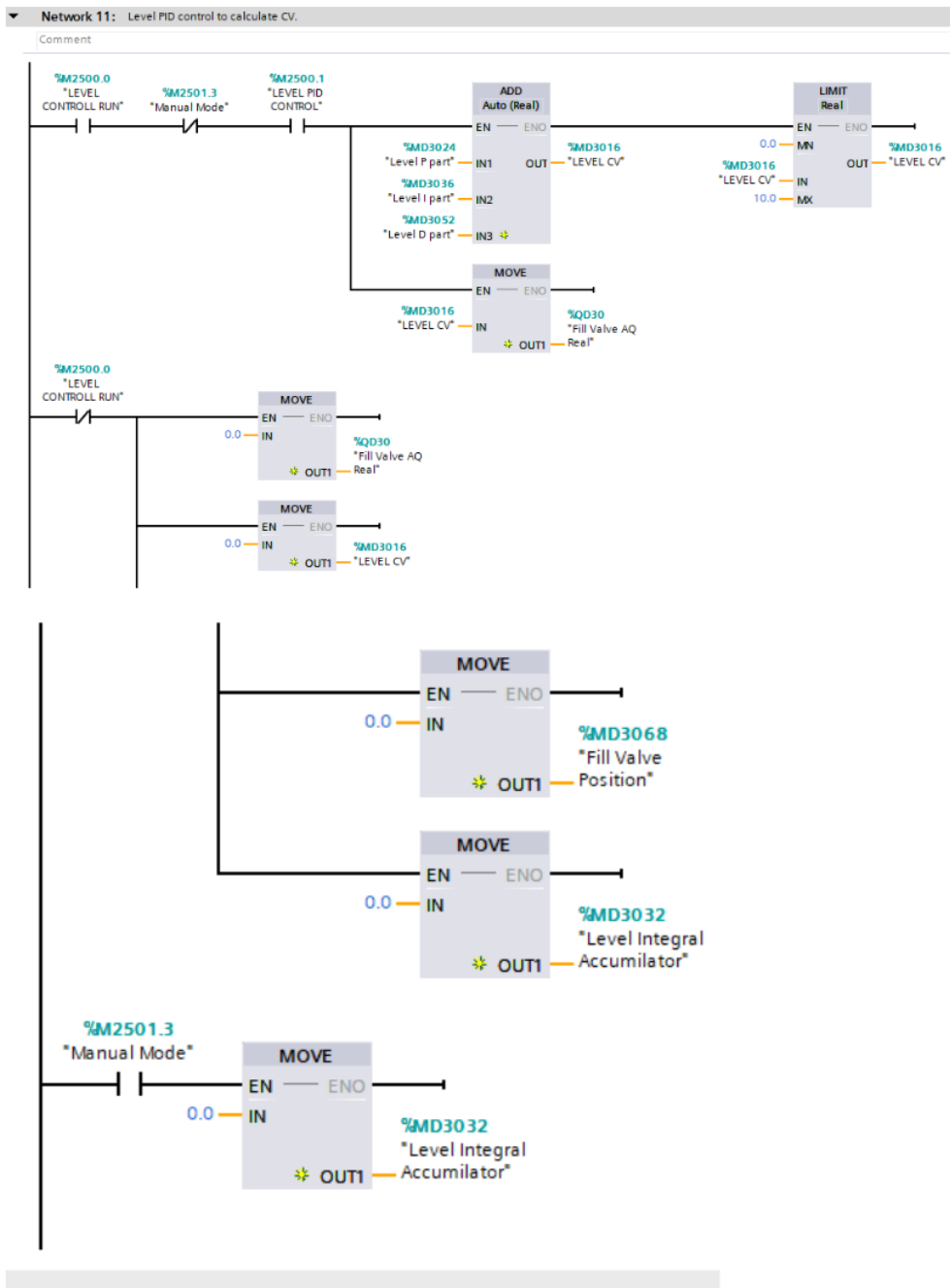
Comment



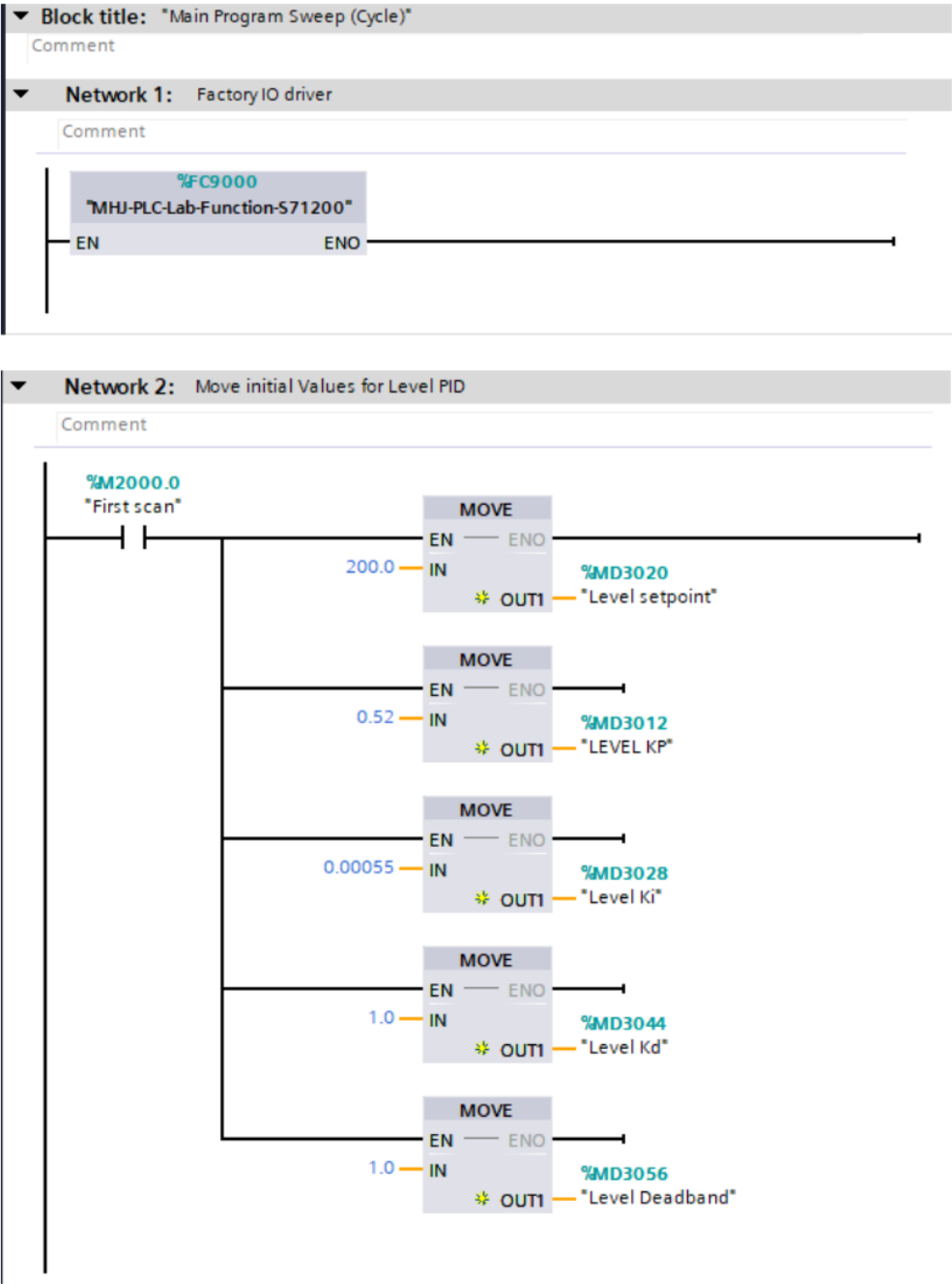
▼ **Network 10:** Level PID control to calculate the D part.

Comment



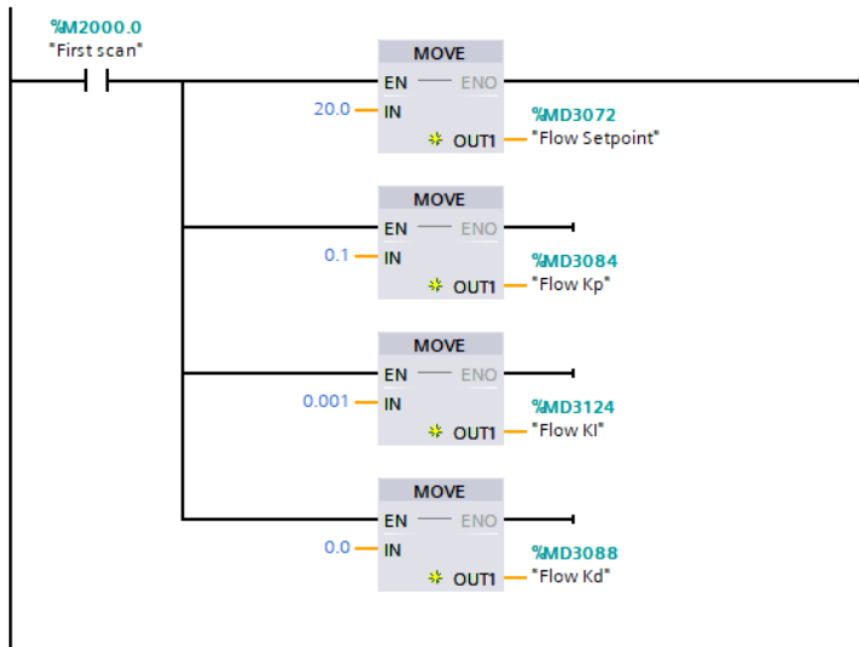


8.3.6 Main



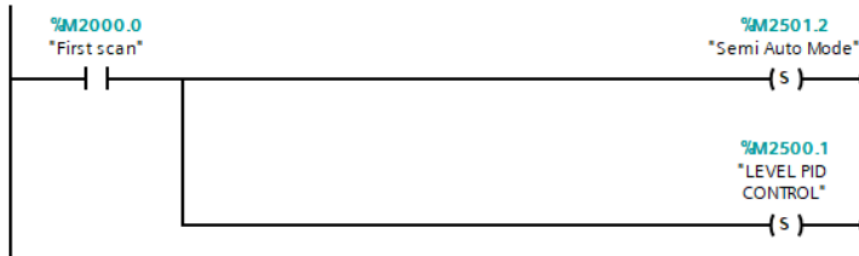
▼ **Network 3:** Initial Values for PID

Comment

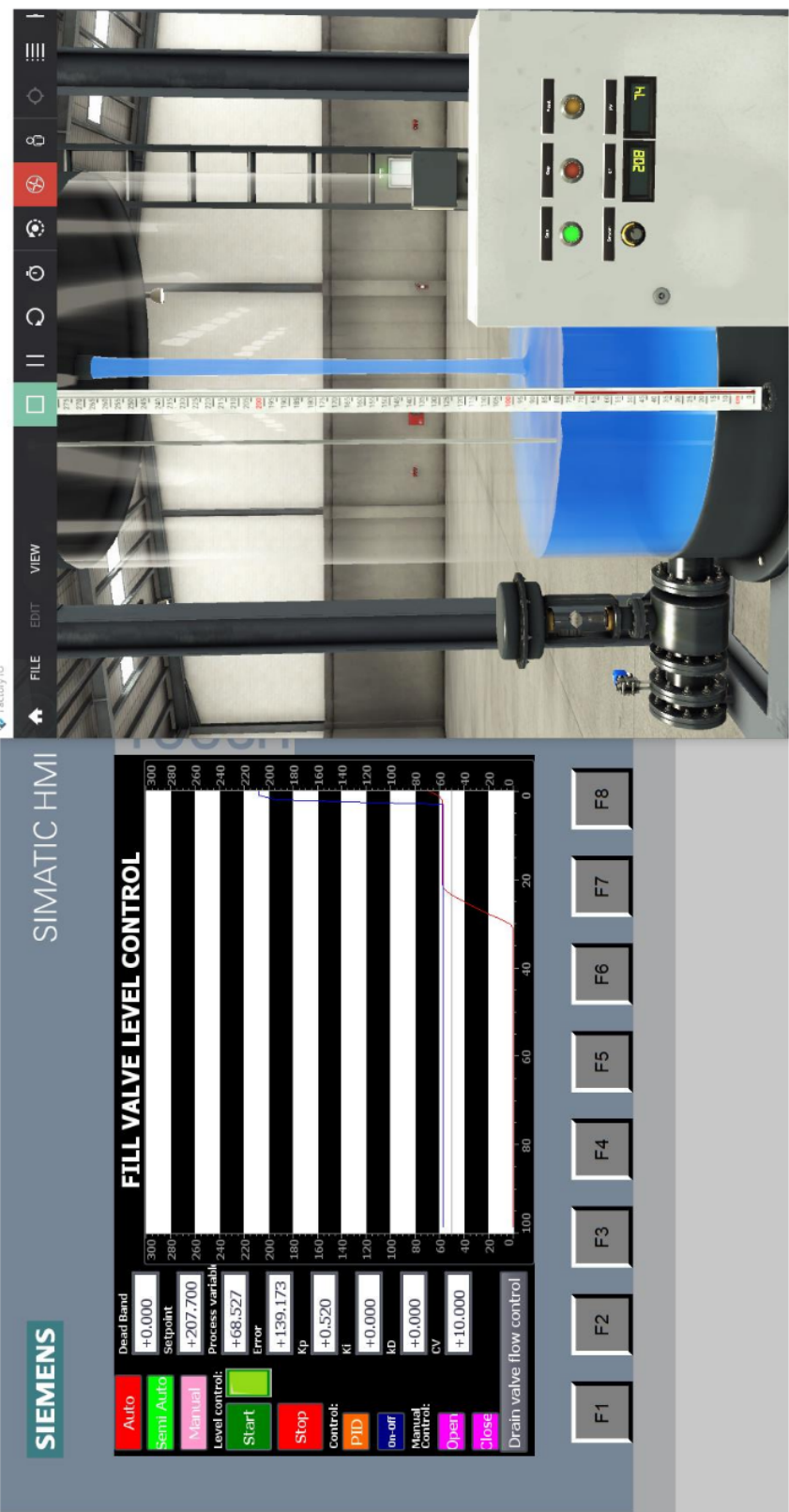


▼ **Network 4:** Mode on Startup

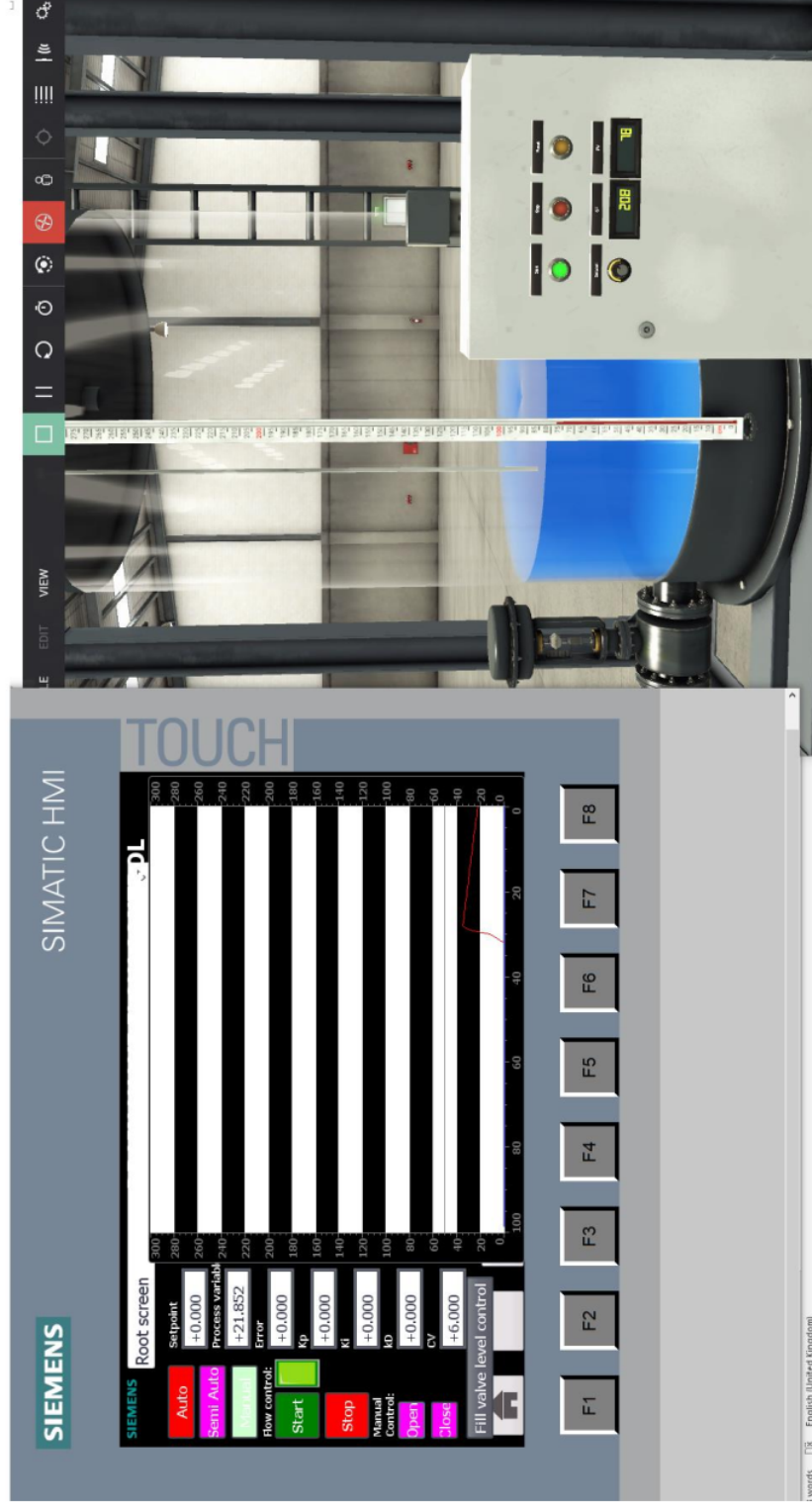
Comment



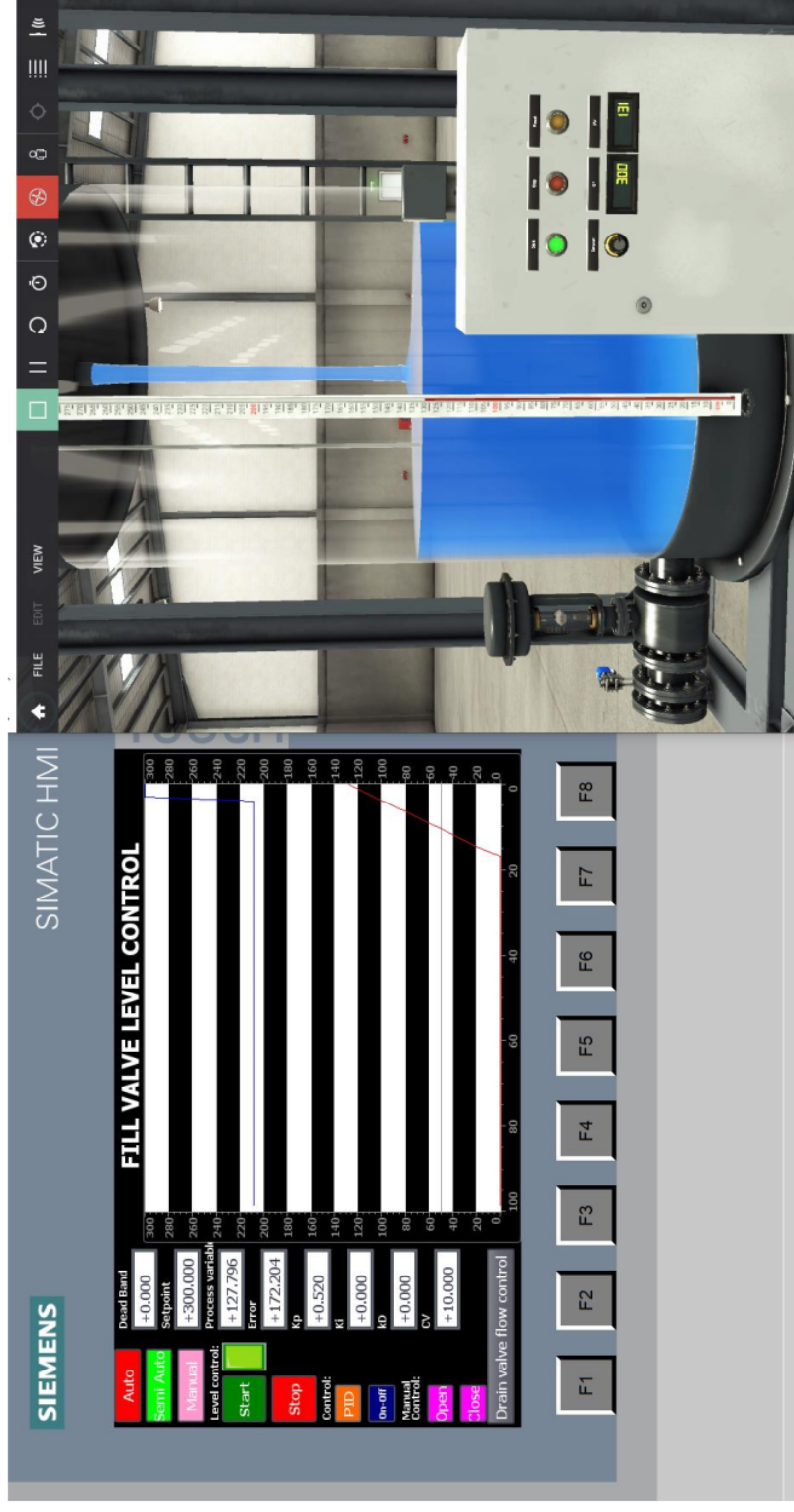
8.4.1 – Manual Filling



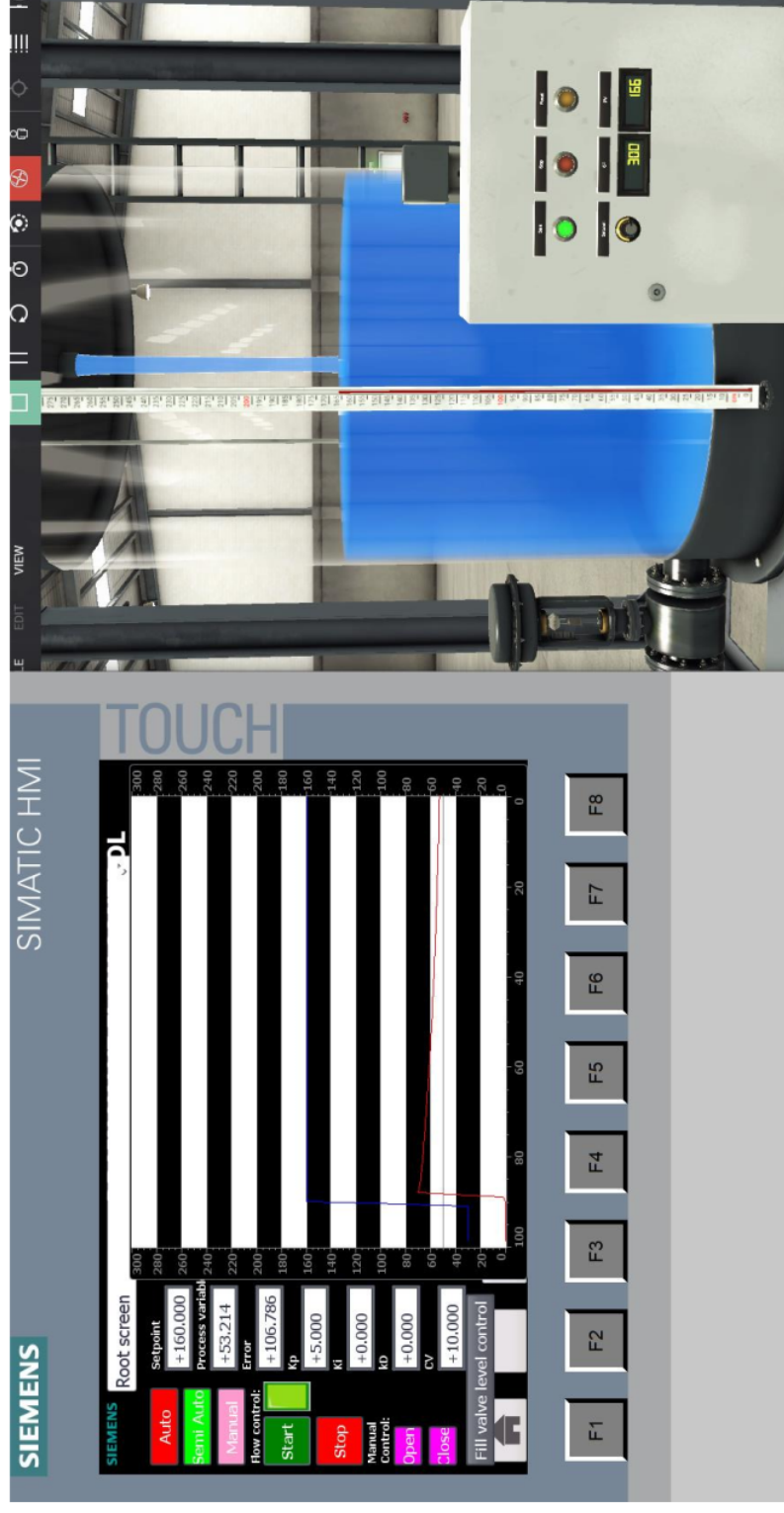
8.4.2 – Manual Draining



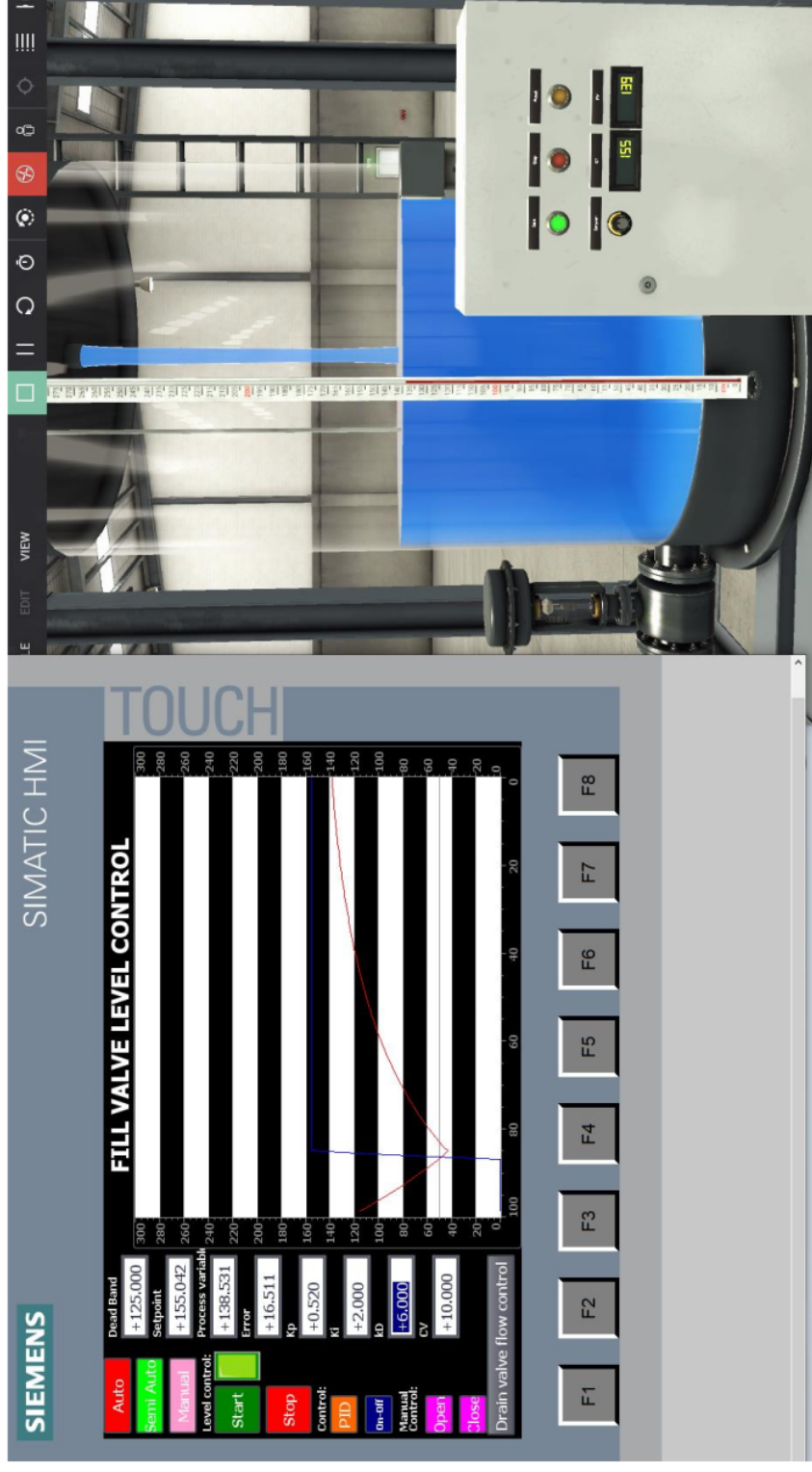
8.4.3 – Semi Auto Fill



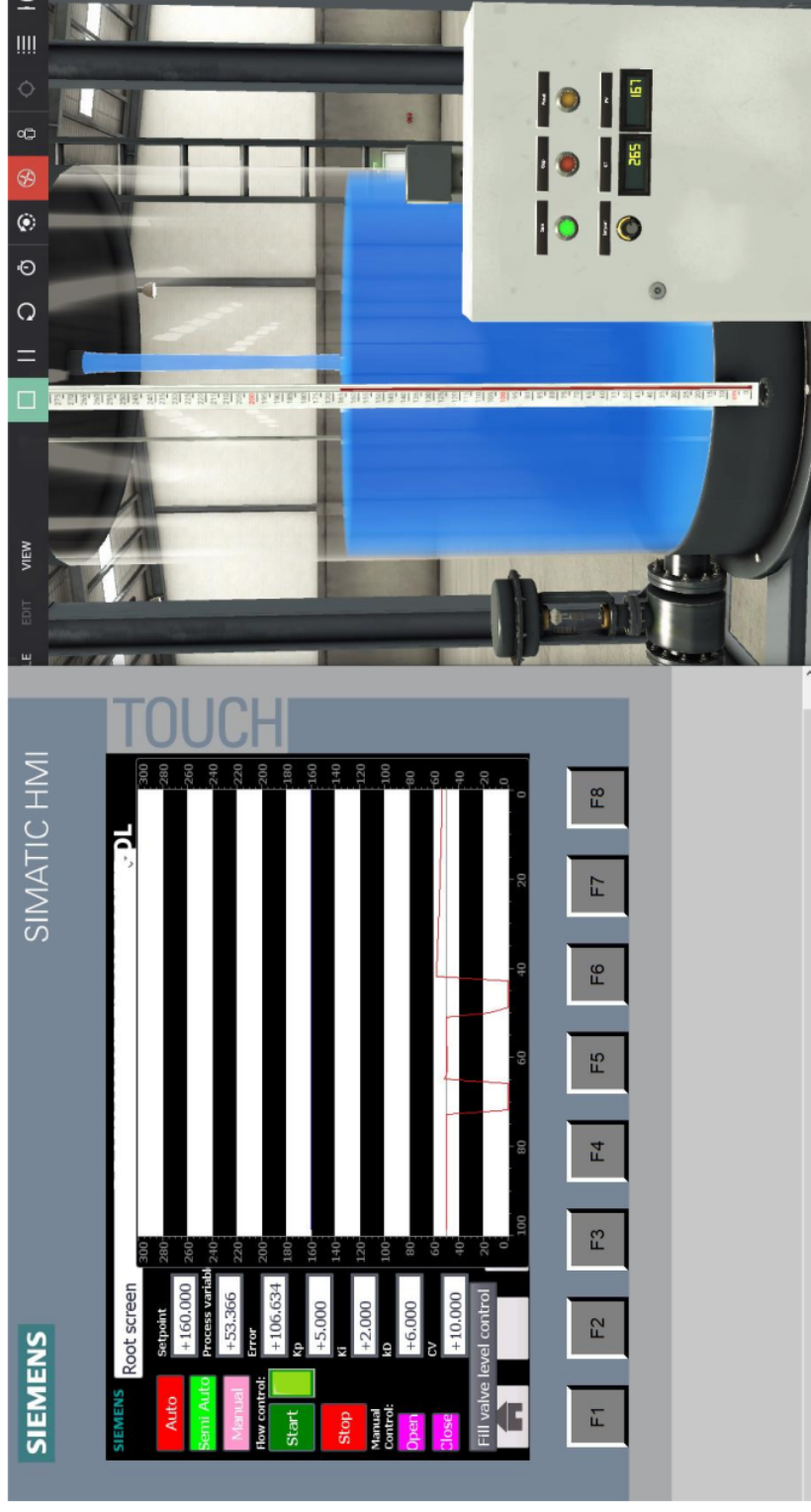
8.4.4 – Semi Auto Drain



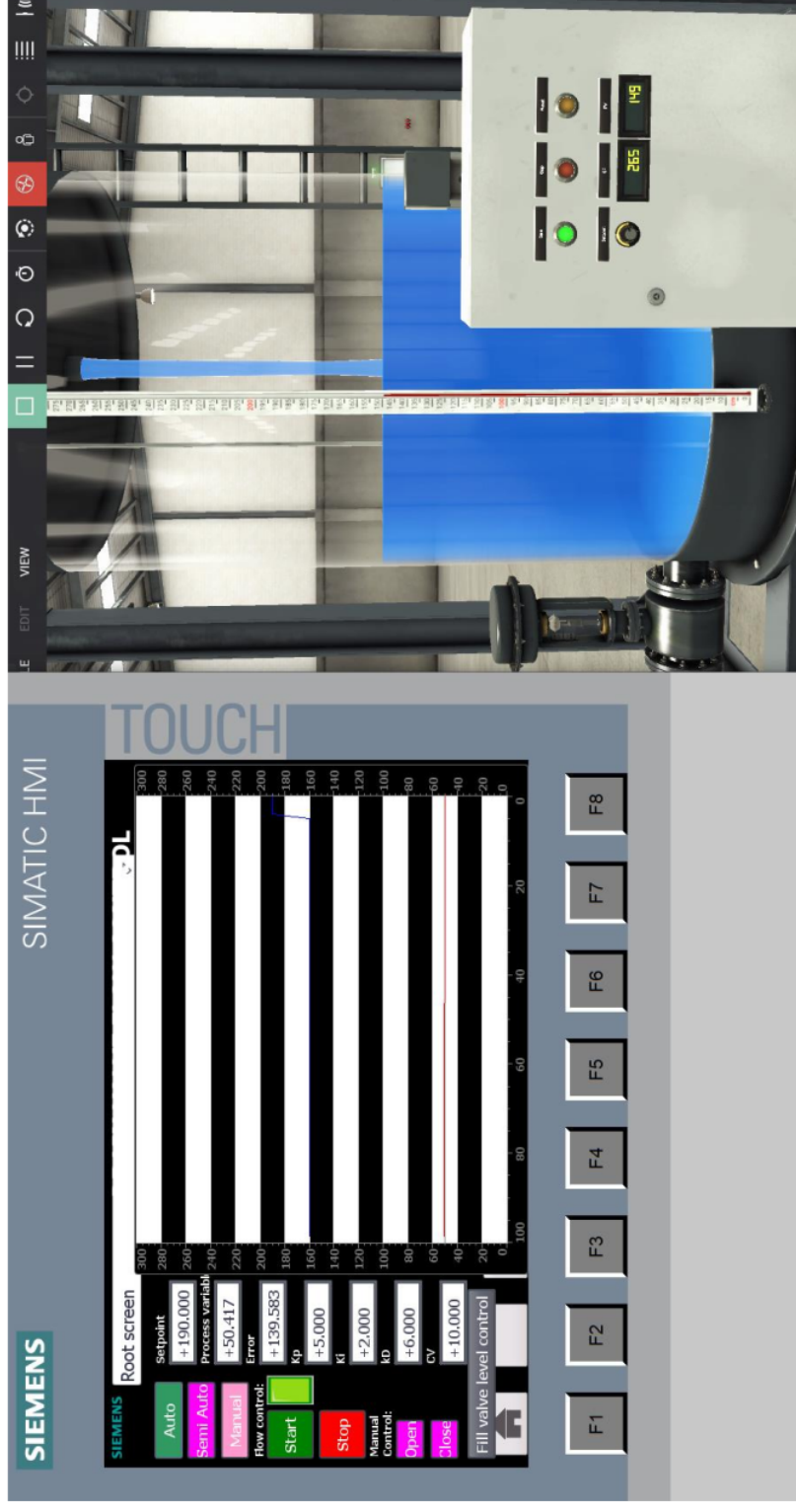
8.4.5 – Dead Band Set



8.4.6 – Tuning Valves

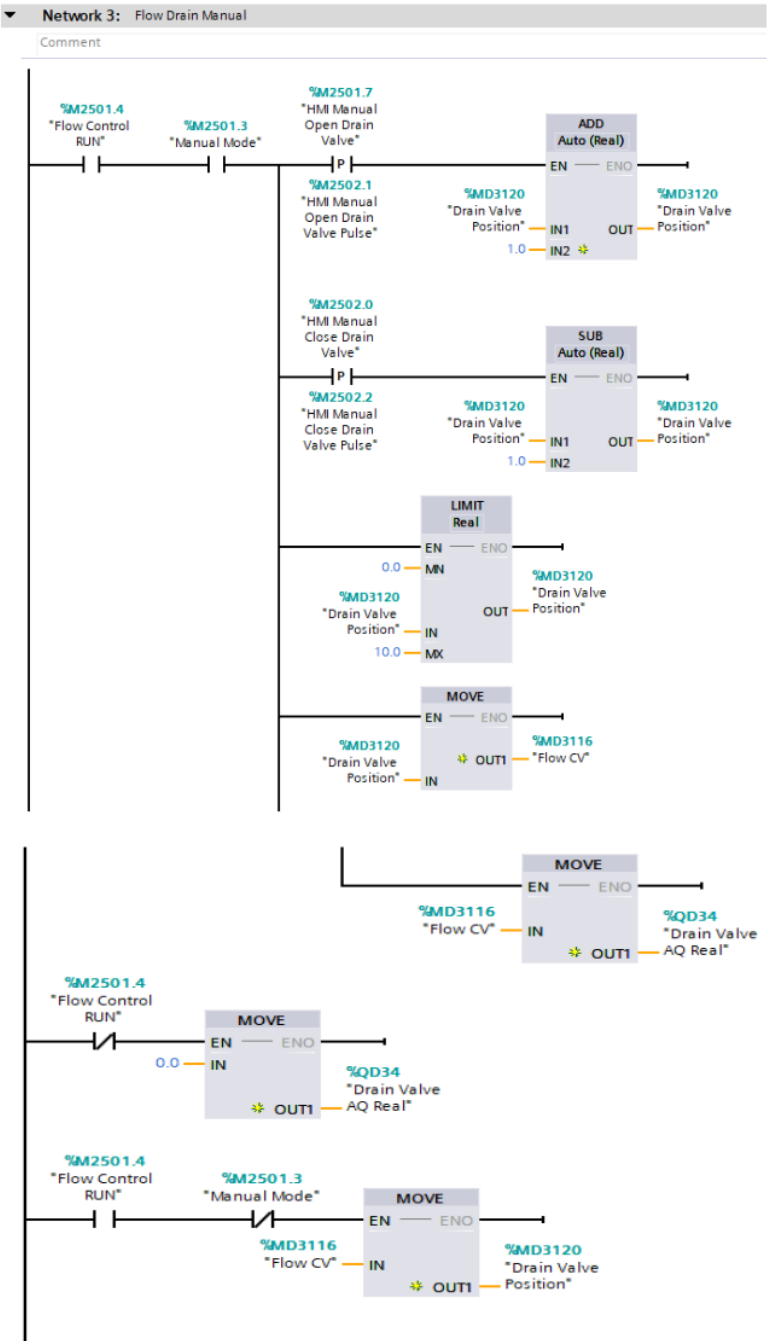


8.4.7 – Automatic Mode



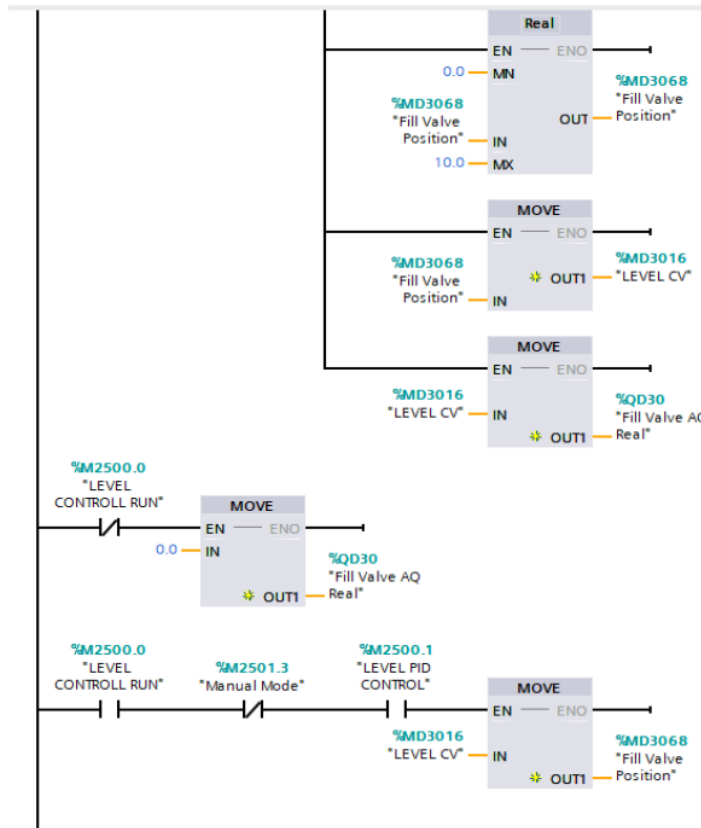
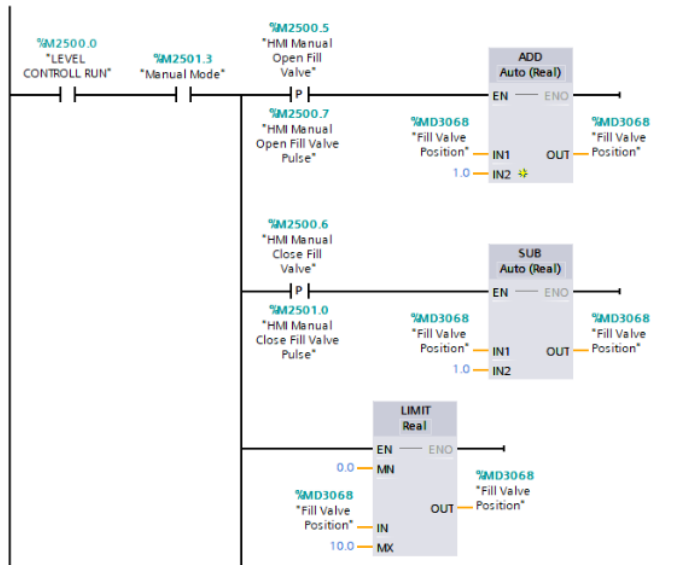
8.5. – User Requirements

8.5.1 - Manual Controls



Network 4: Manual Control Fill Valve

Comment



FINAL GRADE

GENERAL COMMENTS

Instructor

54/100

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QM

Correctly cited

Citation method conforms to Harvard standard, well done.

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PAGE 8

Text Comment. This is supposed to be an IO list not a tag table, columns 2 and 4 are not necessary at this point

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Text Comment. the two sensors for level and flow should have their own symbols but you have drawn them as potentiometers

Text Comment. There should be an analogue output module also

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Text Comment. There are no comments to show understanding

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GRADING FORM: NEW CSG-RUBRIC

HARRI JONES

1. ENGAGEMENT WITH LITERATURE

-  Engagement with an extensive range of relevant and credible literature. Consistently accurate application of referencing. (14/20) **14**

2. KNOWLEDGE AND UNDERSTANDING

-  Knowledge of the basic underlying concepts and principles is accurate with a good understanding of the field of study but lacks depth and/or breadth. (10/20) **10**

3. COGNITIVE AND INTELLECTUAL

-  Good evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data, with minor errors. An emerging ability to use evidence to support the argument. Mostly valid arguments and logical judgements. (10/20) **10**

4. PRACTICAL APPLICATION

-  A good and appropriate application of basic methods, materials, tools and/or techniques. Clear **10**

appreciation of the context of the application.
Good evidence of different approaches to
problem-solving in particular contexts and
proposes mostly appropriate solutions. (10/20)

5. TRANSFERABLE SKILLS



Mostly coherent, organised and accurate work, in a suitable structure and is for the most part clearly expressed. Can work effectively independently and/or as part of a team, with clear contribution to group activities. Demonstrates the skills for employment requiring the exercise of some personal responsibility, with some areas of strength and some of minor weakness. (10/20)

10