



Level Control with DeltaV

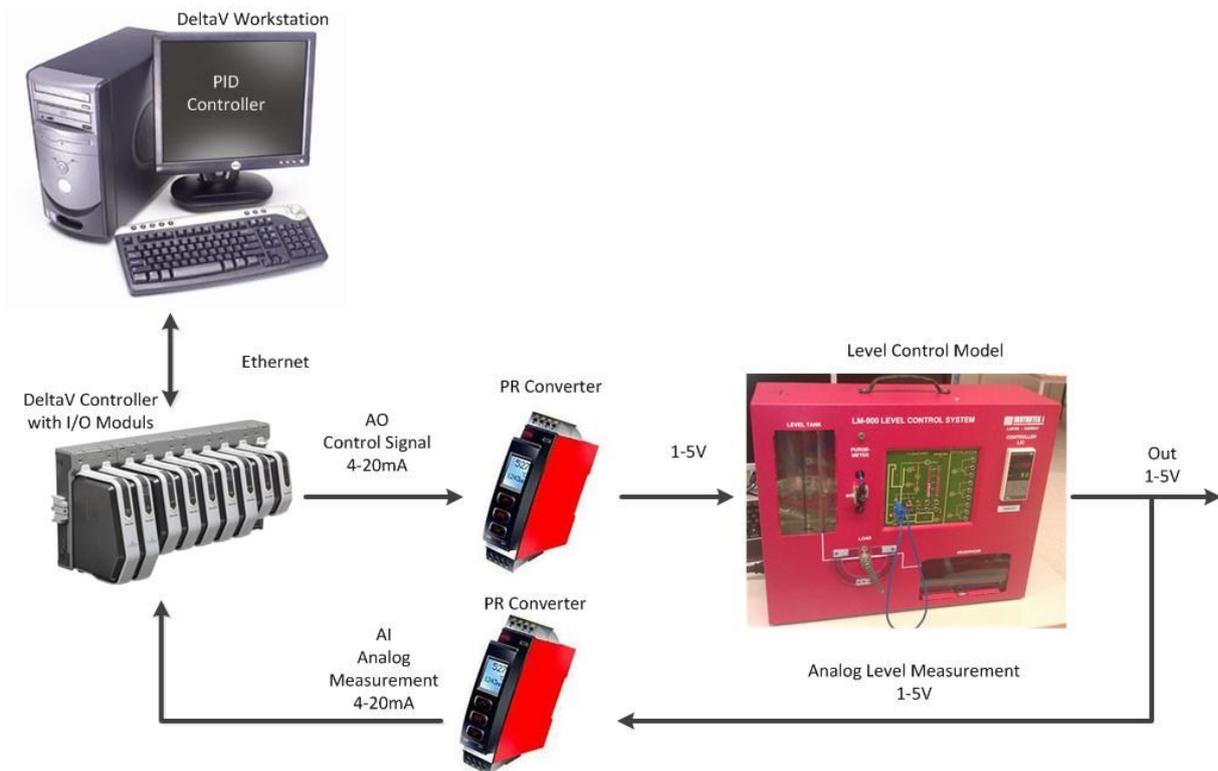


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1 INTRODUCTION

In this task you will learn how to create a program and a HMI to regulate the level in a tank model using a PID in DeltaV. Figure 1-1 shows the Level Control System you will be regulating.



Figure 1-1 Level Control System

Equation (1-1) is the mathematical calculation of the volume in the tank.

$$A * \frac{dx}{dt} = K * (u - u_0) - F_{out} \quad (1-1)$$

Where:

- $X[\text{cm}]$ is the level in the tank
- $U[\text{v}]$ is the control signal to the pump
- u_0 is the bias voltage needed to get any flow (with u less than u_0 there is no flow into the tank).
- $A[\text{cm}^2]$ is the cross-sectional area
- $K[(\text{cm}^3/\text{s})/\text{V}]$ is the pump gain
- $F_{out}[\text{cm}^3/\text{s}]$ is the outflow through the valve

2 PROGRAM

In this chapter we will learn how to create the program used to control the level in the level control system.

Before we start to program in DeltaV we would like to start on an empty program where no in or outs are used. This is easily done with the use of database. To avoid adding all the hardware configurations each time, we have premade a database that is empty, but contains the hardware configurations we need.

The First thing you need to do is to log on to the DeltaV station with username: Administrator and password: deltav. When this is done choose DeltaV Desktop. Click on the start-menu and Database Administration. Double click on the icon Copy Database, choose Student1 and write your name in the Copy to field. Figure 2-1 is showing you how it should look like.

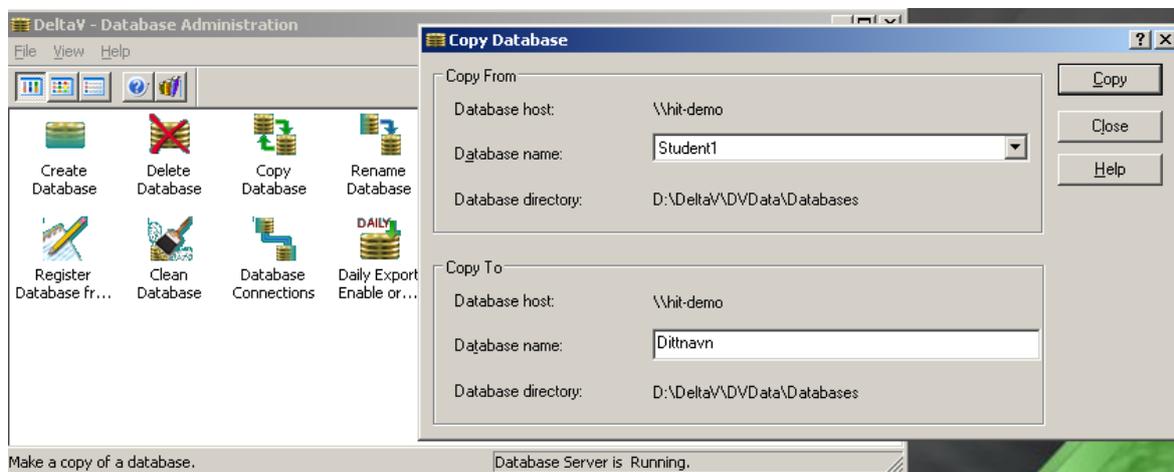


Figure 2-1 Database

Now set the database you just made active, with the Set Active Database button. Select the database you just made and press ok.

Your database is now created and activated. Go back to start menu and start DeltaV Explorer.

Right click on control strategies and choose new area. Call this area Level control.

We now have a new area called Leven control. Now we just need to configure a control module. Grab a PID module from library. See Figure 2-2.

Choose Library→Module Templates→ Analog Control, Select the PID_LOOP and drag and drop it down to your Area called Level control.

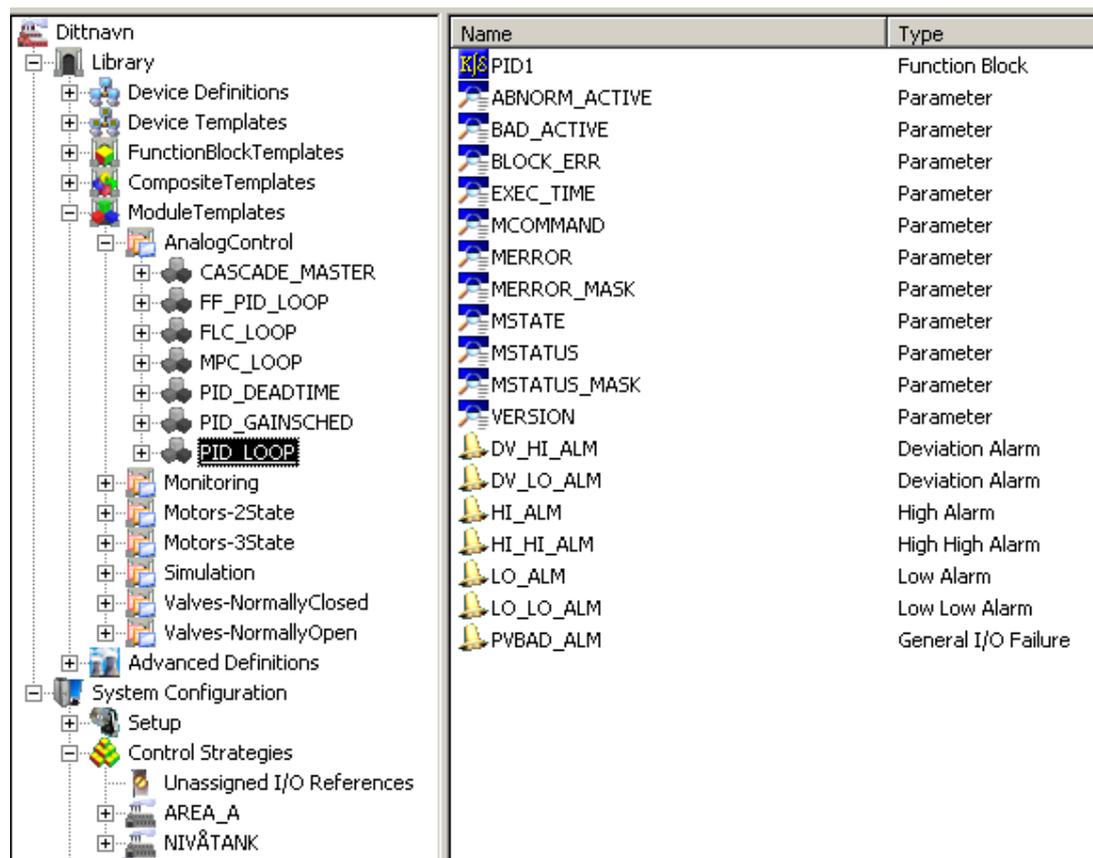


Figure 2-2 PID_LOOP

You will find the PID loop you just added in your Level Control area. Right click the PID_LOOP and choose open with Control Studio. See Figure 2-3.

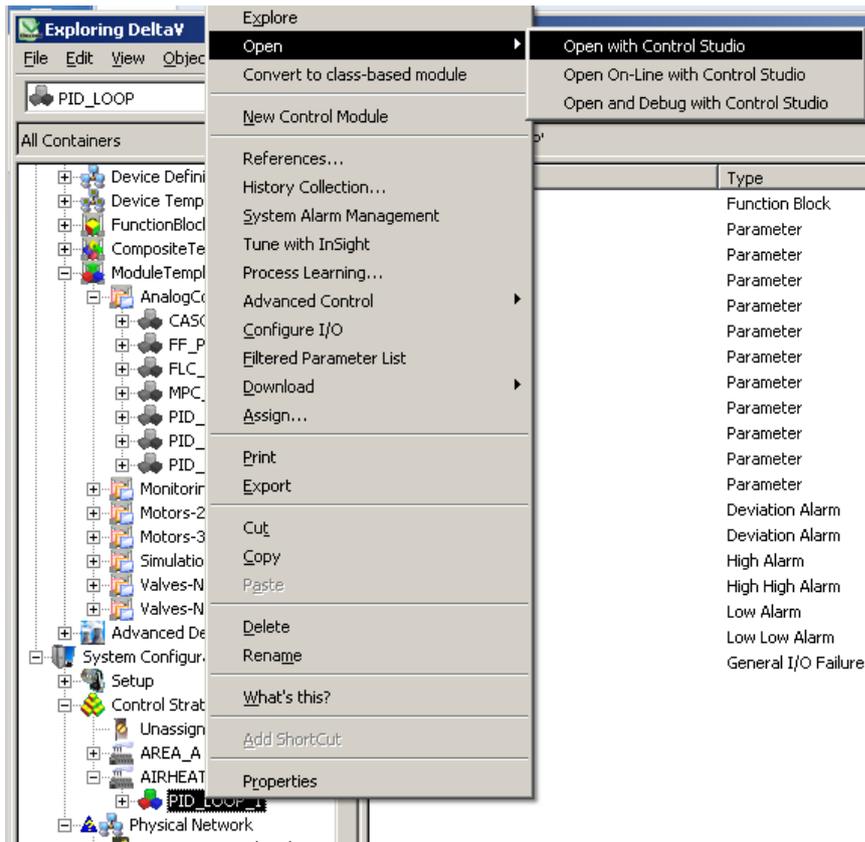


Figure 2-3 Open with Control Studio

We can now see we have a PID block. To control the level we need one Analog inn and one Analog out. We need to connect these to the block. Right click the PID block and choose Assign I/O-To-Signal Tag. See Figure 2-4.

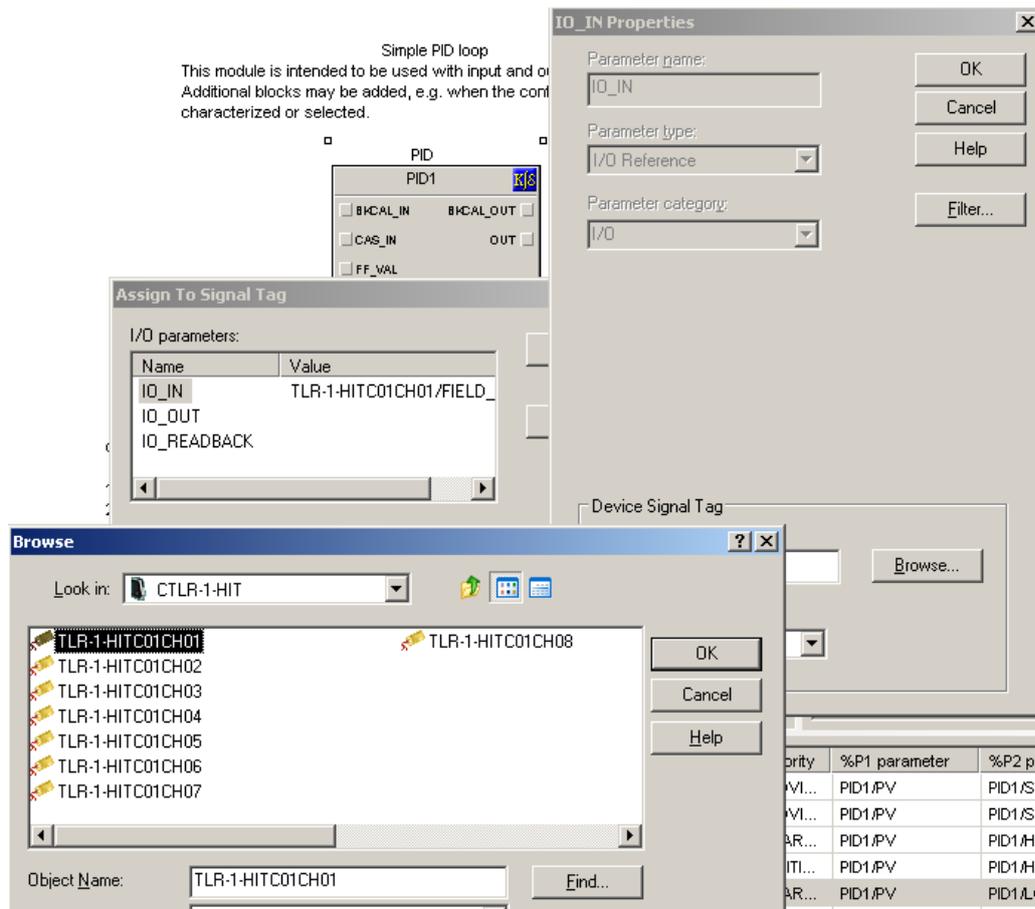


Figure 2-4 Assign I/O to signal tag

First choose IO_IN and press modify.

Browse Device Tag, Double click CTRL and choose TLR-1-HITC01CH02. This is the second analog in on the analog in module (CH01).

Press ok until you get back to where you can choose IO_OUT. Browse device Tag, double click CTRL and choose TLR-1-HITC02CH01. This is the first analog out on the analog out module (CH01). Press ok and then close. We have now connected the I/O to the PID controller.

Now we need to activate the I/O. This is done in Exploring DeltaV. Choose applications → I/O configuration. See Figure 2-5.

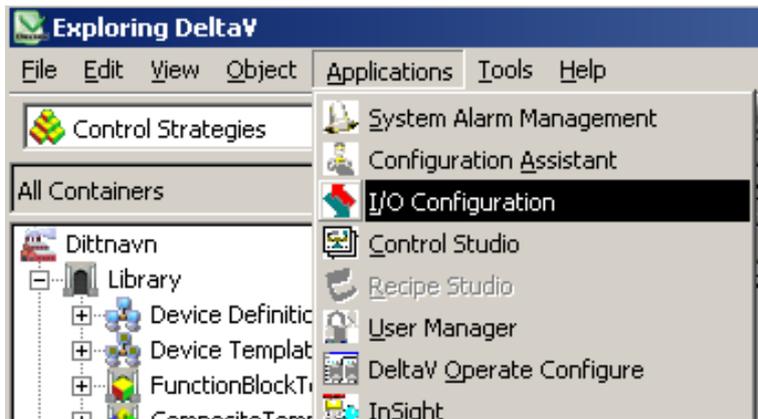


Figure 2-5 Exploring DeltaV

Here we can see all the modules that are connected to the station. See Figure 2-6. Choose C01 and right click the CH02 and enable it. Do the same with C02→CH01. CH02 under C01 and C02 should now be activated.

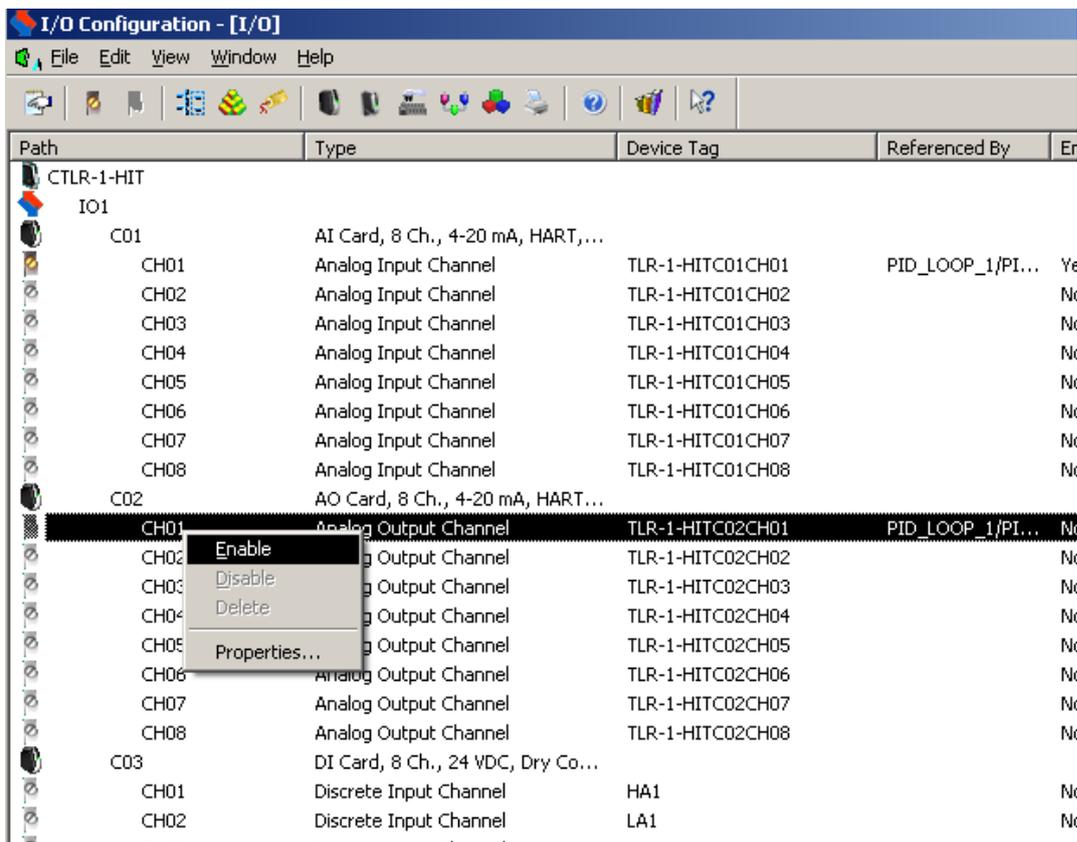


Figure 2-6 Configuration - I/O

Now we need to return to Control Studio and download our program. This is done by pressing the big arrow called Download. See Figure 2-7. You will then get a question box that asks if you want to assign the module. Press yes, Choose CTLR-1-HIT, press Ok, and yes on the Control Studio box. After that, press ok and yes on everything until you have downloaded. If you get any error messages just press Ok and proceed.

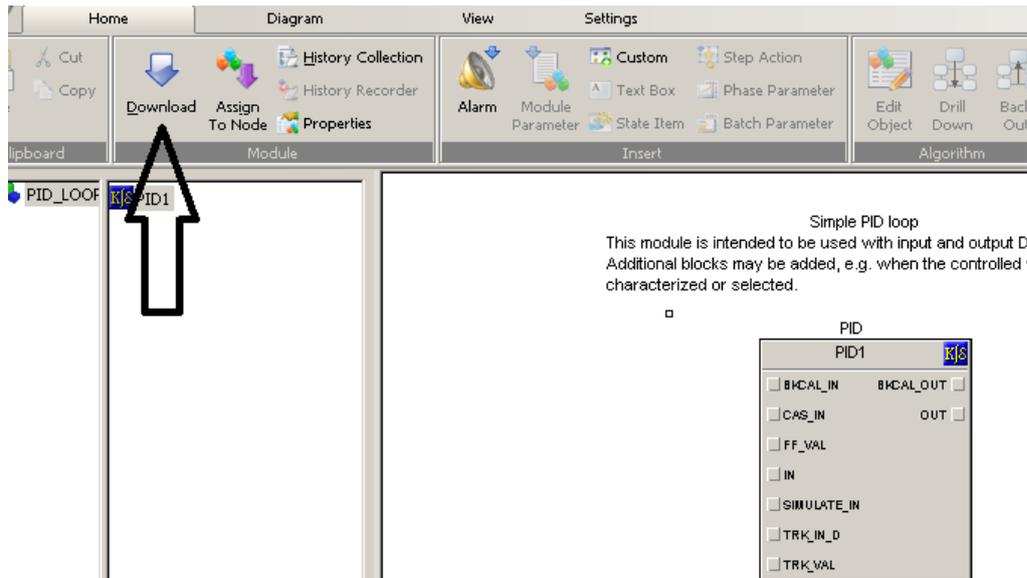


Figure 2-7 Download

The control module and I/O is now connected to the hardware module. For alarms and such to work we need to connect this to the history module that is premade in DeltaV

Then we return to Exploring DeltaV, choose Level Controand and drag and drop it down to Alarms And Events. See Figure 2-8.

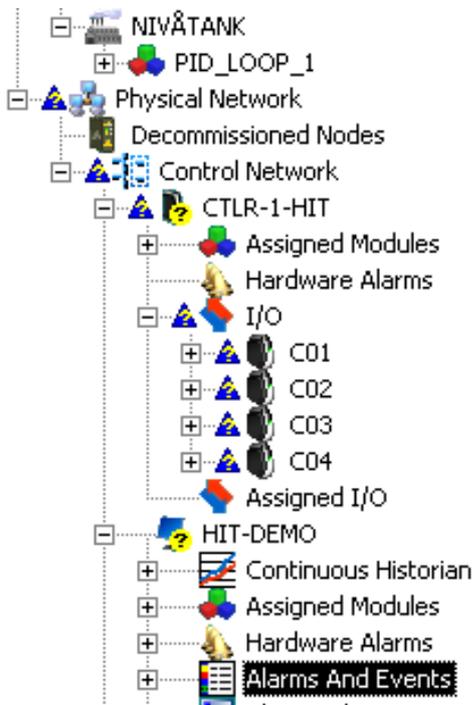


Figure 2-8 Alarms And Events

The last thing that needs to be done before we start making the user interface is to make sure everything is downloaded. Right click on Physical network and choose Download physical

network. Right click again and download setup data. Right click on Control Network, choose download control network. Right click again and download Setup Data. See Figure 2-9

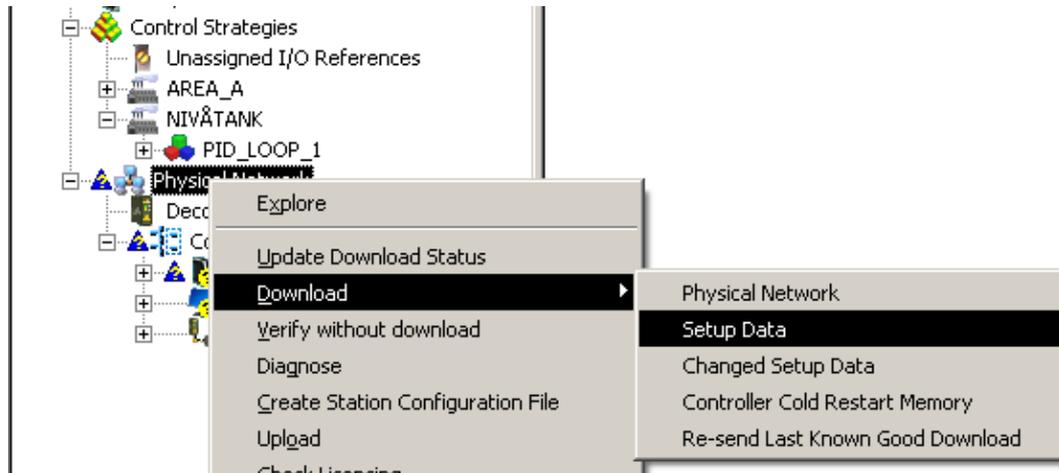


Figure 2-9 Download Setup Data

Enter CTRLR-1-HIT, right click I/O and press download.

Before we make our Interface we need to download the program in Control Studio once more. See Figure 2-10. Every time you make a change to the program we need to download it again.

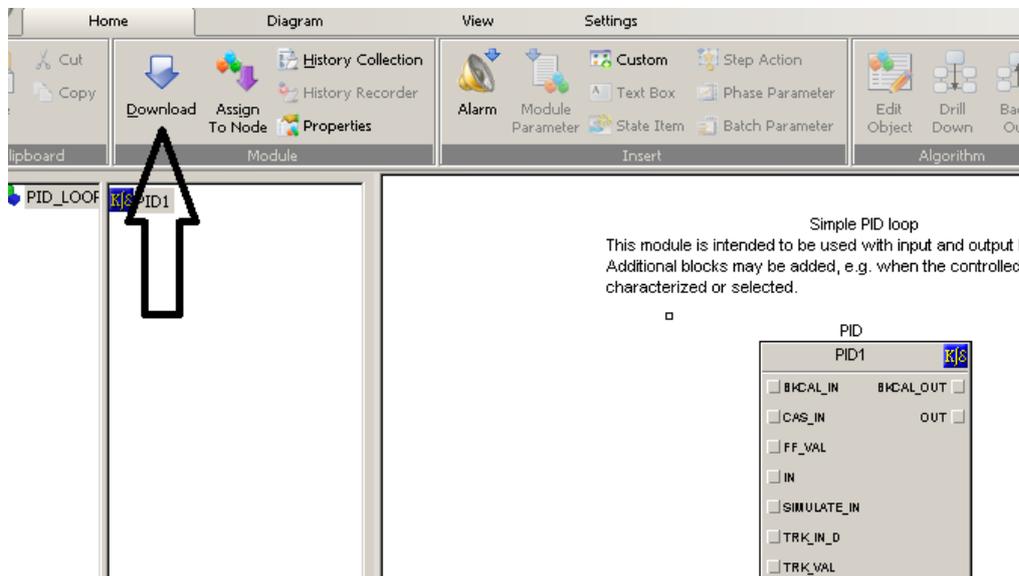


Figure 2-10 Download Again

The program should now be ready. We just need to make the HMI

3 HMI

To be able to read and write values and simulate a process we need to create an HMI.

When you are in Exploring DeltaV. Go to applications and press DeltaV Operate Configure. See Figure 3-1

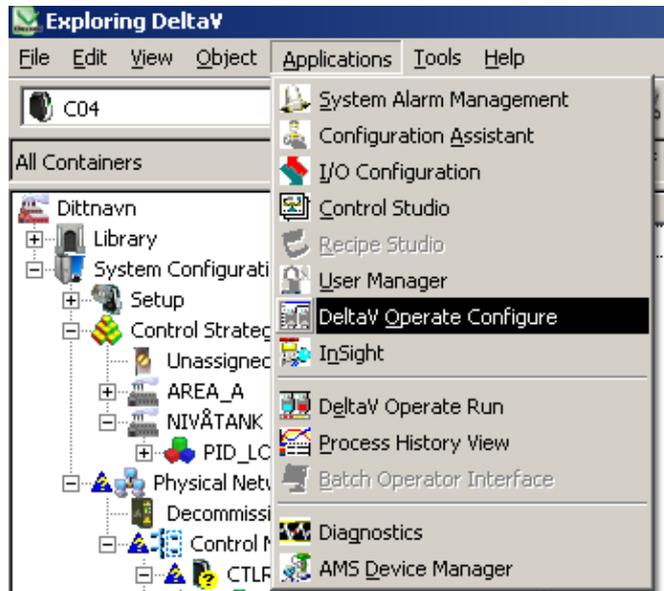


Figure 3-1 Exploring DeltaV

Press the +sign on the folder Pictures, then templates and double click on main. You will then get a standard picture. See Figure 3-2.

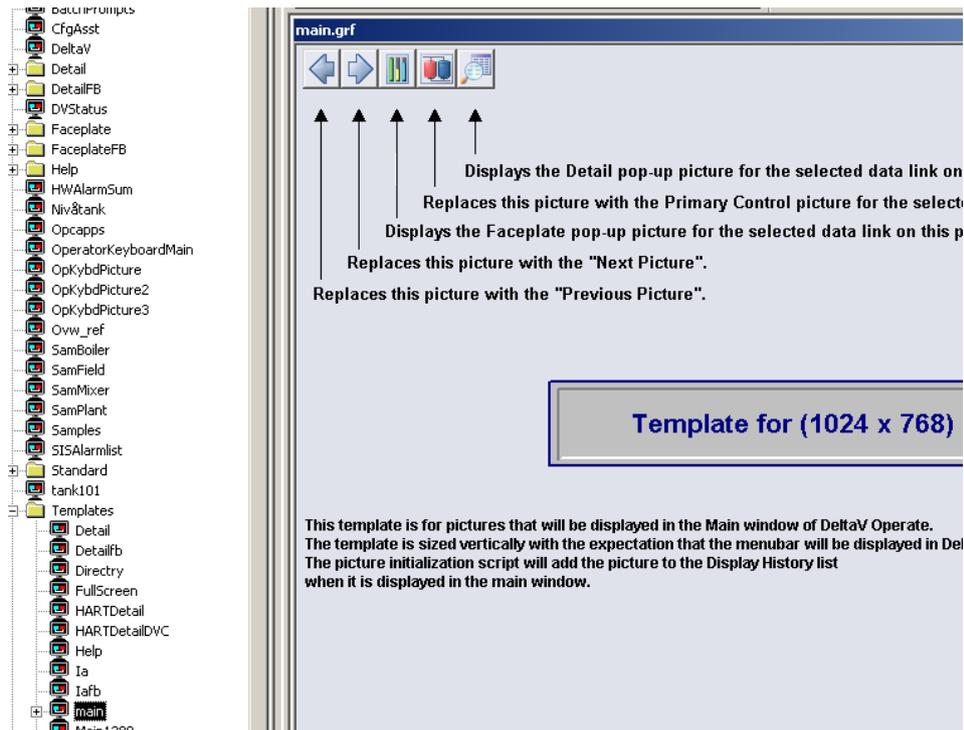


Figure 3-2 Main Picture

Delete all the text on the picture so you get a black picture like the one below. See Figure 3-3.

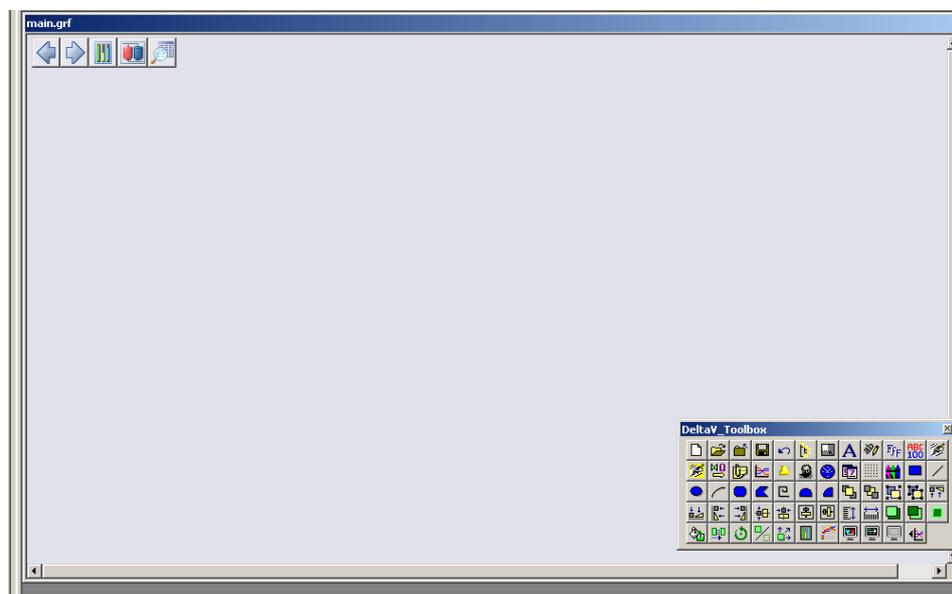


Figure 3-3 Blank Picture

Now we can begin creating our interface. In the left column you will find premade components. We will need a tank, a pump and some pipes. We choose TanksAnim under Dynamo Sets. Drag and drop the tank to our drawing board. This tank needs to be connected to our I/O to be able to simulate the level. See Figure 3-4.

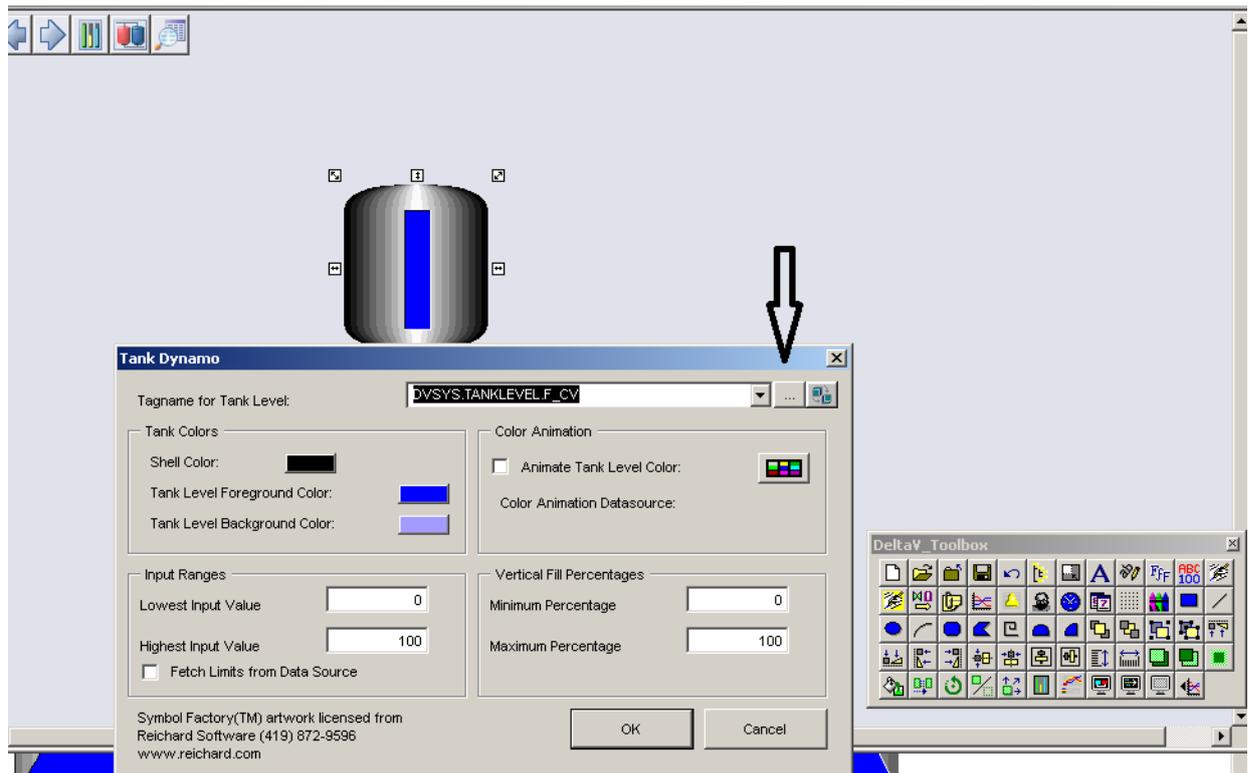


Figure 3-4 Tank

Press the  button. After that, press brows DeltaV, Control parameters, level control, PID_LOOP_1, PID1 and double click PV. See Figure 3-5.

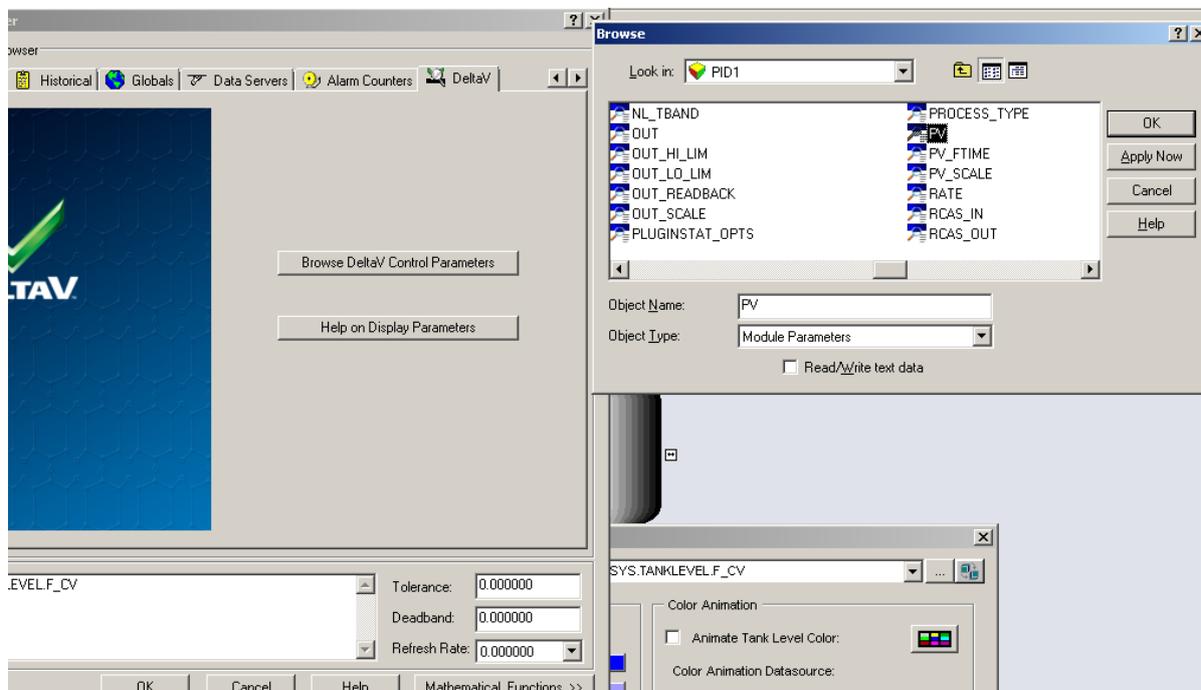


Figure 3-5 Connect PV

Press ok until you get back to the picture. We will now find a pump.

Choose a suitable pump from PumpsAnim and drag and drop it onto the drawing board.

This we can be connected to the I/O. check the box for Animate Pump Color. Press the  button and do exactly the same as you did when connecting the tank, except that you will choose OUT instead of PV.

We can also choose what kind of color the pump will have at different values. Choose green color when the pump starts. See Figure 3-6.

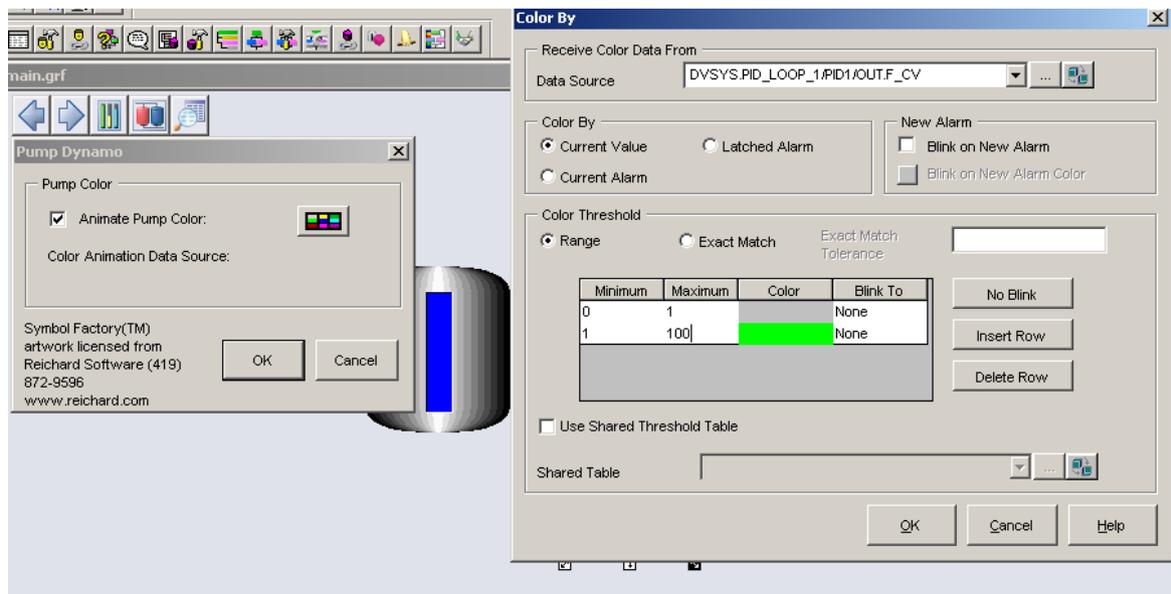


Figure 3-6 Pump Color

Now we need to draw some pipes. Just drag and drop some pipes onto the drawing board and adjust them. See Figure 3-7.

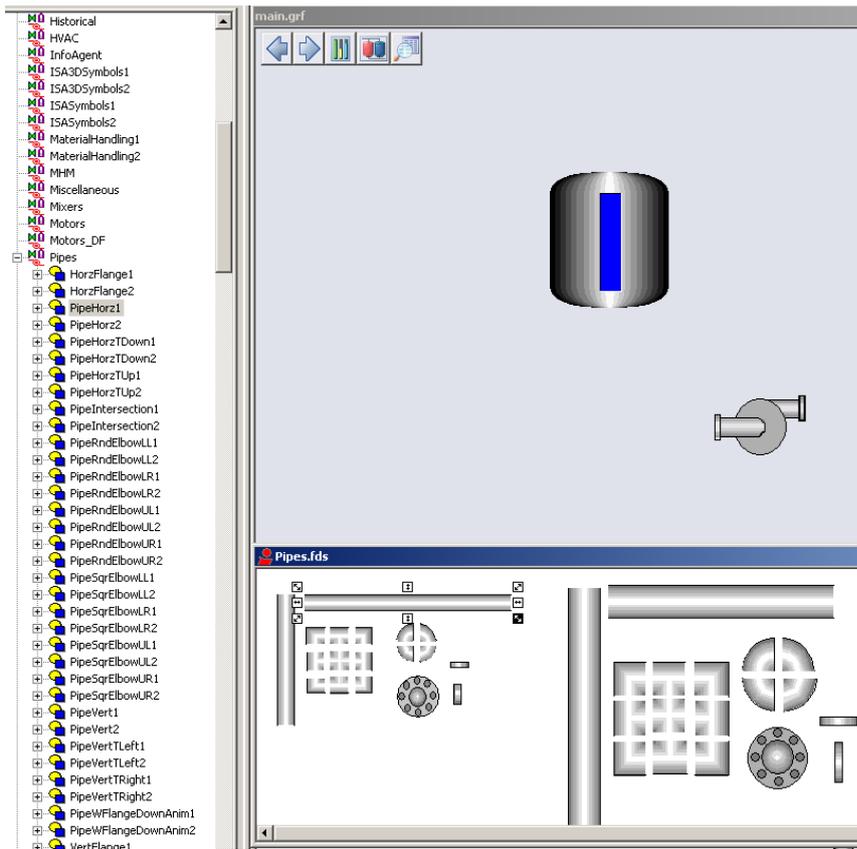


Figure 3-7 Pipes

The picture can for example look like this. See Figure 3-8. There are loads of opportunities.

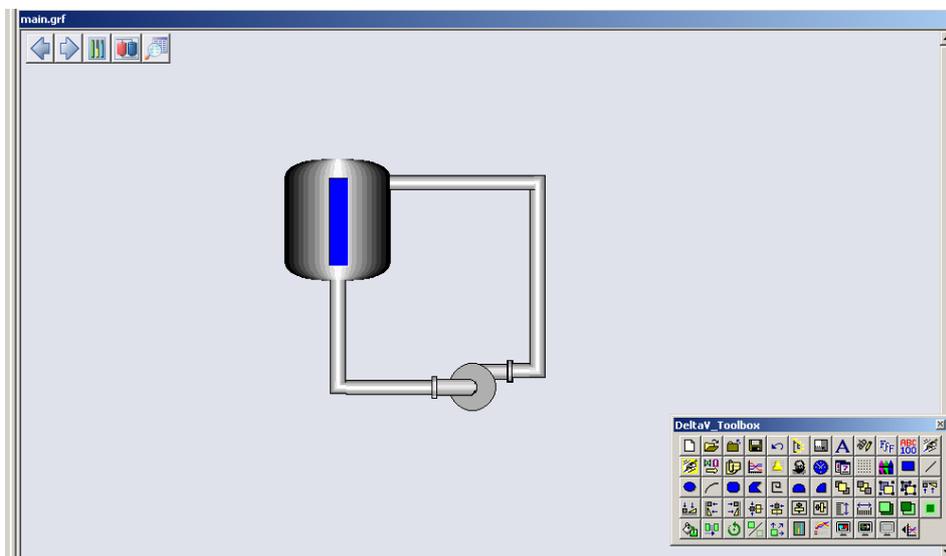


Figure 3-8 Model

At the end we need to make some variables. Let's make one for PV, SP and one for OUT (so we can control it manually).

Here we will use DeltaV_toolbox. Press the big A and write in the variables on to the screen. These variables need to be connected to our PID regulator. Let's start with PV. Press ABC100, which you will find in DeltaV_Toolbox.

Now press the  button. See Figure 3-9.

Browse DeltaV control parameters, level control, PID_LOOP_1, pid1 and double click PV, then double click CV. Press ok until the data link box appear. Here we change type to Numeric and press OK. Place the variable next to PV.

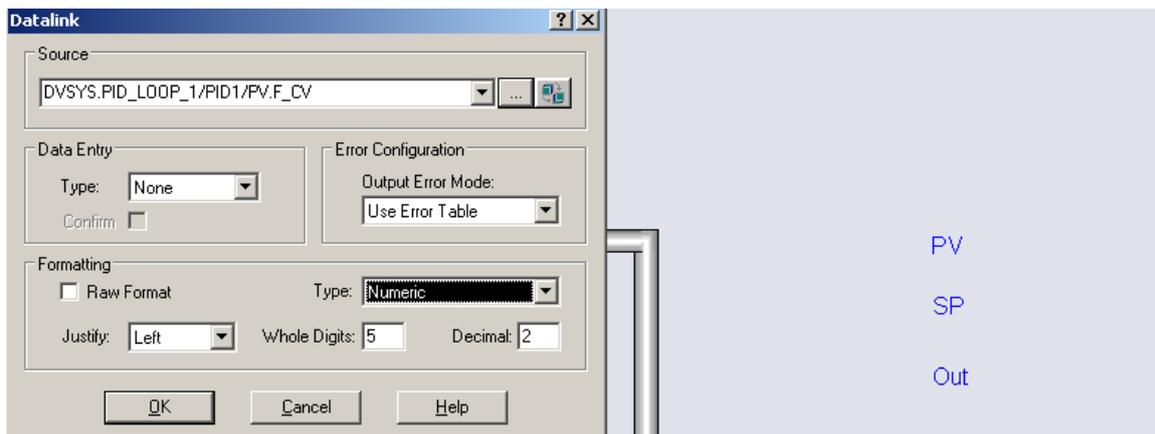


Figure 3-9 Datalink

Exactly the same method when we made the CV variable, except we will now choose SP. In the data link box we must also choose in-place on the data entry to be able to write values. Place the variable next to SP. See Figure 3-10.

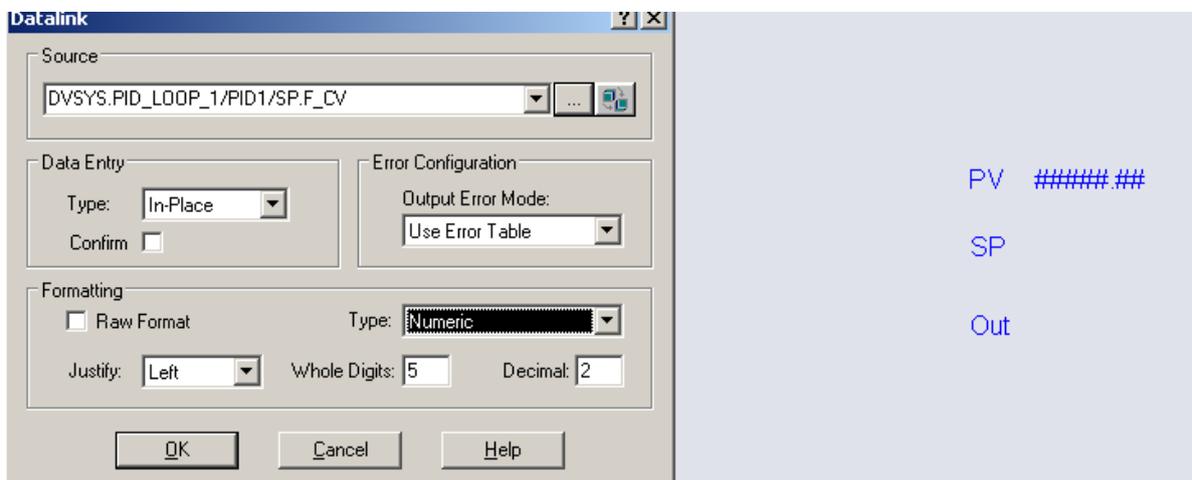


Figure 3-10 PV variable

The only variable left is OUT. Exactly the same method as when we made the CV variable, except we will choose OUT. Place the variable next to OUT.

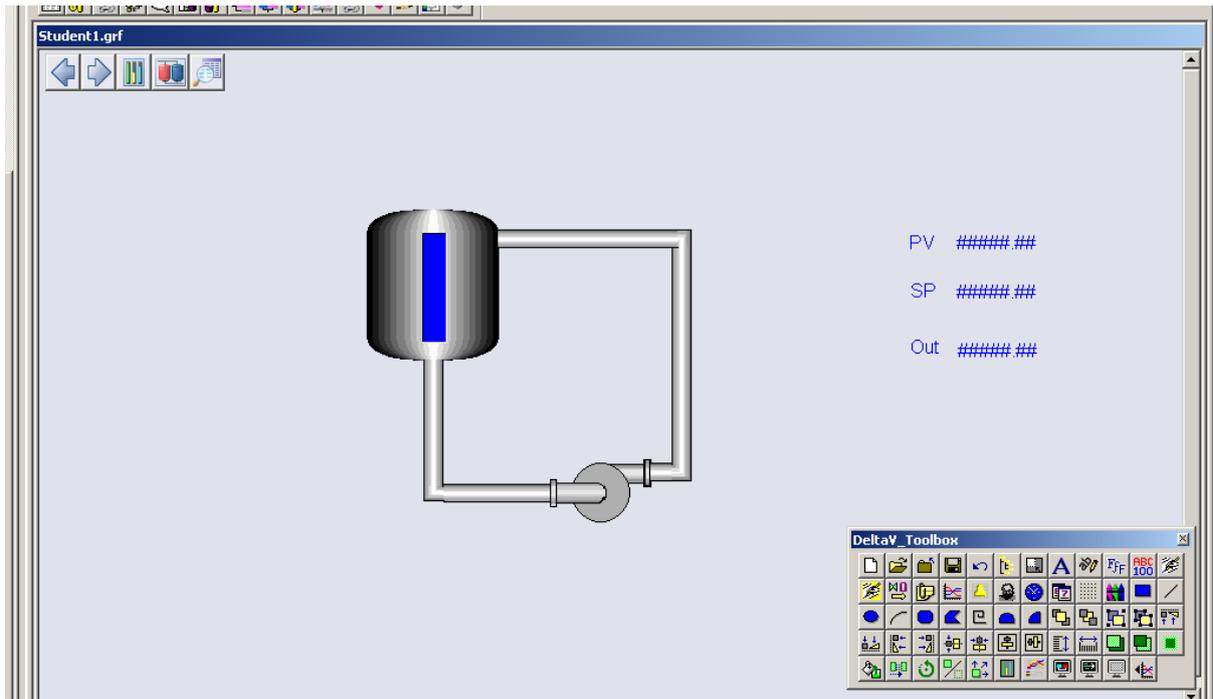


Figure 3-11 Model Completed

You have now created a program and a HMI that can be used to regulate the level in the tank. See Figure 3-11.

Press **ctrl+w** to set the program in run mode.

4 OPERATE

To operate the model we need to physical connect it to DeltaV. Figure 4-1 shows a sketch of how the model is planned to be wired.

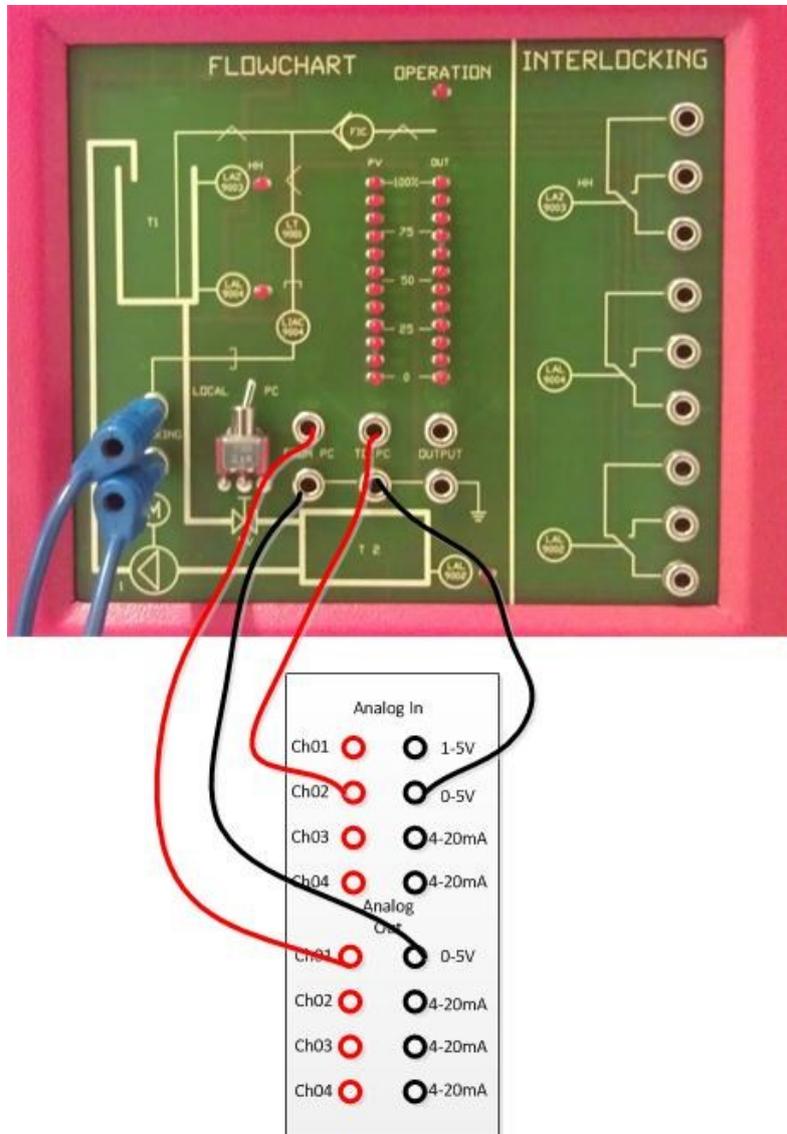


Figure 4-1 Connection of the model

When the model is connected you can press Ctrl+w to enable run mode, the model is now ready to be controlled.

To get the faceplate up you need to mark either SP or OUT. You then press the faceplate button in upper left corner. If you press the button with the magnifying glass on, the detail point will appear. This is where you change the PID parameters. Under “tuning”, Gain is the P-value, Reset is the I-value and Rate is the D-value. We choose P=2 and I=10 as start values. But feel free to experiment and find better values. See Figure 4-2

On the faceplate you have options to control the process manually or set it to auto. You can trend the regulator by pressing the button that looks like a trend. You will then see SP, OP and PV.

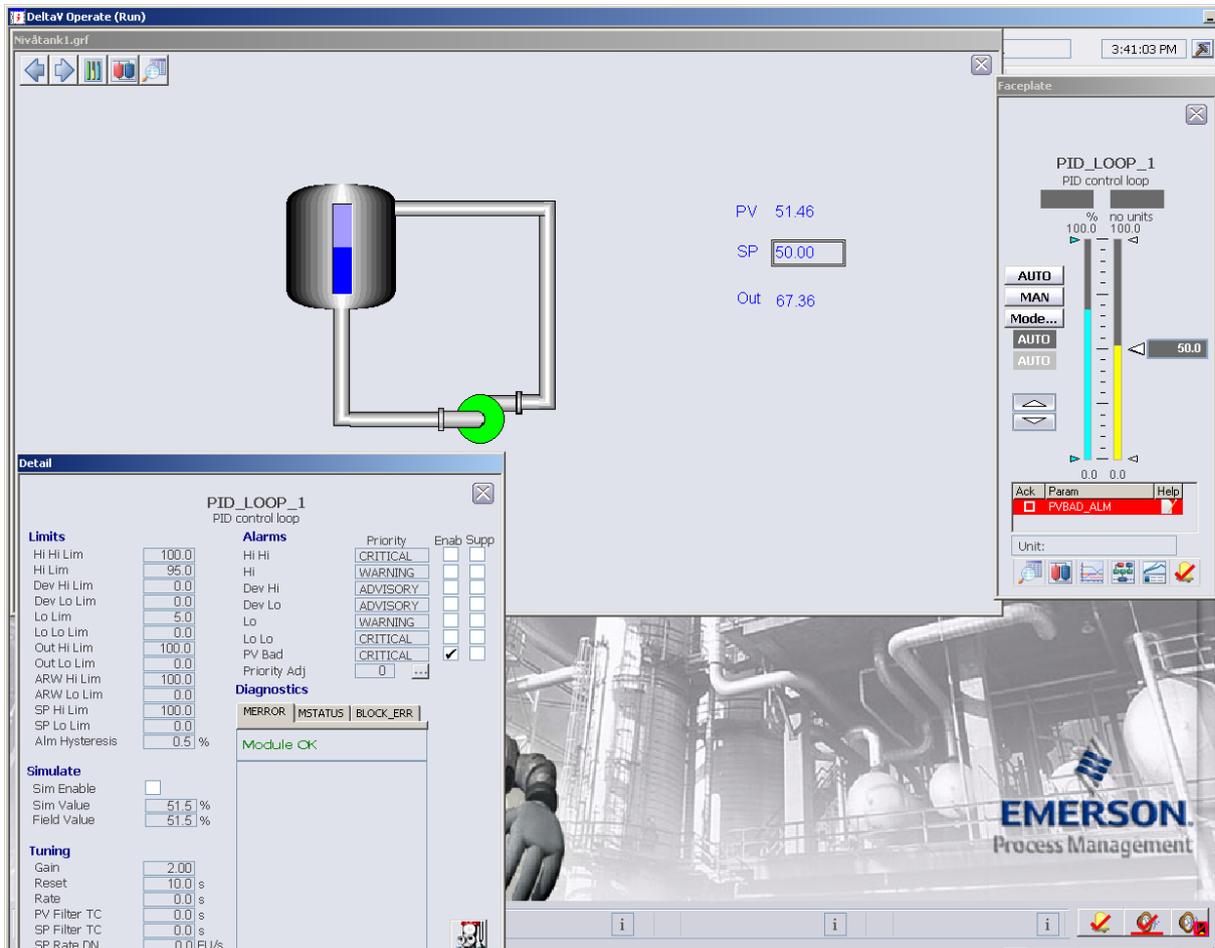


Figure 4-2 Operate run