Accord Designer

User Guide

Controller / Process Model

Document: Accord Designer V4.12.1.0 User Guide - Controller

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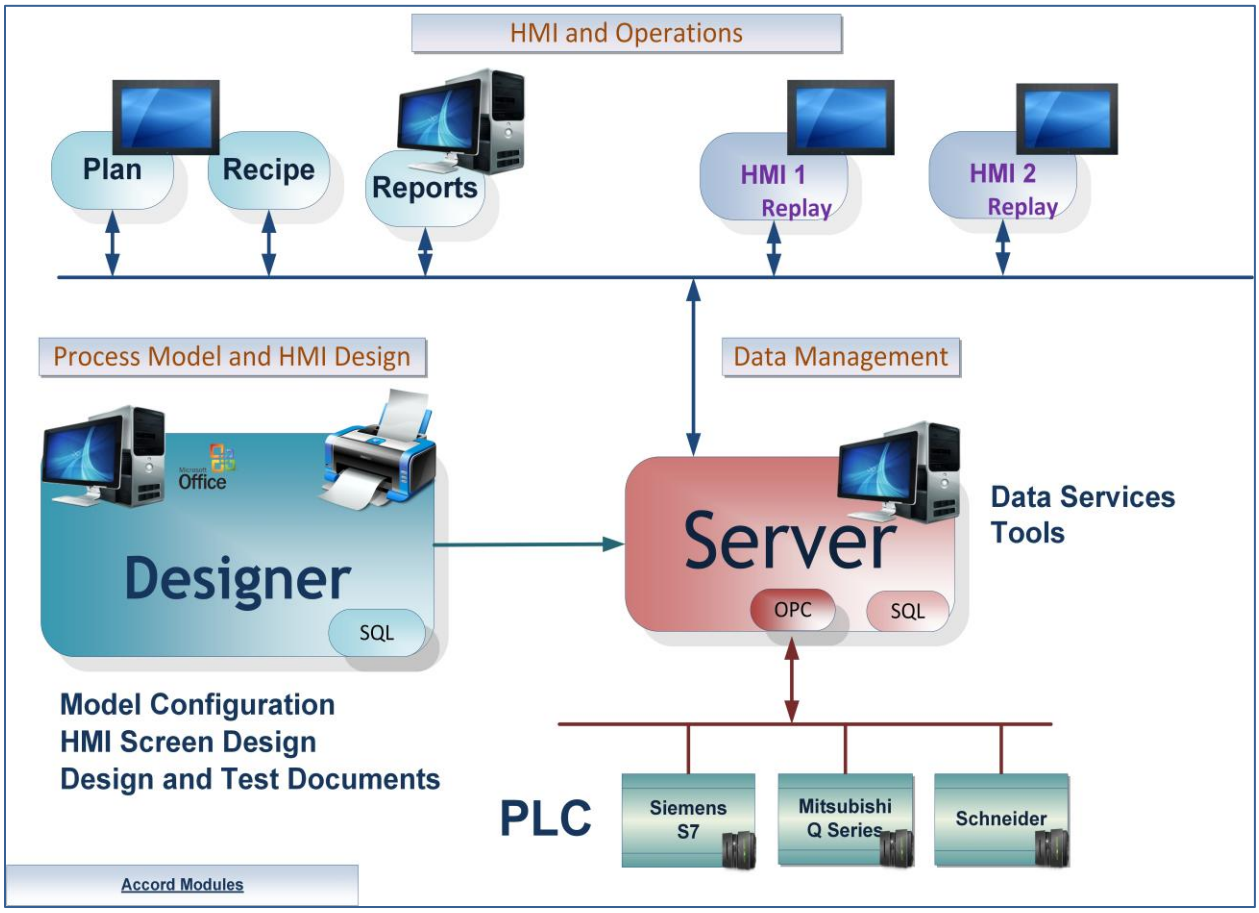
1 Introduction

Accord Designer provides a graphical environment for engineering personnel to develop process models and associated HMI screens for control systems.

Process Model development is carried out by configuring equipment and programs and HMI screens are developed by placing devices and programs onto the screens. All relevant linking and control is implemented automatically by the Accord Server service. Items are available in HMI, Recipe or other modules when initially configured in Designer.

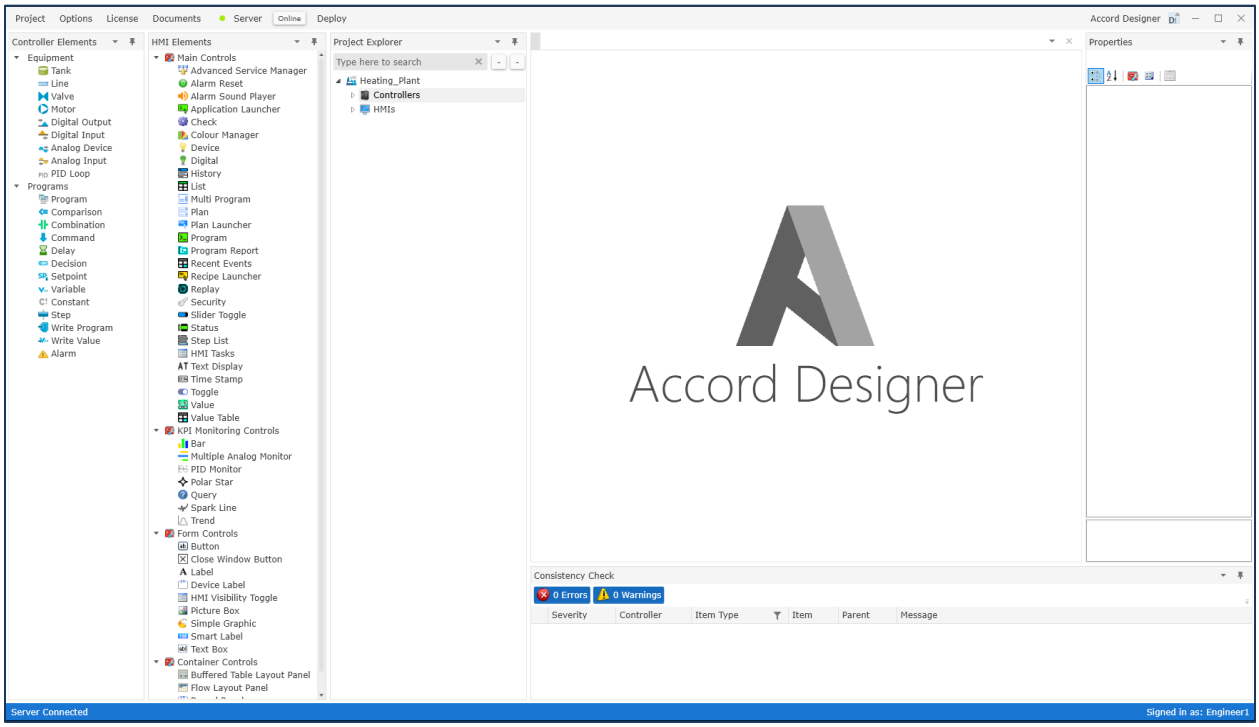


Accord Platform Modules

The Accord Modules may be hosted on single PC or distributed across many PC's.

See also Accord Installation V4.12 User Guide

2 Designer Layout



Initial Designer Screen, showing containers for Plant and Controllers and HMIs

The Designer window is comprised of the following:

- Top Level with Plant or overall system name
- A search window
- - Buttons for collapsing Open Controller or HMI menus
- Containers for controllers (PLC's or Emulators) and HMI's
- Toolboxes for HMI and Controller elements
- Centre Panel for HMI Screens
- Properties configuration section
- Consistency Check Section

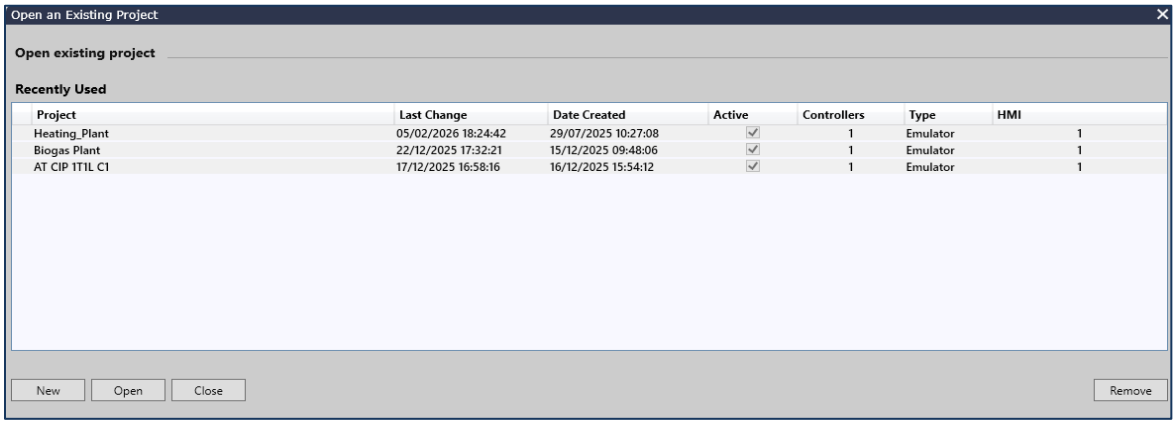
There is also information along the bottom border.

- Status of Server connection
- Name of the signed in user

Panels may be detached and moved to different areas to suit the users workflow.

2.1 Designer Menus

The Project Menu allows a project to be Created (New) , Opened or Removed.



The list of Projects in the database is shown, with Dates of creation, last change, Active (in Server) status, the Number and type of Controllers and the Numbers of HMI applications.

The Options Menu contains Appearance Customization, for Theme, Font and Colour.

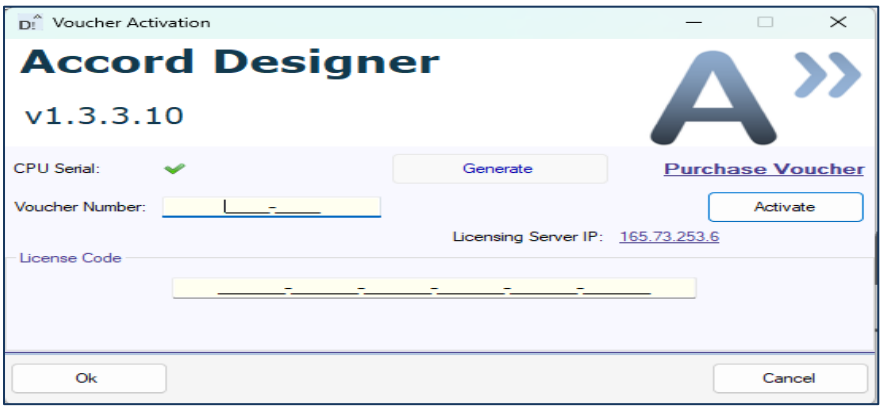
The Documents Menu provides to access the I/O List, Equipment SDS, Process Description, Process FDS and SDS documents.

The Server Menu provides Restart of Server, the Configuration Report, Code Generator Utility, Settings, HMI Tasks, Simulator, Relay, Data Integrity and Events, described in Service User Guide.

2.1.1 License Menu

The License Menu shows a License Type (Development or Production), the Expiry date for the License, an option to buy a License, and the Product Version.

The Development License is used for system Design and Testing using Emulator and Simulator.
The Production License is used for site installations, with an OPC or Accord IPC license.



Licence Purchase is using a Voucher obtained from Logicon or agent. The new licence is enabled by entering the voucher code and pressing Activate.

The dot beside Server on top menu is green when Server is running and Red when not Running.

2.2 Online Mode

This shows a summary status of items in the controller by colour in the standard method

- Grey – Off or Manual Off or Inactive
- Green – On or Manual On or Active
- Red – Alarm or Error
- The Online mode is toggled on and off using the Online button.

2.3 Restart

This allows the Server to be Restarted. This action has no effect on a controller but may show items re-initialising on the HMI Screens.

The service must be restarted after changes to the following:

- Device Logging – changes to devices being logged or deadbands.
- Archiving – change to thresholds or date or time settings.
- Communications – changes to Port Numbers, for Advanced, Redundancy or ActiveX
- HMI – changes to any object Status text
- HMI – changes to Engineering Units text
- Addition or Removal of a Controller

The system may notify that a Restart is required.

3 Model Configuration

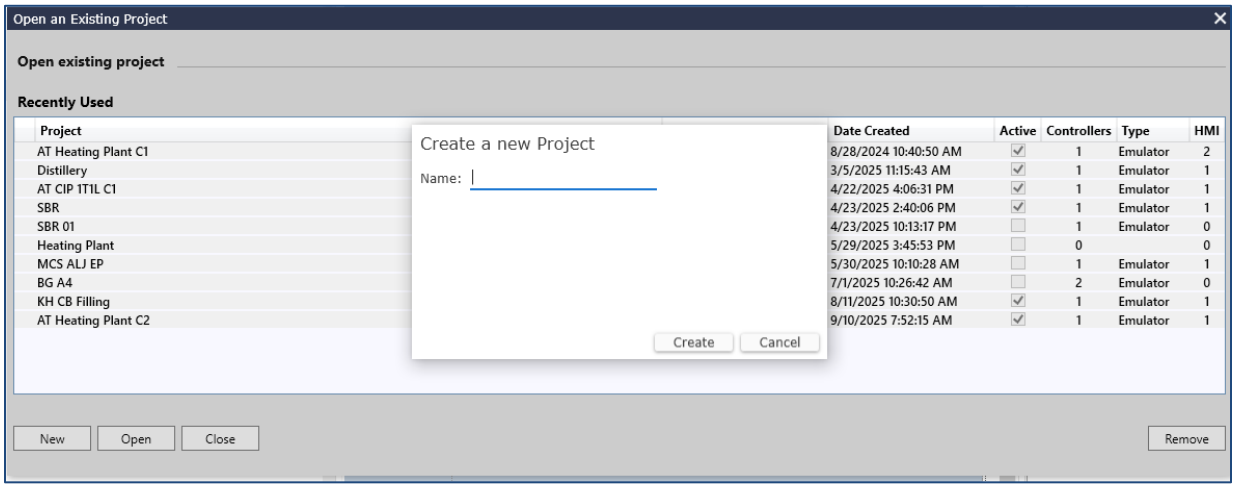
Designer includes full functionality for model generation or modification; for adding, removing or changing an item. Design and Test documents, which completely match the process model, may be automatically generated.

Designer provides the addition and configuration of equipment and programs using drag-and-drop or right-click-and-add, and using copy-paste, rename and remove and providing properties panels for each item and tables in which items can be added, removed, or have their properties changed using drop down or editing. The application should make configuration of a process model easy and understandable.

3.1 Projects Table and Creation of a New Project.

The Projects table shows the projects on the PC and the Times for Creation and Last Change, and if the Project is Active in Server, on Emulator, and the Number of Controllers and the Number of HMI's configured. Projects may be Renamed or Removed here also.

The Server module will operate on Projects which are made Active or Enabled. Server must be stopped to change the status of a Project here.



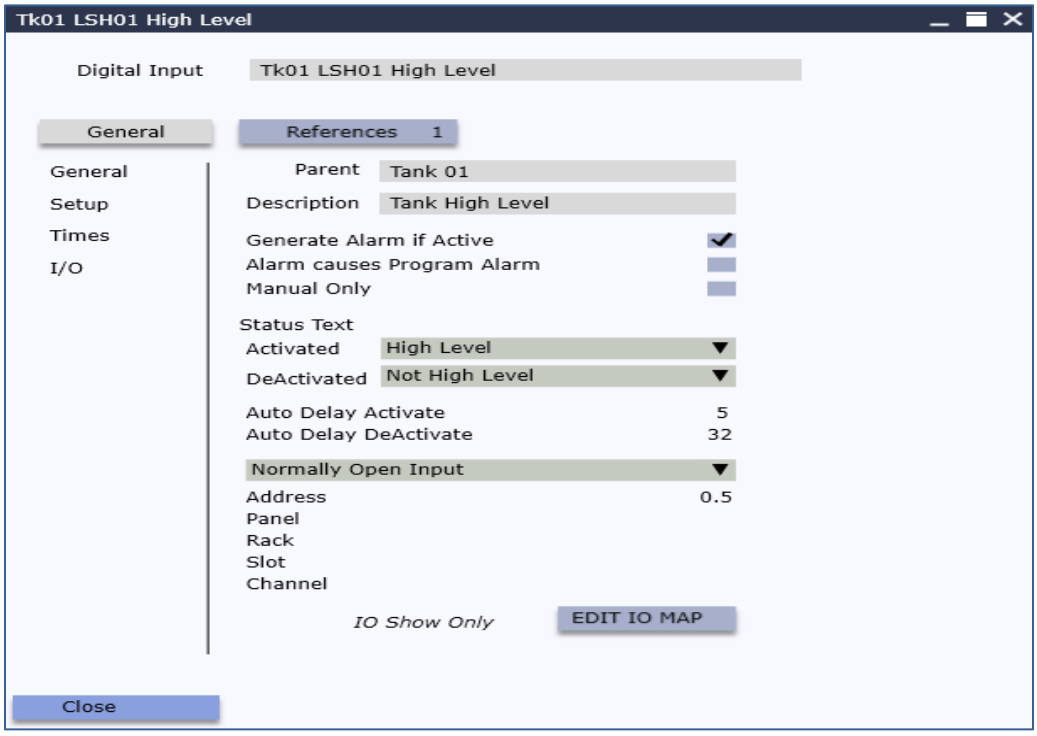
Project List with panel for New Project

A New Project is added using the Create Button. The new Project is listed, with the assigned name used for configuration.

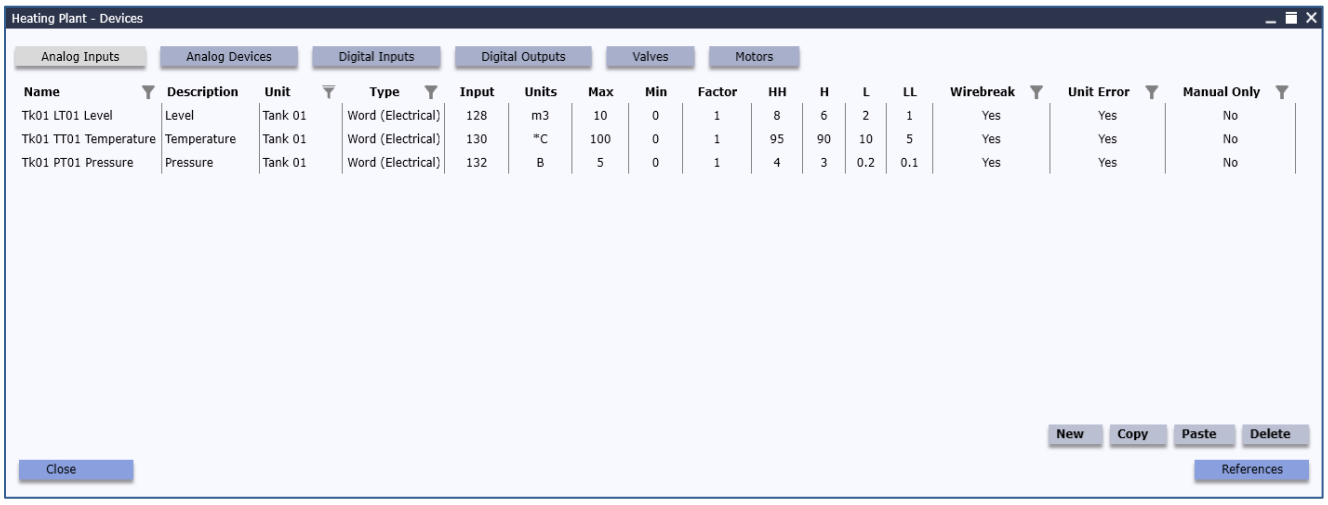
A sample project for a Heating Plant is included with Installers, for initial learning.

3.2 Process Model Note

Designer provides a method for configuring Process Models by defining Equipment Objects (such as Valves) and Programs and Program objects (such as Alarms) and linking these items by listing them in tables or tables to provide required functionality. The application should make devices and aspects of items accessible for editing as much as possible.



Sample of Properties of a Device

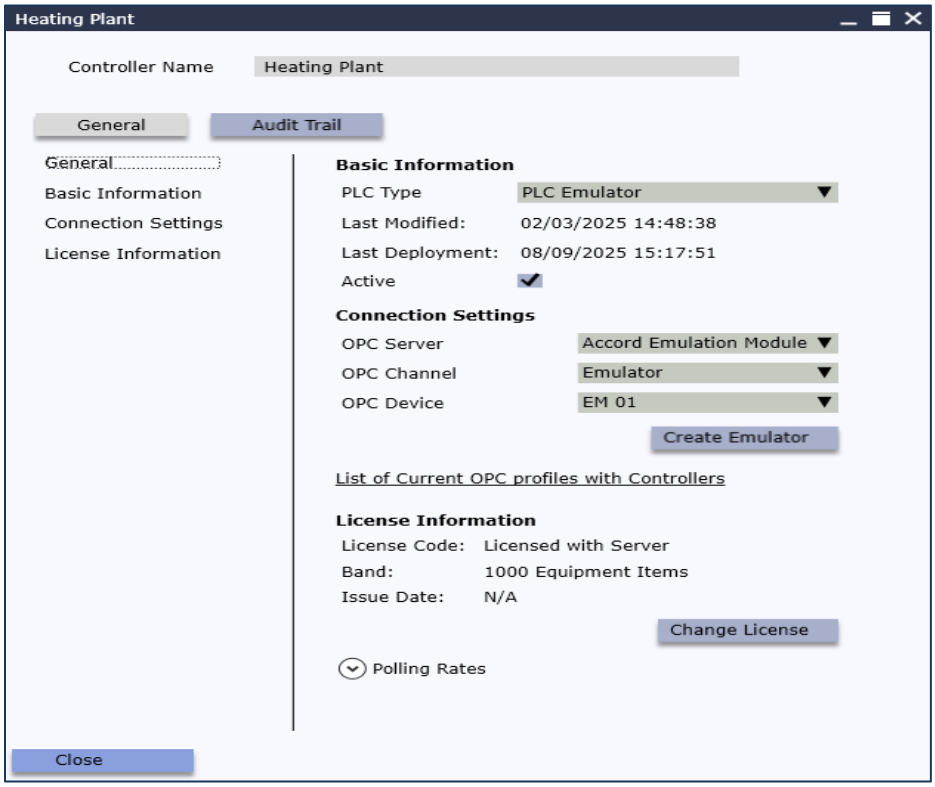


Sample of Table of Devices in a Unit

3.3 Setting up a Controller

A Controller holds a Process Model as the developed model will be transferred to a single PLC or Emulator instance. A controller can be added by right-click in the Controllers and selecting New

3.4 Controller Summary



This is accessed by right-click properties for the Controller.

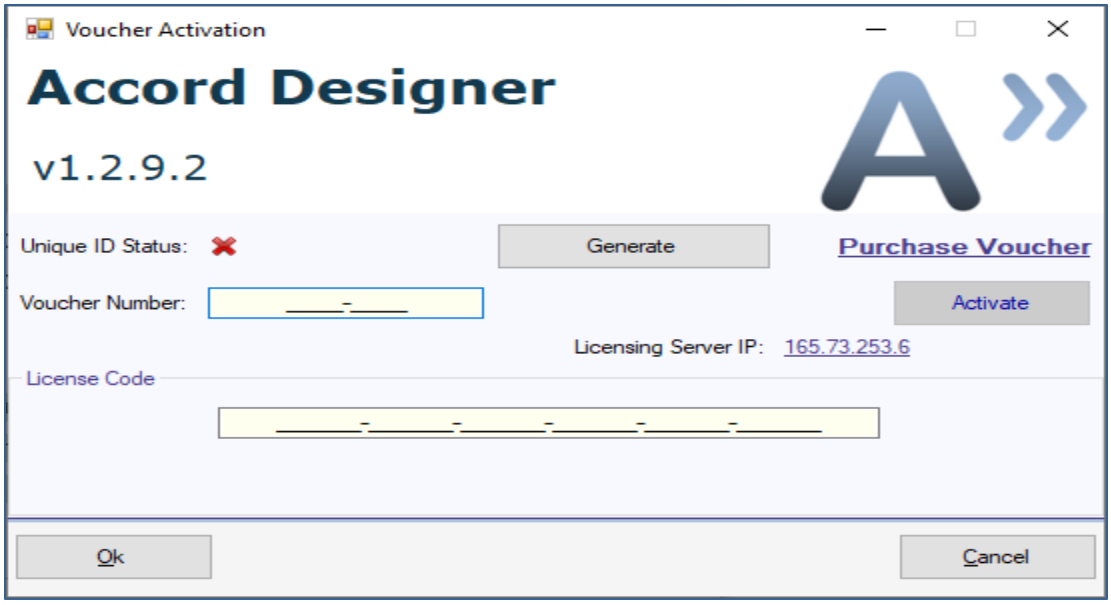
Controller Properties

The Details section allows the user to configure the following:

- PLC Type - Selection of the Controller Brand, or Emulator.
- Active – Selection of the controller being Active in Accord Server
- OPC Communications settings for the PLC or Emulator, including Polling Rates
- License Information.
- Area or section of the company or plant

The setup can generally be completed by Dropdown menu and selection. An Emulator Profile is automatically created, and this may be changed to an OPC or Accord IPC profile later when Designer is in Production mode.

3.4.1 Licencing of the Controller

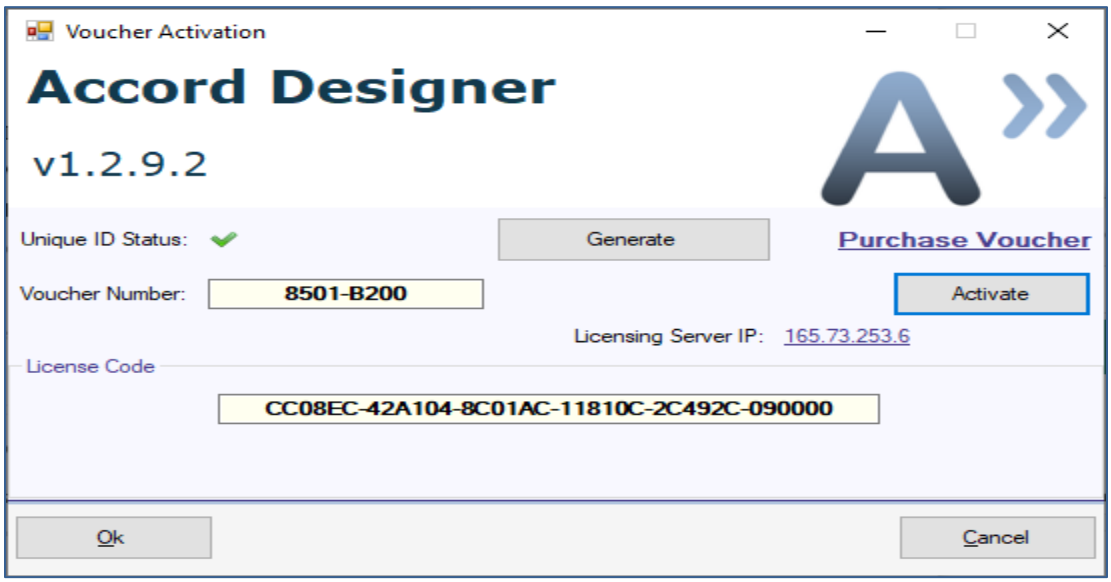


Project before Licencing

The screen will initially show no information.

A Unique ID, activated by clicking on the Generate button, is used to match with the PLC.

Note: If a PLC is already in use and matched to another PC, then resetting the Unique ID will reset the communications with the already matched PC.



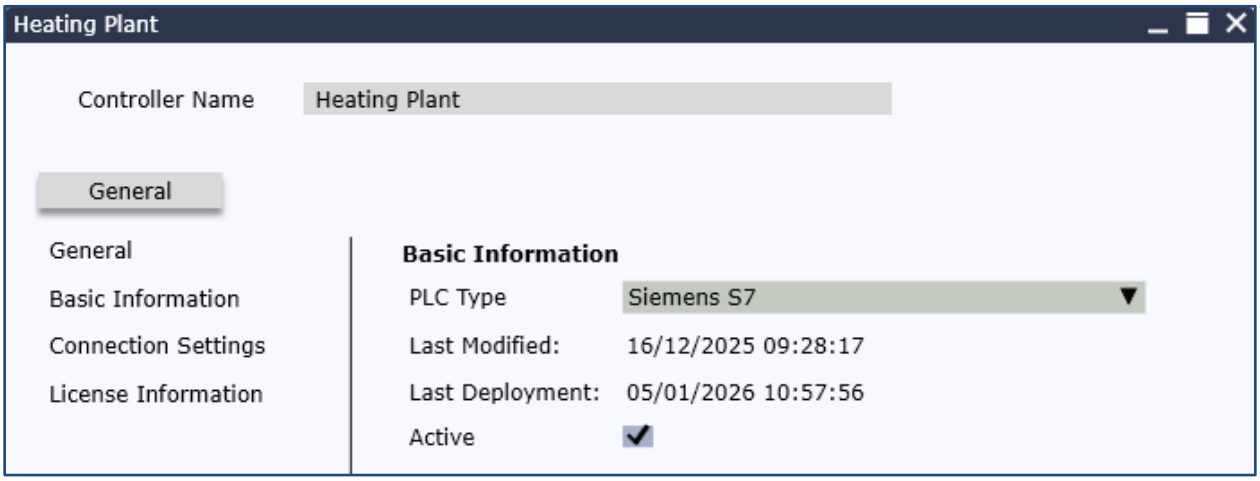
Licenced Project

The PLC is licenced for the PC by entering a Voucher Number and pressing Activate. The License code is generated by the Licensing Service.

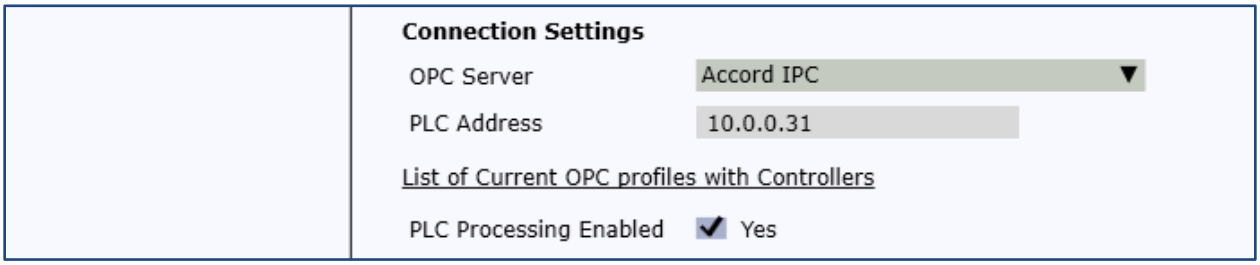
3.4.2 Accord Integrated Process Control

The Integrated Process Control (IPC) is built-in and provides a simple direct communication path between Accord Server and the selected PLCs.

Accord IPC is set up in the Project Controller's properties.



The PLC Type is selected as Siemens S7. The OPC Server is configured as Accord IPC in Connection Settings and the IP Address for the PLC is entered.



The PLC License type must be configured correctly for Accord IPC to start up correctly for controllers in Production Mode.

Connection status can be viewed in the Accord Server window.

4 Configuration of Equipment Units

Equipment is contained in Units, to reflect process drawing, which are comprised of:

- Analog Devices (with PID Loops)
- Analog Inputs
- Digital Outputs
- Digital Devices
- Digital Inputs

Items associated with a Tank or section of line are placed in a Unit. There are two types of units: Tank Units and Line Units.

In configuring a process plant a Tank Unit contains equipment which is connected to the Tank and a Line Unit is usually section of line between block valves or a block valve and an end-of-line drain valve. A Line Unit is a usually a section of plant which is used for transfer.

Units are grouped for presentation purposes and both Tank and Line Units may contain equipment Devices and Instruments. Examine the plant drawing and process description to decide on the setup of Units.

A continuous operation system, in which there is one main program, may be configured using 1 Unit. A sequential system, in which there is more than one program, and the different programs will use different parts of the equipment would be configured using Units.

4.1 Unit Common Functionality

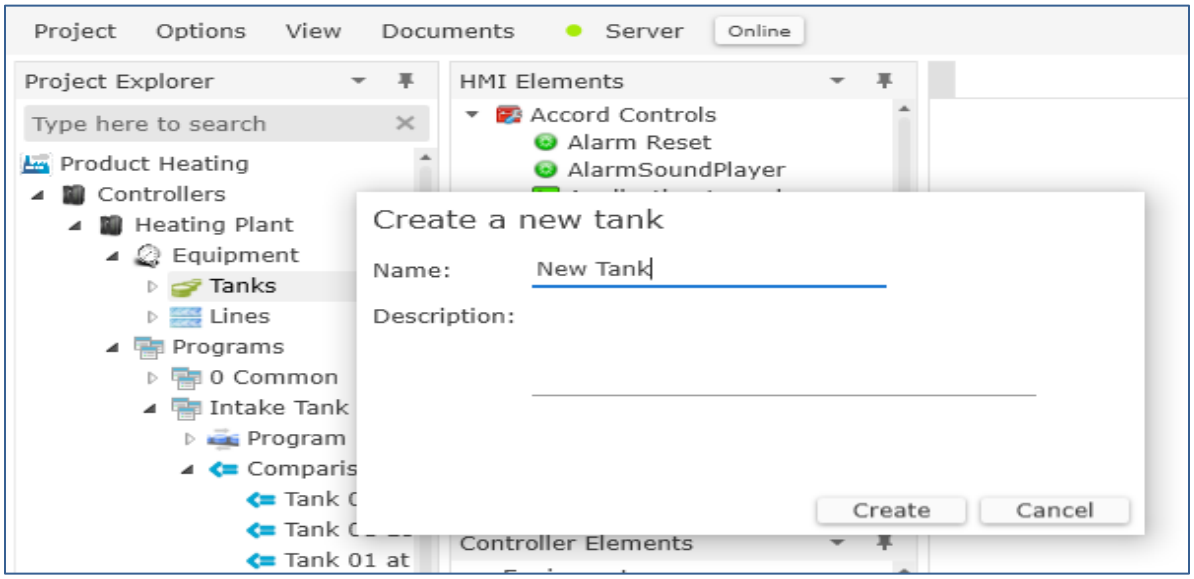
A Unit is a logical section of plant, and use of equipment units allows safe operation:

1. If a device (analog or digital) in a unit is in Maintenance then devices in that unit will be Affected by Maintenance and may not be activated
2. If a device (analog or digital) in a unit is in Error and the device is enabled to cause a Program Alarm then the program which is using or attempting to use the unit is placed in Alarm.
3. If a Unit is Reserved by a program and another program attempts to select the Unit then that new Program may be placed in Alarm if Unit Selected Alarm is configured.

When a Unit is configured it may be placed in a program in the Program Equipment section. The program will then be able to use, or access, devices and instruments in the unit.

4.2 Insertion of Units – Tanks or Lines

Units are inserted into the Model by dragging from the toolbox into Tanks or Lines groups or right-click on group and adding the unit type.

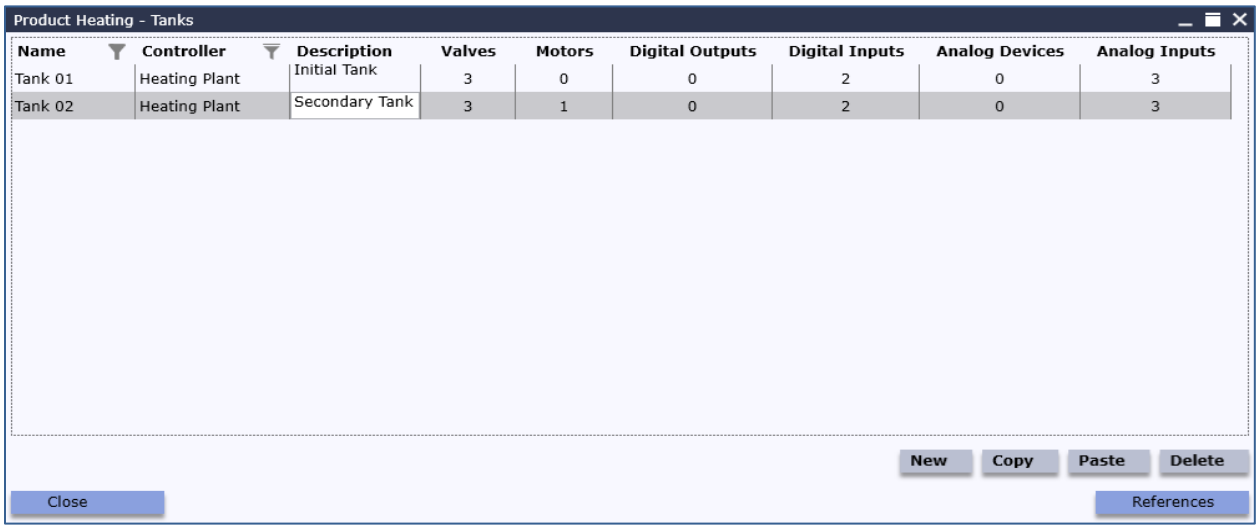


2.

Creating an Equipment Unit

There is a prompt for the Unit name to be entered. This may be based on the Unit identification in plant drawings (P&ID's). In this example the name New Tank is given to the Unit.

Double-clicking on Tanks shows a table of properties of the Tanks and a description for the Tank can be entered here.

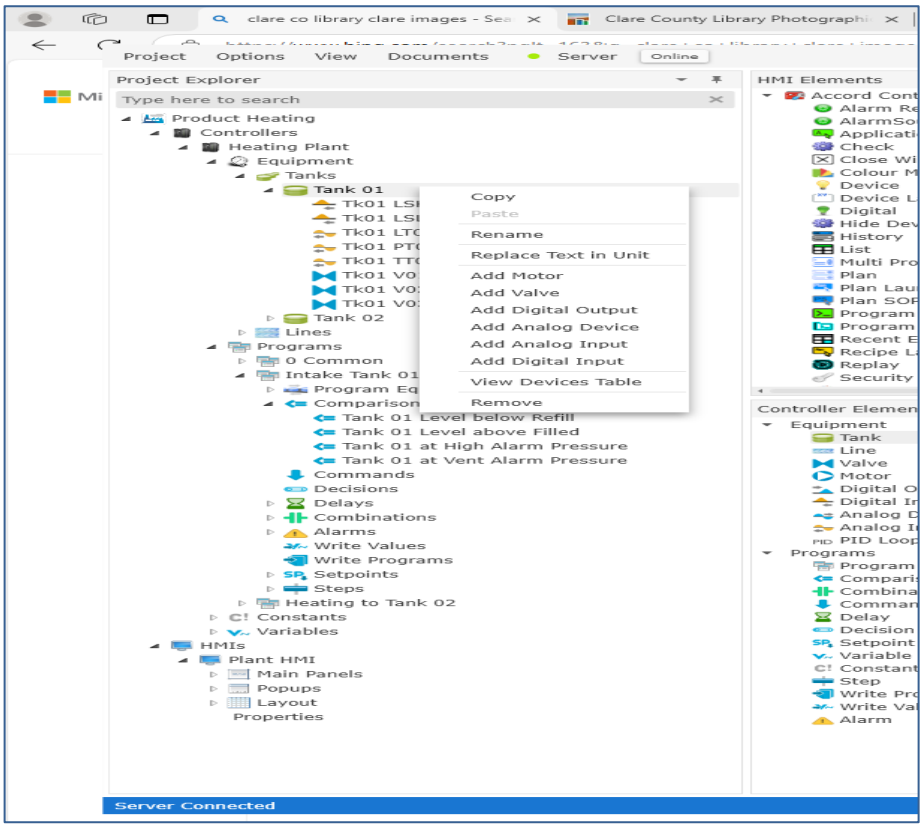


List of Units

4.3 Adding Devices Items to Units

Equipment items may be added into Units by

1. Dragging in the appropriate icon from the equipment toolbox
2. Right-clicking on the Unit to add required item type
3. Copy and Paste of a similar item, by right-click or in Table.
4. Adding into a Table



Addition to a Unit which contains Valve, Analog Input and Digital Inputs

A guidance prompt may appear during some Addition methods.

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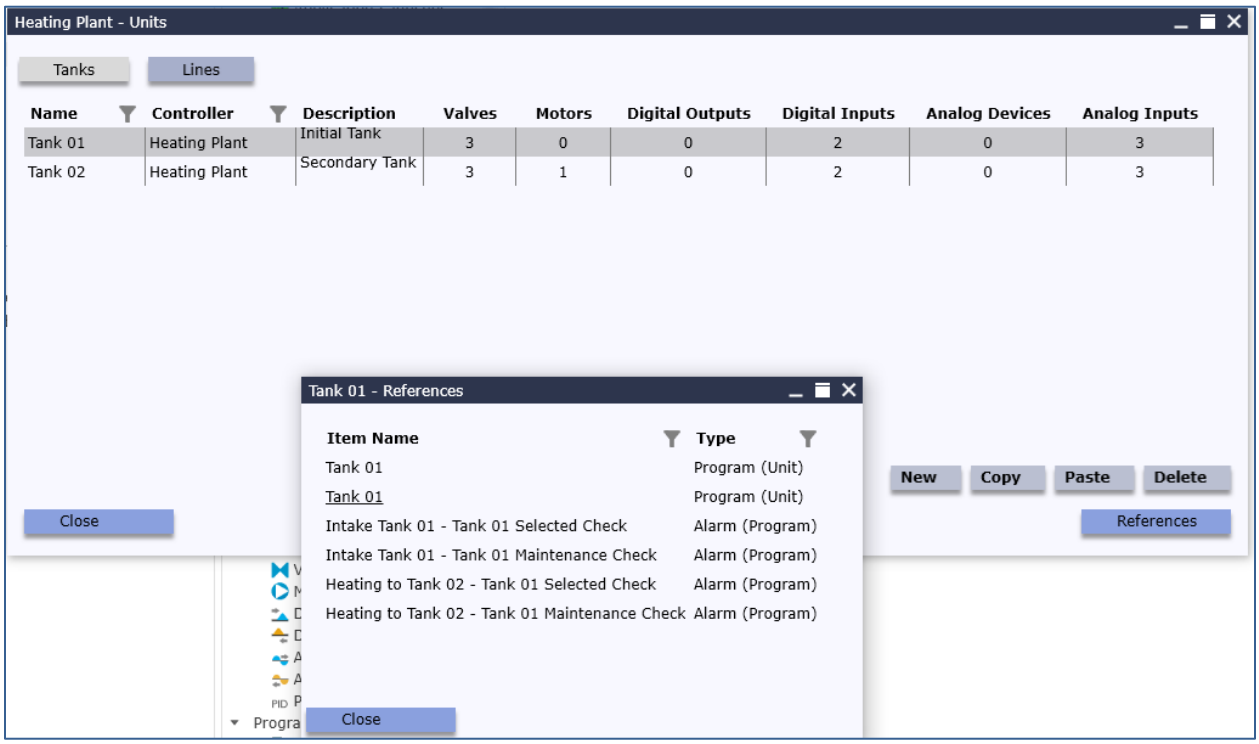
4.3.1 Copy and Paste of Units

In addition to insertion of devices, right-clicking on the Unit gives the options to Rename, Delete, or Copy the Unit.

A Tank or Line unit may be copied and pasted within the object unit Tank group or line group. Copying a Unit creates an exact copy of all the information for the Unit. The copied unit and all the components must be renamed, and re-configured, including changing I/O addresses with correct settings.

4.4 Cross References for Units

Cross References may be accessed by right-click on Equipment and View Units Table and selecting a Unit in the List and clicking References in the bottom of panel.

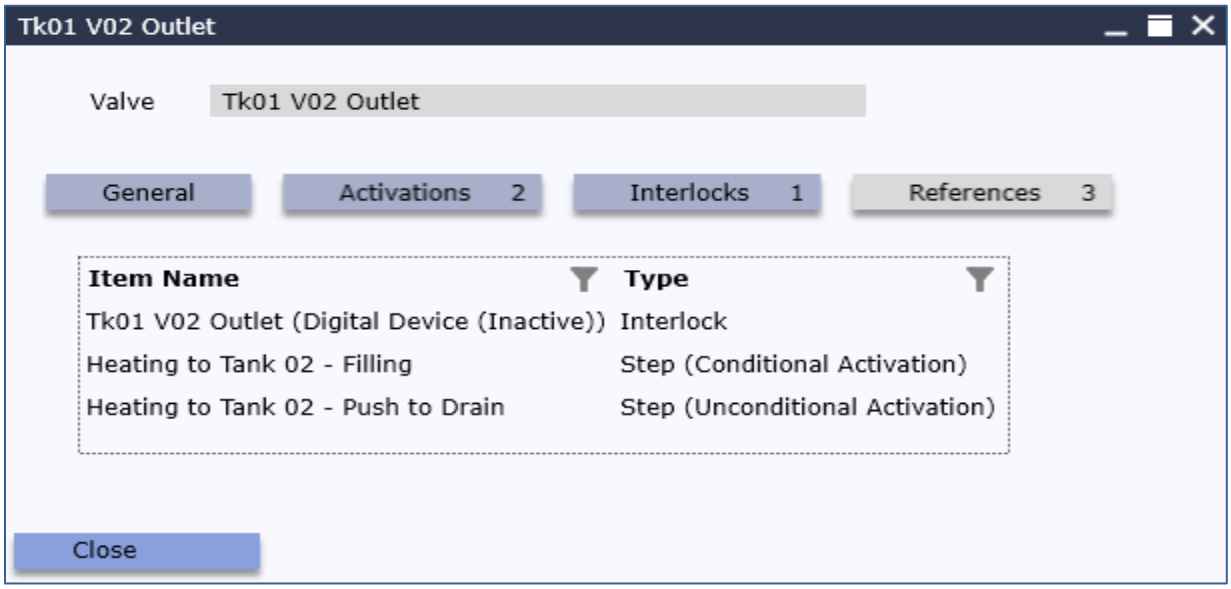


Cross reference screen for Unit

Clicking on a Link under an item will bring up the properties for that item.

4.5 Cross References for Devices

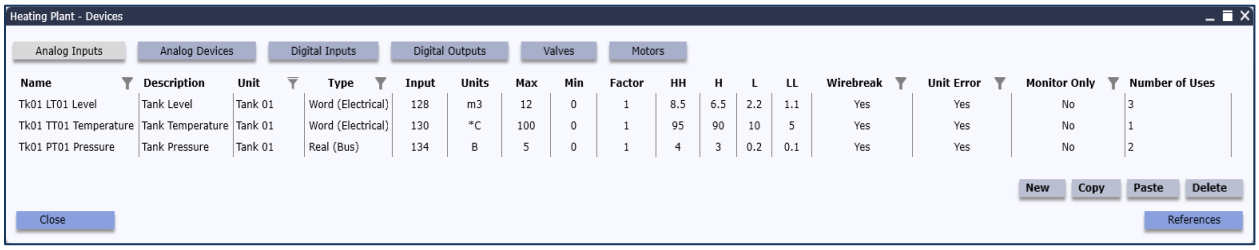
Cross References may be accessed by selecting References in the device property panel.



Cross reference for Unit

The unit shows the unit that the item belongs to.
The sections buttons show all the areas where the items could be cross referenced. The number in the sections refers the number of occurrences in areas where this item is used.
Clicking on the link will access the referenced item.

4.6 Devices Tables

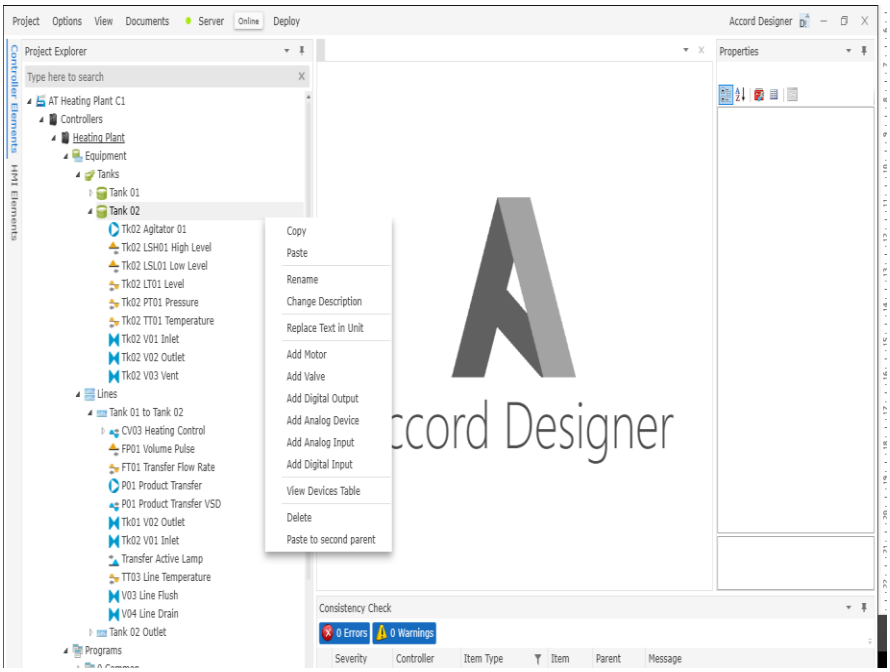


The Table has tabs for Analog Inputs and Devices, Digital Inputs and Outputs, Valves and Motors. The table contains the Name, Description, Unit, Type, and other information depending on the item type, including the Number of Uses. Visibility for the columns may be selected by right-click and Select Columns, and all columns are filterable. All devices can be accessed from here and all data can be exported using Right-click Export.

4.7 Linking of Units

Tank or line units are linked when a digital device is part of both units. This is achieved by selecting the valve in one unit and right-clicking to copy the valve and then selecting the required second unit and right-clicking to use the function “Paste to Second Parent”.

This function is only for Digital Devices Valve.



Selection of Valve in Tank and Insertion by “Paste to second parent” in Line Unit

It is possible to link any two units in this manner. Such linking needs to be carried out carefully to reflect the actual plant or process. A valve that is a component of two units is accessed and treated in the same manner as a valve that is a component of only one unit.

It is important to link units using this function in order to ensure that attributes of both units that are dependent on devices are treated exactly the same.

Such attributes are:

1. Unit, and any Program using the Unit, may be put in Alarm if the valve is in error.
2. Other Devices in the Unit are placed in Affected by Maintenance if the valve is in maintenance.

5 Configuration of Equipment Devices

Following insertion in a unit, a device is configured with settings that will determine its operation and its description in documentation. During insertion, the device is given a name and short description. The name may be changed at any time.

There are sections for General for Name and Unit, and for Setup, Times and I/O Address in the properties. There is also a button for references. The I/O Map Table can be accessed.

5.1.1 PLC I/O Description – Card Setup

A PLC is composed of a CPU and I/O cards on racks, and in some cases communications processors, special function modules and bus based I/O.

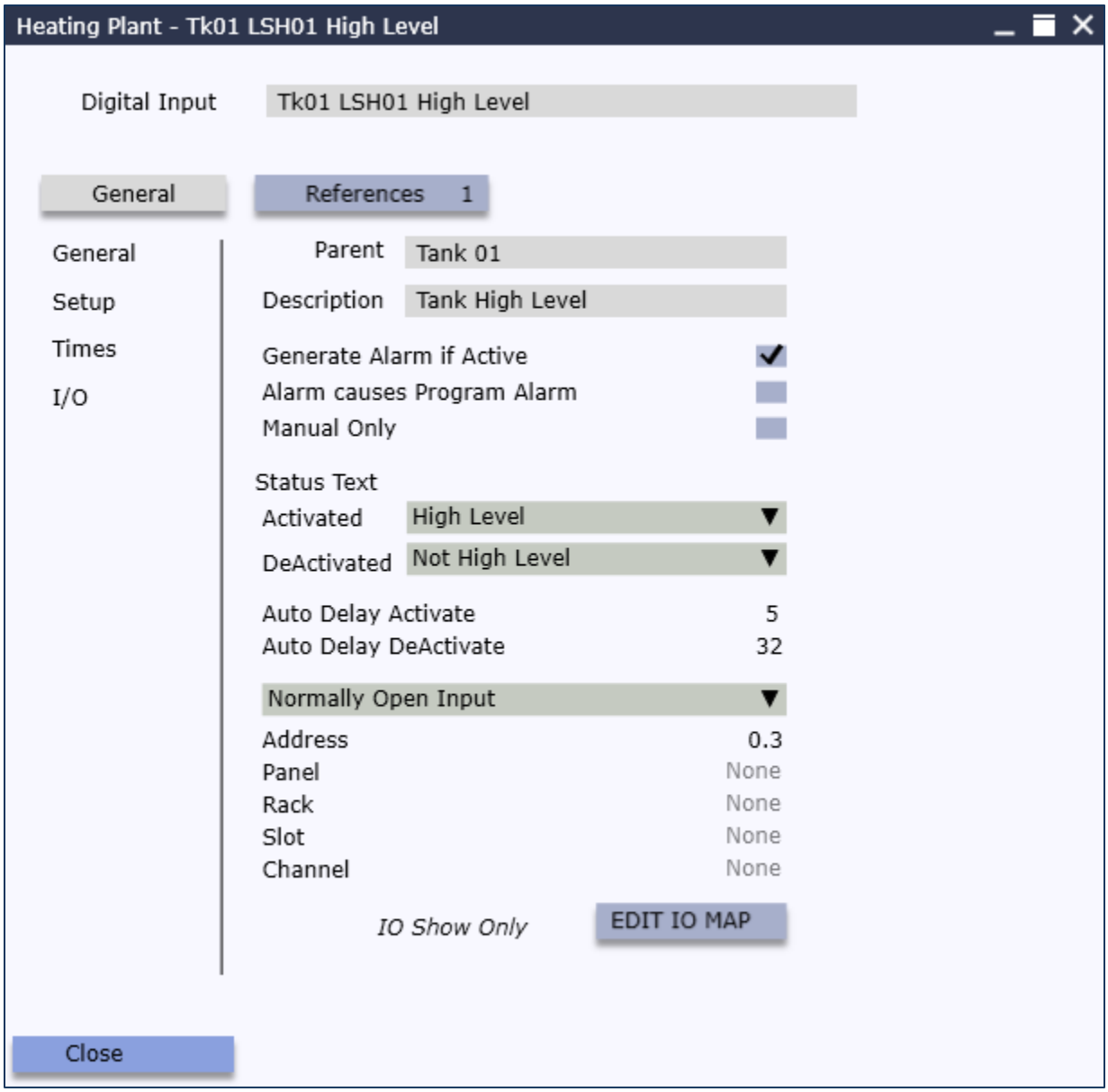
The PLC I/O description for a Device is available in the I/O setup area.

The fields for Panel, Central Rack, Slot and Channel are all text input fields. Once a text is entered for a device or instrument it then becomes available for other objects in the project. No validation is performed on this data. The same combination of information could be entered for more than one device. This could give rise to erroneous documentation as each device must be unique, so care must be exercised in entering this information.

The fields are free text fields and data may be used more than once (i.e. the Slot Nr.) It is the overall combination of data input that should be unique.

5.2 Configuration of Digital Inputs

Digital Inputs are items such as Level Switches, Proximity Switches, signals from other PLC's, buttons and other inputs that do not have a corresponding digital output.



Digital Input Setup

5.2.1 Digital Input Setup

The following aspects of the device may be filled in for Setup.

Setup:	Explanation
Parent	This is the Unit that the Input switch is in. The field is Read-Only.
Description	A description of the device, for documents and maintenance.
Generate Alarm	This causes an On/Active state to cause an HMI Alarm, with the Description appearing in the Alarm.
Alarm causes Program Alarm	This causes an On/Active state to cause a Unit Alarm and then a Program Alarm if a program is working on the Unit.
Manual Only	This is used if the Input is not referenced in a program, only used for display.
Status Text Activated / Deactivated	This text is used to describe the On and Off states of the item in the HMI controls. This is a free text field.
Times:	**Explanation**
Auto Delay Active	This is the 'de-bounce' time, in seconds, for which the Digital Input must be present before it is recorded as being On/Active.
Auto Delay Inactive	This is the time, in seconds, for which the Digital Input must be not present before it is recorded as being Off/Inactive.
I/O:	**Explanation**
Normally Open / Normally Closed	A Digital Input is normally recognized as being ON when the electrical signal to the PLC input point is present. By selecting the Normally Closed Input, the user can declare that the input will be ON when the electrical signal is not present. A common example of this is a Tank Low Level Signal where (for failsafe reasons) the true low level (tank empty) is recognized when the signal is present.
Address	This is the PLC input address for the device. This must correspond to the point address of the item according to PLC format.
Panel, Rack, Slot, Channel	These fields can be used to describe the location of the signal, for maintenance and documentation.

5.3 Configuration of Digital Device Objects

Digital Devices are items such as Valves, Motors, and Digital Outputs (signals, such as to other PLC's), that have a PLC Digital Output and may have Digital Inputs as Feedbacks.

Each Digital Device is assigned 1 Output and a number of Feedbacks may be configured. The type required is selectable in the setup area.

There are following types of Digital Valve Feedbacks:

- No Feedback
- 1 Feedback (Feedback True when Activated)
- 1 Feedback (Feedback True when Deactivated)
- 2 Feedbacks (Feedback True when Activated & Feedback True when Deactivated)

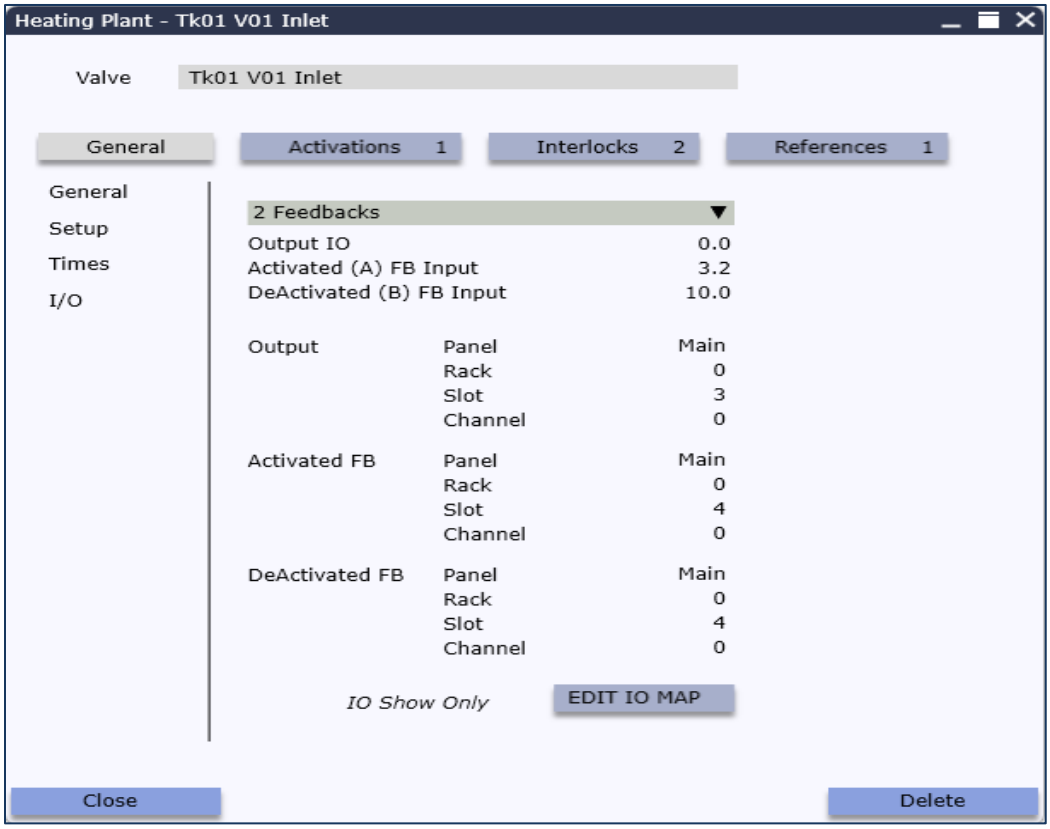
Feedback True when Activated may be thought of as a Normally Open feedback
Feedback True when Deactivated may be thought of as a Normally Closed feedback

There are following types of Digital Motor Feedbacks:

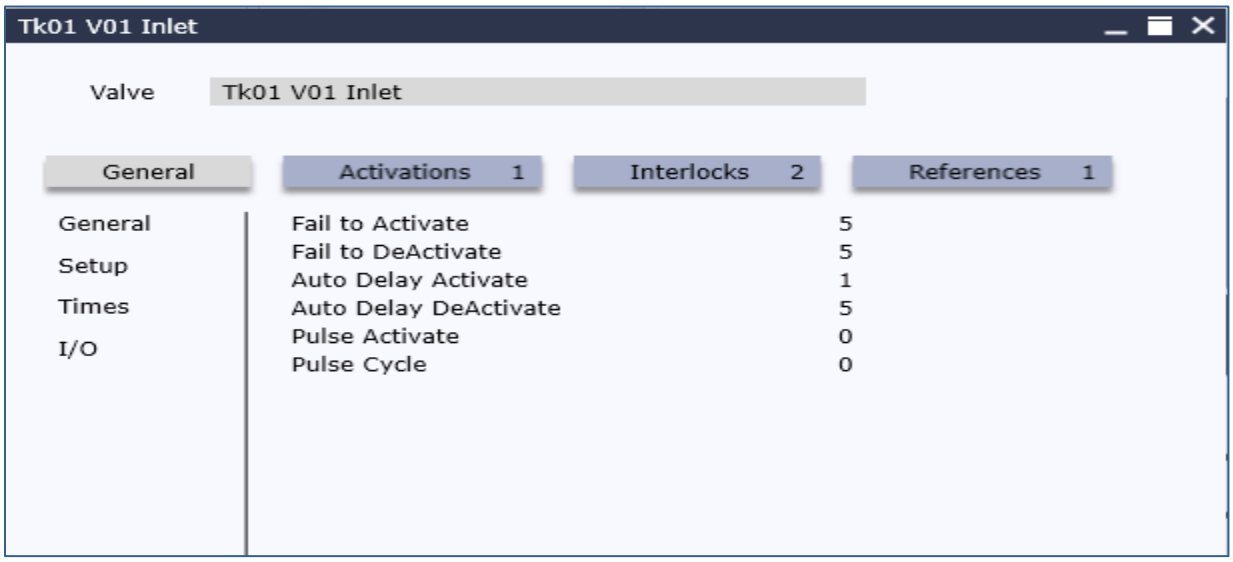
- No Feedback
- Run Feedback (Normally Open)
- Run Feedback (Normally Open) with Isolator (Normally Closed)
- Run Feedback (Normally Open) with Trip (Normally Closed)
- Run Feedback (Normally Open) with Isolator (Normal Closed) and Trip (Normally Closed)

A Run feedback indicates that the motor contactor is engaged.

5.3.1 Setup



Setup showing type and I/O points



Times allows Editing of Fail, Delay and Pulse times

5.3.2 Setup Fields

The following aspects of the device must be filled as required:

Setup:	Explanation
Type	This sets the type and number of feedbacks for the device.
Parent	The Parent Unit for the Device, and a second Parent in case of Valve that is part of 2 Units
Description	A description of the device, for documents and maintenance.
Remain Active during Program Hold	This enables the item to stay On or Activated if the Program (sequence) that has activated the item goes into Hold or Error state
Reserved for Automatic	This is to have the item reserved for automatic only. When this is selected then Manual mode can only be selected with a specific additional override.
Alarm causes Program Alarm	This causes an Error state to cause a Unit Alarm and then a Program Alarm if a program is working on the Unit.
Manual Only	This is used if the Input is not referenced in a program, only used for display.
Status Text Activated / Deactivated	This text is used to describe the On and Off states of the item in the HMI controls. This is a free text field.

Times:	Explanation
Fail to Activate	This is the time, in seconds, that the valve or motor is allowed to travel without correct feedback status. If this time elapses then the valve or motor is placed in error.
Fail to Deactivate	This is the time, in seconds, that the valve or motor is allowed to have an Activated feedback while deactivated and at rest. This indicates a feedback signal when not expected e.g. a valve lifting against pressure.
Auto Delay Activate	This is the time, in seconds, that the valve or motor activation will be delayed by the device routine. This is used to avoid pressure issues.
Auto Delay Deactivate	This is the time, in seconds, that the valve or motor deactivation will be delayed by the device routine. This is used to allow closing of the valve or motor in a controlled manner to avoid line hammer and other pressure issues.

Pulse Activate	This is the time, in seconds, that the valve or motor will be pulsed for during the pulse cycle. Example Cycle time = 60, Pulse Time SP = 15 Valve will be activated for 15 seconds, deactivated for 45 seconds, activated for 15 seconds in a cycle while requested by program step.
Pulse Cycle	This is the overall time of the valve or motor pulsing cycle in seconds.

I/O	Explanation
Output	This is the PLC Digital Output address for the device. This may be Electrical or Bus address.
Feedbacks Valve- Deactivated Valve- Activated Motor-Isolator Motor-Run Motor – Trip	PLC Input address for Feedbacks. These are shown and available depending on the selected device and feedback types.
Panel, Rack, Slot, Channel	These fields can be used to describe the location of the signal, for maintenance and documentation.

The I/O for the item must be filled in. It will be checked for duplication in consistency check.

5.3.2.1 Feedbacks Types for Valves

1. 1 Feedback when Deactivated (Normally Closed) - Valve with feedback signal that is On (True) when the valve is deactivated
2. 1 Feedback when Activated (Normally Open) - Valve with feedback signal that is On (True) when the valve is activated
3. 2 Feedbacks - Valve with Activated and Deactivated feedback signals
4. No Feedback - Valve with only an Output and no associated Inputs.

Note: Valves are understood to be “Air/Motor to open & Spring to close”. In the case of a valve which is “Air/Motor to open & Air/Motor to close”, this may be catered for as two valves.

5.3.2.2 Feedbacks Types for Motors

1. Run Feedback (Normally Open) - Motor with a Running feedback signal that is On (True) when the motor is activated.
2. Run (Normally Open) and Isolator (Normally Closed) - Motor with a Running feedback signal that is On (True) when the motor is Activated and an Isolator signal that is true at all times to indicate that the motor is not electrically isolated
3. Run (Normally Open) and Trip (Normally Closed) - Motor with a Running feedback signal that is On (True) when the motor is Activated and a Trip signal that is true at all times to indicate that the motor is not tripped.
4. Run (Normally Open) and Isolator (Normally Closed) and Trip (Normally Closed) - Motor with a Running feedback signal that is On (True) when the motor is Activated and an Isolator signal that is true at all times to indicate that the motor is not electrically isolated and a Trip signal that is true at all times to indicate that the motor is not tripped.
5. No Feedbacks - Refers to a motor which only has an activation

Note; For Output and Feedback addresses; PLC addresses are represented per PLC editor.

Example used Siemens notation and numbers 4 & 7 correspond to Q 4.7 in Siemens PLC notation which is Output byte 4, bit 7.

Note: Accord configured I/O is usually processed cyclically in the PLC.

5.3.3 Interlocks Section

Interlocks are conditions of devices and instruments that prevent a device from activating. This is to prevent damage to equipment or to material. For example, a pump may not run if a low level in a pipe exists to prevent the pump running dry, or two particular valves may not open together to prevent product mixing.

Interlocks are applicable to HMI manual activation as well as automatic activations.

Clicking on the Edit Interlocks button brings up the Interlocks Section.

There are two types of interlocks allowed.

Section Any - Device is Interlocked if Any item is True.
Section None - Device is Interlocked if No item is True (unless One item is True).
Both sections are considered always, - the Device will be interlocked on either section.

Interlocks Setup for a Device.

In the example the Valve Tk01 V01 Inlet is interlocked if:

1. Tk01 LT 01 Level is above HH Setpoint or Tk01 LSH01 High Level is True
   OR
2. Tk01 V03 is not activated

Interlocks are added using the Dropdown for Device Type and Item and selection of Type 'Any Of' or 'None Of'. All of the appropriate items are made available by means of drop down menus.

5.3.3.1 Types of Interlocking Items:

- A Digital Input is Active
- An Analog Input is above High-High Alarm setpoint
- An Analog Input is above High Alarm setpoint
- An Analog Input is below Low Alarm setpoint
- An Analog Input is below Low-Low Alarm setpoint
- A Digital Input is Inactive
- A Valve is activated / open
- A Motor is activated / running
- A Digital Output is activated
- An Analog Input is below High-High Alarm setpoint
- An Analog Input is below High Alarm setpoint
- An Analog Input is above Low Alarm setpoint
- An Analog Input is above Low-Low Alarm setpoint
- A Valve is deactivated / closed
- A Motor is deactivated / stopped
- A Digital Output is Deactivated
- A Valve is in Alarm -error
- A Motor is in Alarm -error

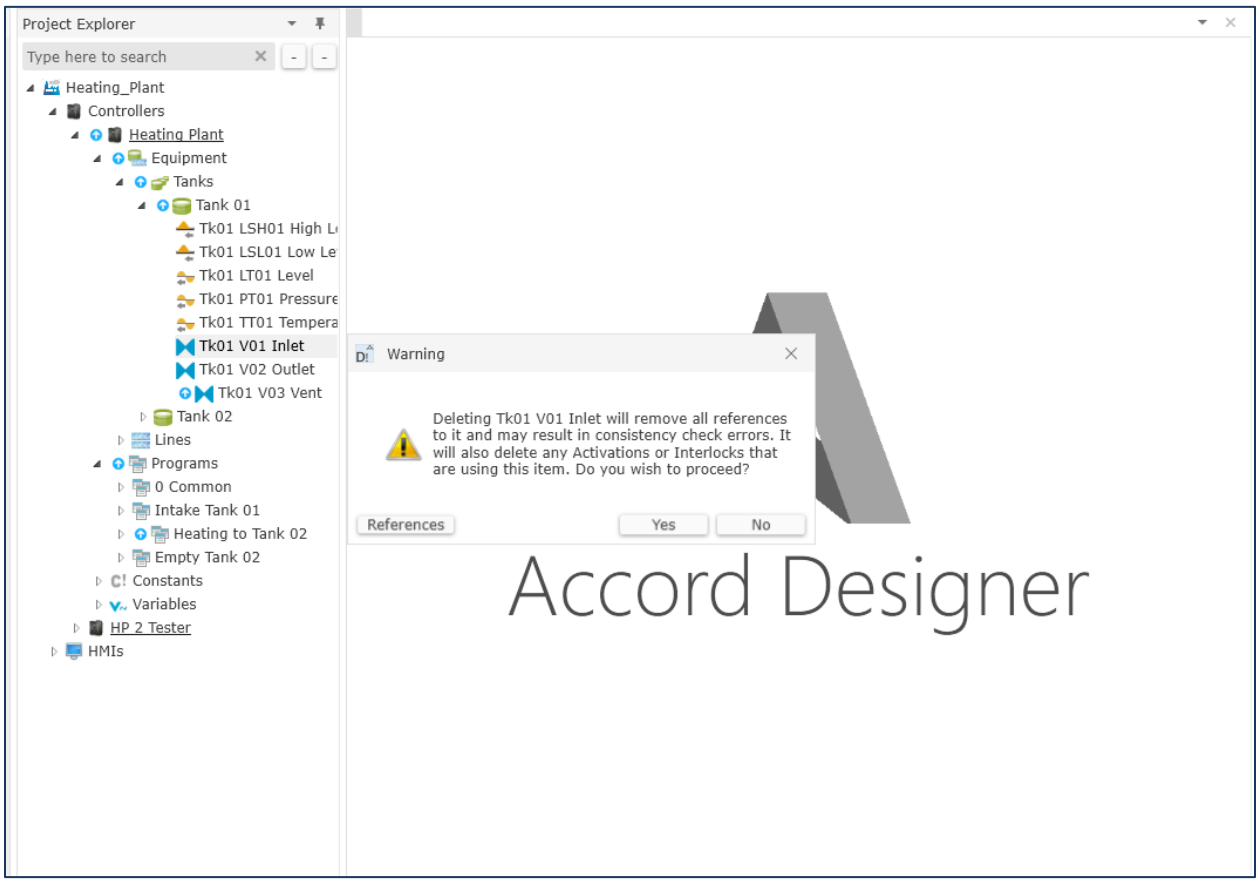
Once the type of condition is chosen the relevant items which are already configured in the same unit(s) become available for the choice of interlocking item in the drop-down menu.

The particular interlocking item is chosen from the drop down menu and the Interlock added by clicking “Add Interlock”.

Interlocks may be removed at any time by clicking “Del”.

5.3.4 Deletion of Digital Devices

To delete a digital device, right-click the desired device and select Delete.



Deletion of a Digital Device

A confirmation warning appears if the device is in use or referenced. The Deletion will remove all uses, activations or references for the device.

A device or any item may also be deleted using Delete in the Properties panel.

5.3.4.1 Deletion of Valves which have two parent Units

There is a choice for removing a valve which is used in two units.

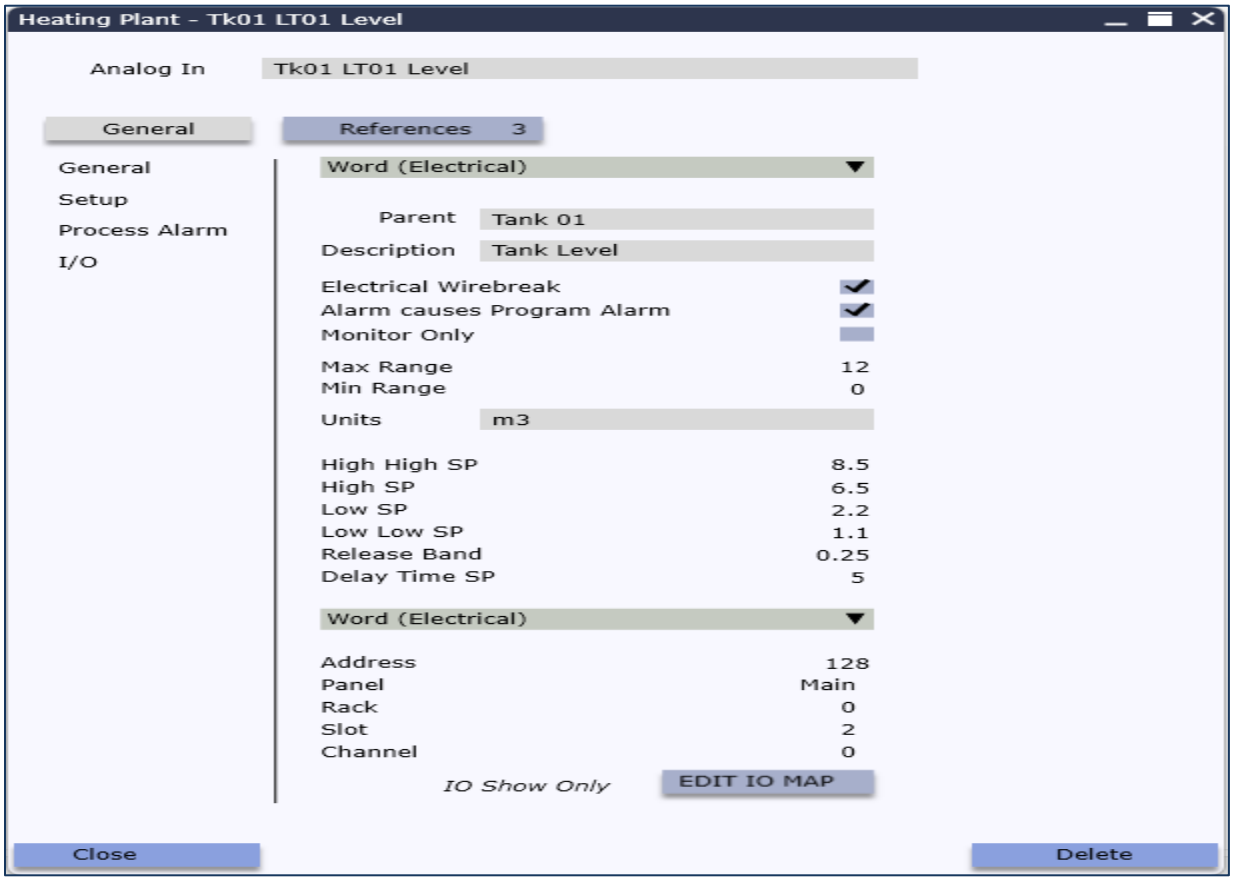
A prompt will request the user to choose between

- Delete Link – Deletes only the link between this valve and the parent unit.
- Delete Valve – Deletes the valve and links to any other parent units.
- Cancel Delete - cancels the Valve removal

5.4 Configuration of Analog Input Objects

5.4.1 Setup

There are settings in the Analog Input properties configuration section.



Analog Input Setup

5.4.2 Setup Fields

The following aspects of the instrument must be configured:

Setup:	Explanation
Parent	The Parent Unit for the Device,
Description	A description of the device, for documents and maintenance.
Electrical Wirebreak	To check for Wirebreak Alarm
Alarm causes Program Alarm	This causes an Error state to cause a Unit Alarm and then a Program Alarm if a program is working on the Unit.
Manual Only	This is used if the Input is not referenced in a program, only used for display.

Min Range	The lower value of the range in engineering units that the Electrical Input is to be scaled between.
Max Range	The upper value of the range in engineering units that the Electrical Input is to be scaled between.
Scaling	Scaling Factor applied to Bus based signals
Engineering Units	The name of the process units that is to be used in documentation and HMI Controls.

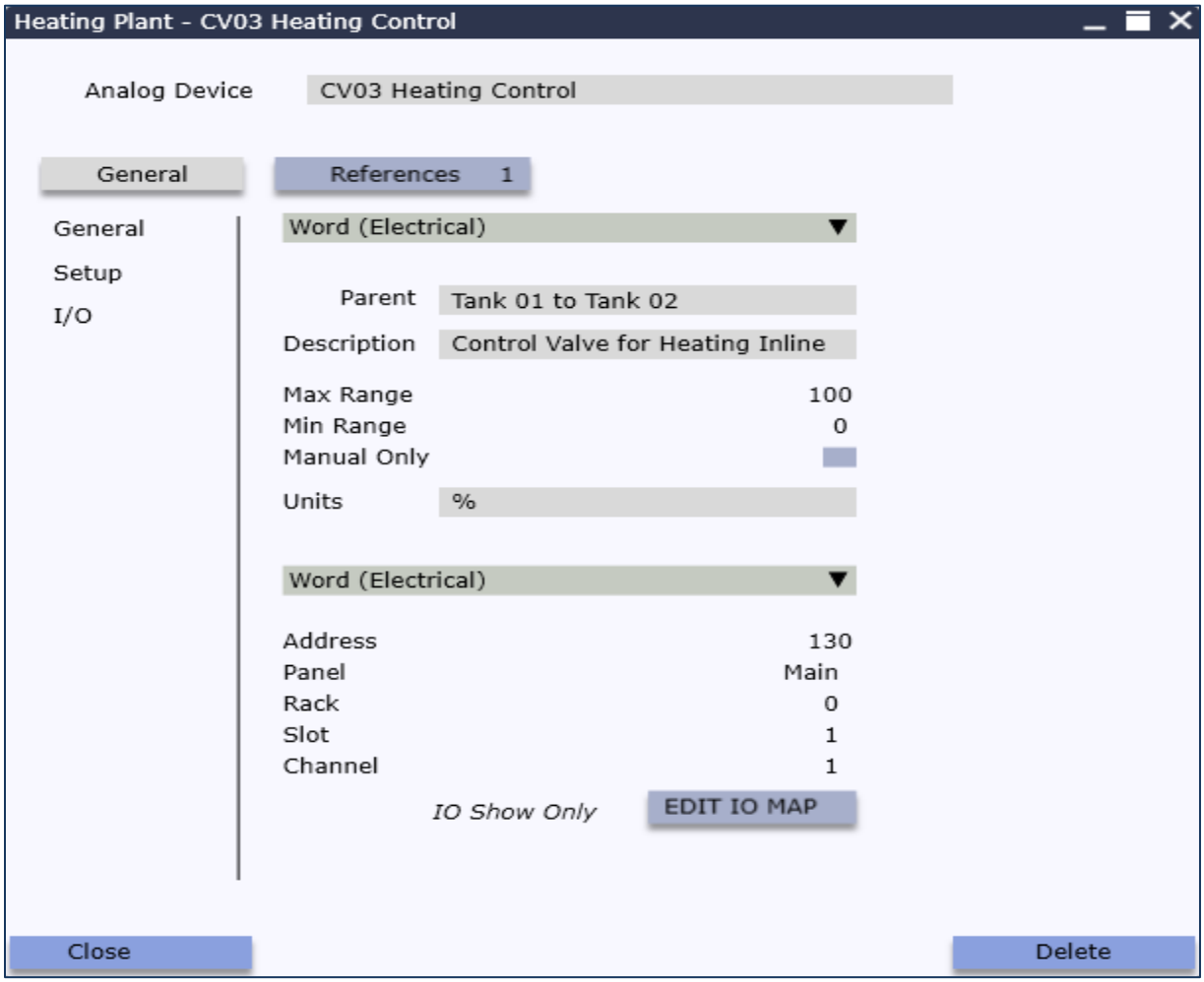
Process Alarm:	Explanation
High- High SP	This is the setpoint at which the High-High Alarm occurs.
High SP	This is the setpoint at which the High Alarm occurs.
Low SP	This is the setpoint at which the Low Alarm occurs.
Low-Low SP	This is the setpoint at which the Low-Low Alarm occurs.
Release Band	This is the value that the scaled value must recover by in order to release the alarm point. Example - If the high alarm is set to 90 and the alarm timer is 5 seconds and the hysteresis is set for 2 then the high alarm will be set if the Analog Input scaled value exceeds 90 for 5 seconds continuously. The high alarm will only be released as soon as the value falls below 88.
Delay Time SP	The number of seconds before an Alarm is triggered when the value is greater than or less than the respective Alarm SP

I/O	Explanation
I/O Address	This is the channel of the instrument, represented in word format. Example - 128, corresponds to I/O channel 128.
Input Type	This refers to the type of connection to the PLC, which will affect the scaling routine. The following types are configurable: 1. Word Electrical (Integer) e.g. 0-5 V, or 4-20 mA 2. Real Bus - The signal is read from Bus channel with applied Scaling Factor. 3. Word Bus (Integer) - The signal is read from Bus channel with applied Scaling Factor.
Panel, Rack, Slot, Channel	These fields can be used to describe the location of the signal, for maintenance and documentation.

5.5 Configuration of Analog Device Objects

5.5.1 Setup

There are settings in the Analog Device properties configuration section.



Analog Device Setup

5.5.2 Setup Fields

The following aspects of the device must be filled as required:

Setup:	Explanation
Parent	The Parent Unit for the Device,
Description	A description of the device, for documents and maintenance.
Min Range	The lower value of the range in engineering units that the Electrical Input is to be scaled between.
Max Range	The upper value of the range in engineering units that the Electrical Input is to be scaled between.
Scaling	Scaling Factor applied to Bus based signals
Manual Only	This is used if the Input is not referenced in a program, only used for display.
Engineering Units	The process units to be used in documentation and HMI Controls.

I/O:	Explanation
I/O Address	This is the channel of the instrument, represented in word format. Example - 128, corresponds to I/O channel 128
Output Type	This refers to the type of connection to the PLC, which will affect the scaling routine. The following types are configurable: 1. Word Electrical (Integer) e.g. 0-5 V, or 4-20 mA 2. Real Bus - The signal is written to the Bus channel with applied Scaling Factor. 3. Word Bus (Integer) - The signal is written to Bus channel with applied Scaling Factor.
Panel, Rack, Slot, Channel	These fields can be used to describe the location of the signal, for maintenance and documentation.

5.6 PID Loop Controller

5.6.1 PID Loop Note

A PID Loop Controller is used to control an Analog Device, based on a desired setpoint and feedback (in a loop fashion) from an Analog Instrument, also called the process variable.

An example is where Heat is transferred by allowing a quantity of steam to pass through a control valve. Initially the Temperature in the system (process variable) read by the Analog Input Temperature Transmitter will be low. As the system heats up the Control Valve will begin to close. The ideal is to maintain the Control Valve Analog Device at an output which maintains the temperature Process Variable at the desired Setpoint.

The difference between the Setpoint and the Process Variable is called the Error. The Loop controller allows the system to provide a low steady-state Error for different Setpoints.

PID stands for Proportional, Integral and Derivative control. The three terms refer to portions of the controller loop which provide the output value from the controller which is sent to the Analog device being controlled.

Proportional Control, also called gain, is a straight multiplier factor on the Error

Integral Control, is based on the average Error over recent time period.

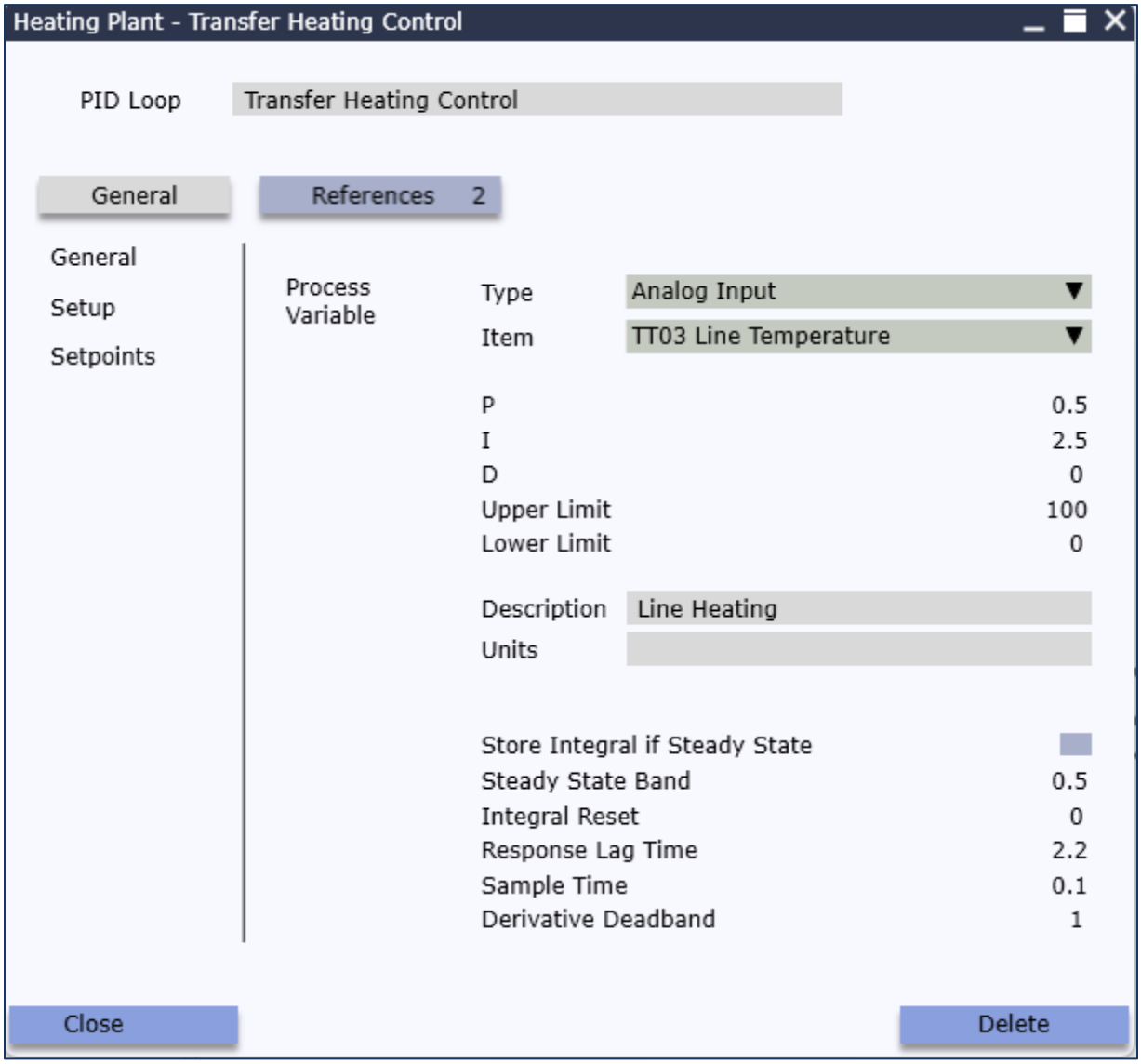
Derivative Control is based on the rate of change of the Output and (Error)

A controller only using Proportional control (P) would always generate an output which would cause the Process Variable to oscillate. Use of the I and D terms allows the user to generate controller action which will provide the required system response in terms of the output not oscillating at steady state. The process of modifying P, I and D terms to achieve smooth non-oscillating response is known as “tuning the loop”. Many systems just use P and I control and leave the derivative D term at 0.

5.6.2 Configuration of PID Loop Controller

Following insertion in a unit object each PID Loop must be configured with settings that will determine its operation and its description in documentation. During insertion the PID Loop is given a name and short description. These may be changed at any time.

There are two sections in the PID Loop properties configuration section. The name and analog device of the PID Loop are given in the Current Item. The PID loop is always associated with an Analog Device.



PID Controller Setup

5.6.3 Setup Fields

The following aspects of a PID Loop may be configured:

Settings	Explanations
AI Source	This is the Analog Input or Variable that is used as the Process Variable. It must be already configured.
P	Proportional, or Gain, Factor.
I	Integral Factor.
D	Derivative Factor.
Upper Limit Output	Maximum Range value for the Loop.
Lower Limit Output	Minimum Range value for the Loop. Often same as the Analog Device.
Description	A description of the device, for documents and maintenance.
Engineering Units	The process units to be used in documentation and HMI Controls.

Setpoints	Explanations
Store Integral when in Steady State	This allows the integral component to be stored, which will give a faster response in case of a PID restart.
Steady State Deadband	Deadband around the Setpoint within which the Loop is deemed to be in steady state. If the loop achieves this state for 100 seconds (given sampling time of 100ms) then the Integral component is stored when the "Store Integral when in Steady State" is enabled. Example- If the Steady State Hysteresis is 2.0 for a Loop with setpoint of 80.0 and then the Steady State is achieved when the Process Variable is between 78.0 and 82.0 for 100 seconds.
Integral Reset	Integral component value used when loop is starting up. Not used if there is a stored Integral Value from "Store Integral when in Steady State".
Response Time Lag	A factor for how quickly the loop is to react. It is used to set the rate of decay of Derivative term effect. The larger the value the slower the loop will act.
Sample Time	This is the interval between successive processing of the PID loop. This is set up in the PLC hardware to be 100 milliseconds. All PID loops are processed from OB35 in Simatic S7 PLC. The Hardware configuration will have OB35 interrupt time set to 100 milliseconds.
Derivative Deadband	The Derivative Deadband is the minimum amount of an error change that will cause a change to the derivative component of the PID calculation. It is a Deadband on the error with respect to the Derivative Component of the PID loop.

These settings are available in Accord HMI PID Controls for tuning the loop on site.

5.6.4 Steps in setting up a PID controller

These steps are generally carried out at HMI or Scada commissioning.

1. The PID Loop sample time will be 100 Ms- this means that the PID Loop and error is evaluated and output is manipulated every 100 milliseconds.
2. The response lag time depending on how quickly the physical loop is to react;
   - Initial guides for this are;
     - Flow controller - in the range 2-5 seconds
     - Temperature controller – in the range 30-40 seconds

     Test the accuracy of these times by manually activating (opening) the PID Loop output item – (analog device - control valve) and measure the time before a response is noted, being a change in the process variable (e.g. Temperature Transmitter).
3. To Tune the PID Loop
   - Initially set Integral and derivative (I & D) terms to 0 (zero)
   - Give an expected setpoint (or 50-70% of the maximum expected output).
   - Adjust the P term until the PID Loop oscillates around the setpoint without closing or reaching upper or lower limits.
   - Measure the time between peaks (i.e. the time for 1 complete cycle between maximum output and minimum output)

Apply P, I and D terms as follows

Proportional and integral control - e.g. Flow control. • P=Initial gain/2.2 I=Periodic time/1.2 Proportional and integral and derivative control – e.g. Temperature Control • P=Initial gain/1.7 I=Periodic time/2 D=I/4

4. PID Loop Restart
   - If the PID Loop is required to Start from value other than Min Range then for check (tick) the box for “Store Integral When in SS”.

     This will cause the integral component of the PID Loop output to be stored when the PID Loop is in steady state, and Loop will load this value on new starts.

Note: Ensure disturbance variable is not set too high as this disables a derivative change effect if the error change between PLC cycles is too small. i.e. If the PID Loop reacts very slowly ensure the derivative term is not redundant.

6 Configuration of Programs

6.1 Program General

Programs contain Steps, which in turn contain Alarms and Activations. The Step sequence and the Alarms and Activations may be dependent on values which are checked in Comparisons, or some logic evaluated in a Combination, and the values may be Analog devices, or Setpoints, or Variables. The values in variables can be changed using Write Variables operations.
These are the components that Designer provides for implementation of a step sequenced program.

The full list of components required is, (as well as reference to equipment devices)

Common Items	
Program	Collection of program items and a sequence of Steps.
Program Order	Order in which programs are to be processed.
Variable	Register whose Value (Floating Pt) is written by the PLC.
Constant	Register which has a constant (Floating Pt) value in the PLC.
Product	A unique object used in the Program Routing System.

Program Items	
Comparison	A test of two signal or values, e.g. Greater than... .
Combination	A logic function. e.g. Tank LSL and Outlet Valve Open.
Command	A single command from HMI to the PLC
Delay	An On Timer type delay for debounce items
Decision	A point selection at the HMI, may be part of a recipe
Setpoint	A value selection at the HMI, may be part of a recipe
Write Value	To perform a mathematical operation
Write Program	To change the step or state of another program
Alarm	A Critical fault or an Event in process operation.
Step	Stage of the program.

Program Recipe Items	
Step Times	Times used when the Step On is to Normal Step-On on Time.
Setpoints	A value type selection at the HMI
Decisions	An On/Off type point selection at the HMI

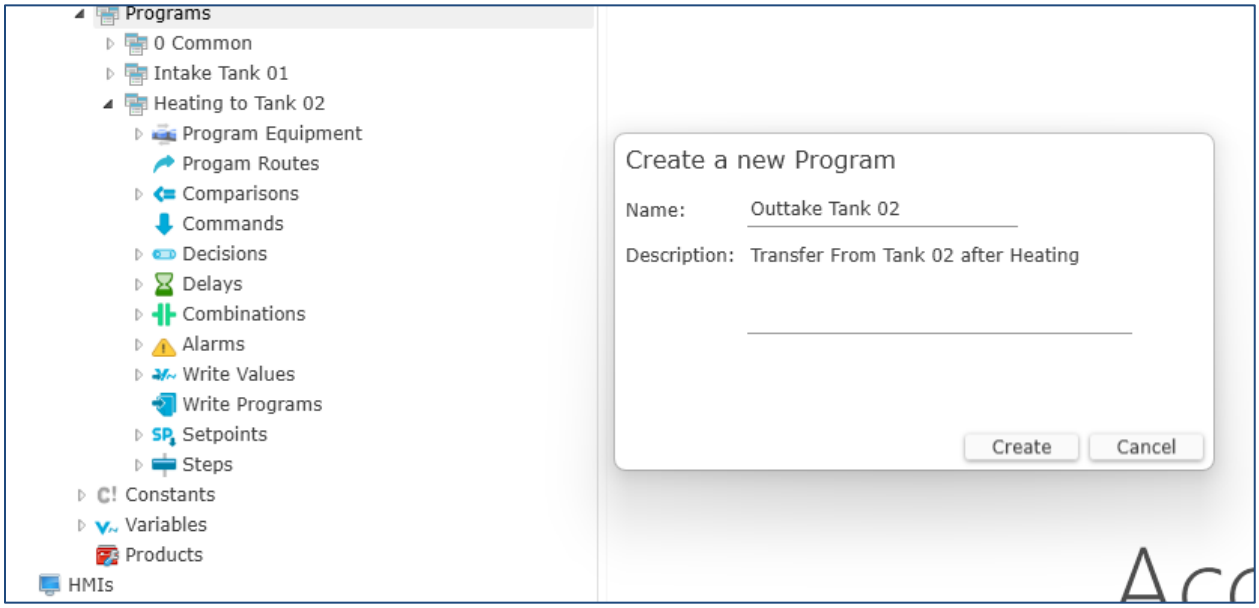
A Program is configured or built by configuring program and by listing them (for enabling) in Steps. Items are configured by dragging the appropriate icon from the Program toolbox or by right-click in the component holder and “adding component ” such as “Add Operation”. Equipment Units must be dragged to Equipment container in order to Activate devices or use items in Conditions etc.

A Program has the following states

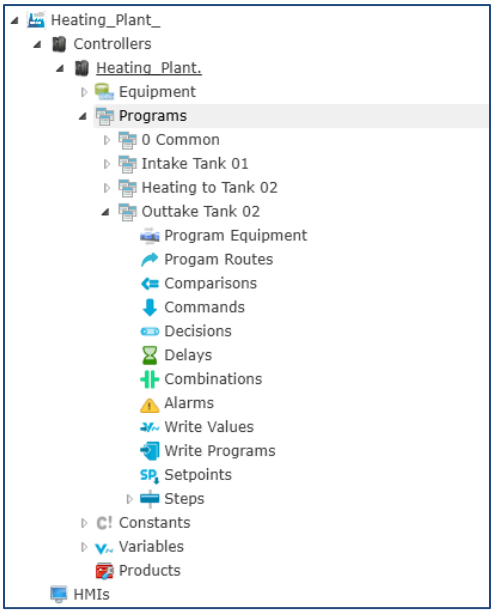
Program States	
Active	Program has been Started
Hold	Disallow Step On, Alarms and activations that are not ‘Enabled in Hold’
Alarm	A program Alarm or an Alarm in an associated equipment device has occurred.
TimeHold	The Step Time is paused.
Running	Program is Active, and not in Alarm or Hold.
Normal Step On	Program goes to the next step in the Step Order
Alternative Step On	Program goes to another step
Step	The number of the step the program is in. Startup Step is 0.
Startup Step	Initial step which checks on any Alarms or Units being reserved by other program being active.

6.2 Insertion of a Program

A program is inserted into the configuration by dragging a program icon from the toolbox to the Program Configuration area, or by right-clicking and Add Program. The inserted program must be named. In example the program is named “Outtake Tank02”. The program sub-component holders are automatically generated.



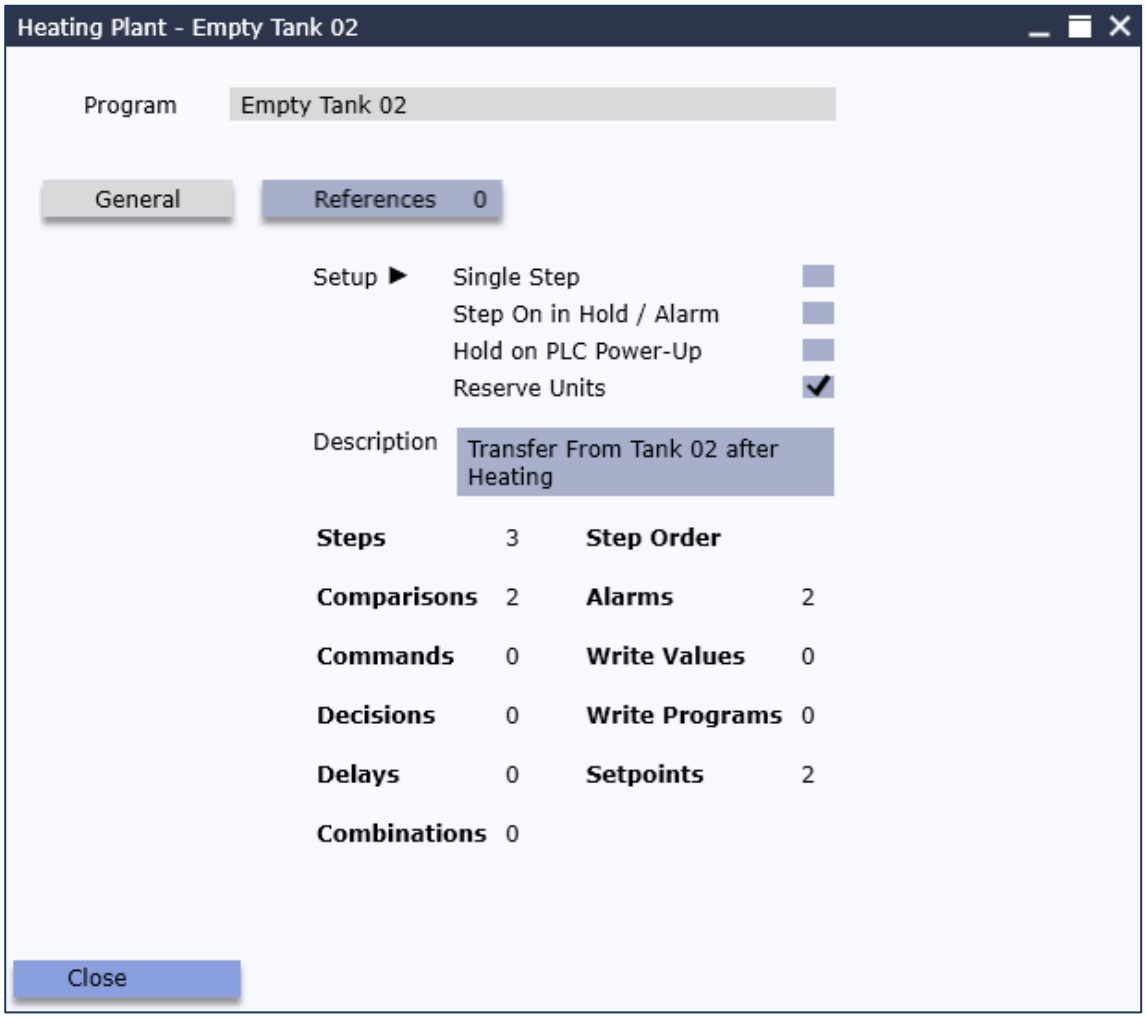
Initial Program creation



Initial Program Containers

6.3 Program Properties

Following Insertion the program initial properties may be configured.



Program Properties

Program Properties:
Single Step – this is for a 'Background Program' which is to run continuously. These programs run Common or Safety functions.

Step On in Hold - The default setting is that a program will not step on automatically if it is in hold or Alarm. This means the Operator must acknowledge the Alarm or restart the program manually. The Enable setting will allow the program to step on Automatically if a Critical Alarm has occurred or while the program is in Hold State.

Hold on PLC Power-Up - If the PLC fails all the information for the system is retained until the PLC is powered up again. The program may be configured to resume if it was running at time of power loss, or be configured to go into Hold, which will require Operator to restart the program.

Reserve Units - Normally a program will 'Reserve' or Select units when it is Active. This means that another program attempting to start using those units will go into Alarm, assuming the Unit Selected Alarms are still in the First Step. However, some programs for background or common functions may not be required to 'Reserve' or select units.
Prestart Operator Actions notes – this information will be used in project documentation.

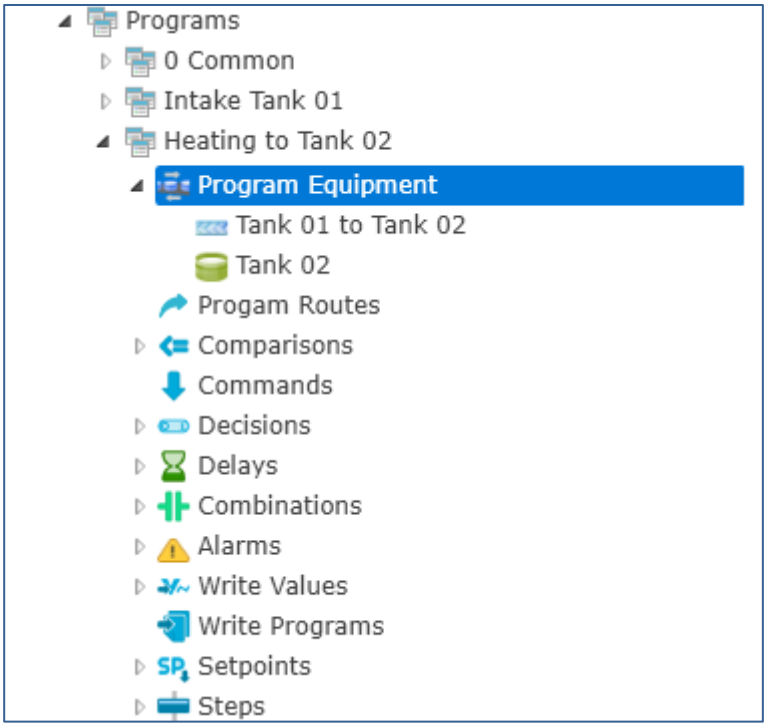
6.4 Equipment Units in Program

Control System Programs work on Devices, which are arranged in Equipment Units.

If an Equipment Item is in Alarm, and a program is Active in a Step which activates devices in the same Unit, then program will go into Alarm.

This is achieved simply by placing the required Equipment into the program Equipment holder. The Tank and line equipment units for the program are dragged from the Tank and line groups into the Equipment holder. Only devices in Units in the program Equipment holder are available for activation in the program.

The Units placed in the container for the program are the Units which may be reserved, and associated Units reserved alarms may stop multiple programs from working on the same equipment.



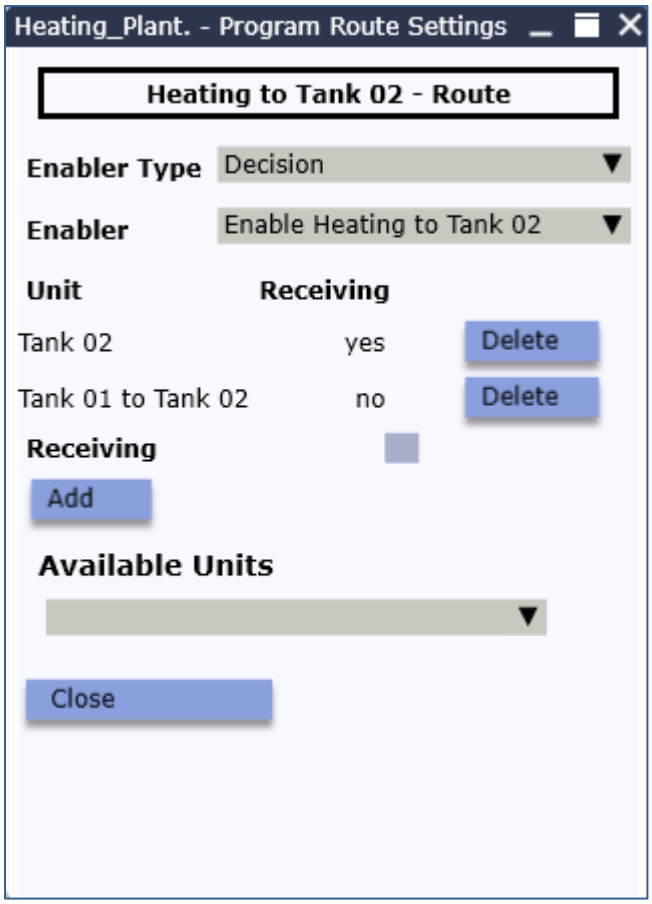
Program Unit Details

A Unit should only be in use by one program at a time in the running plant. When each unit is placed in a program, two alarms are automatically associated with it - Unit Selected Check and Unit Maintenance Check. These alarms are automatically inserted into Step 0. They may be removed if not required. These error checks are important for program interlock, product security and personnel safety. The user may also insert a 'Unit in Manual' Alarm here to cause an Alarm if the program is Active while a device in one of the program equipment units is in Manual.

6.5 Product Id - Configuration of Program Routes

A Program Route is added to the program by right-clicking the Program Route component holder and selecting New or by duplicating an existing item.

The inserted Program Route must be given a unique name.



Setup of a Program Route

6.5.1 Setup

The following are filled in for the Program Route

1. The Enabler Type must be selected.

   The types are

   - Combinations
   - Decisions

Enablers may be configured on items being true or false where appropriate.

2. Unit Selection

A Unit is selected from the Available Units dropdown menu, commonly the first Unit to be added is the end destination of the Route known as the “Receiving Unit”.
The “Receiving” checkbox is ticked if the Unit is to be a Receiving Unit.

3. Add to Route

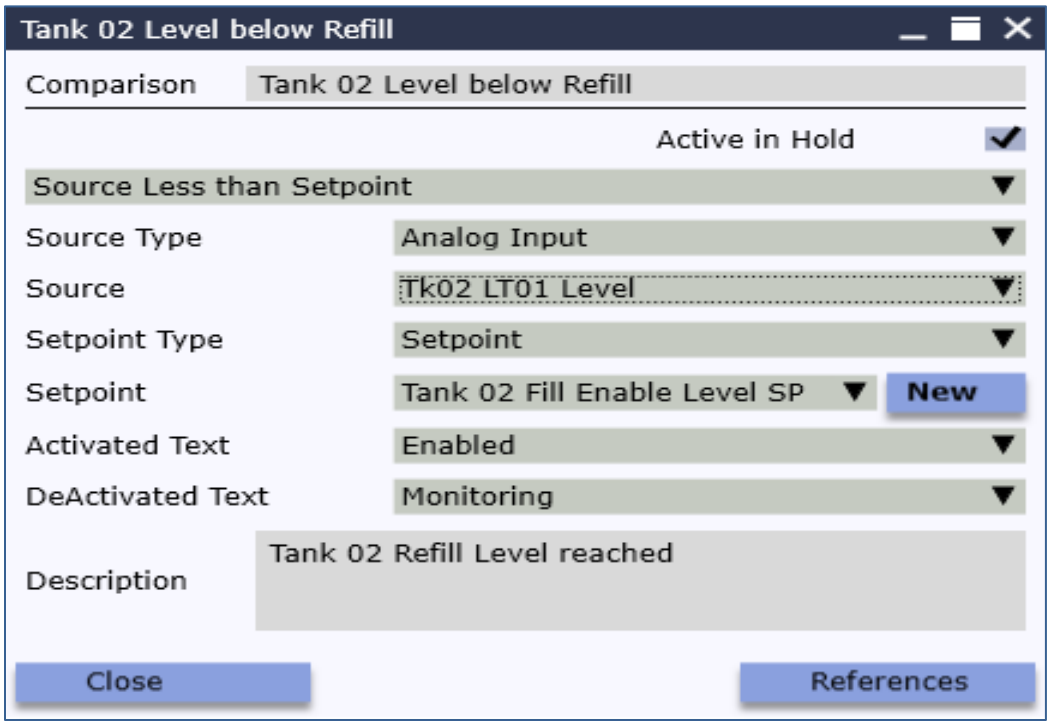
Other Units are added to the Route in same manner.

Note: Program Routes are only accounted for if the “Tracking Route” option is selected in Step

6.6 Configuration of Comparisons

A comparison is added to the program by dragging the comparison icon from the toolbox to the program comparison component holder, or by right-clicking on the holder and selecting New or by duplicating an existing item.

The inserted comparison must be given a unique name.



Setup of a Comparison

6.6.1 Setup

The following are filled in for the comparison
Comparison Type:

- Source Less than Setpoint,
- Source Less than or Equal to Setpoint
- Source Greater than Setpoint
- Source Greater than or Equal to Setpoint
- Source Equal to Setpoint
- Source not Equal to Setpoint
- Source within Deadband of Setpoint
- Program in Step

Source and Setpoint declaration

- Analog Inputs
- Analog Devices
- Setpoints
- Constants/Variables

4. Active in Hold Selection

This is selected to allow the Result to be True if the Program is in Hold or Alarm.

5. Texts and Description.

The desired Texts for Active and Inactive Status may be filled in, along with a description, which is used in auto generated Documents.

In the example the Comparison is True if Tk02 LT01 Level is less than a Setpoint Tank 02 Fill Enable Level SP.

Note: New Setpoints and Constants/Variables may be generated by clicking on the New button.

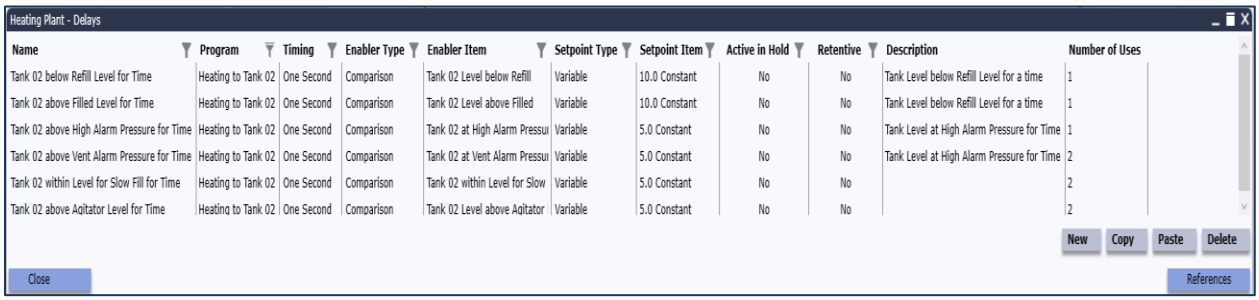
For Setpoints a default value is used in Designer but may be changed in HMI or Recipe.

The maximum and minimum values will be bounds that apply in HMI and Recipe. There is an Option to allow each Setpoint to be changed or not allow it to be changed, when program is Active.

A delay may be applied by using the Comparison in a Delay (see Delays)

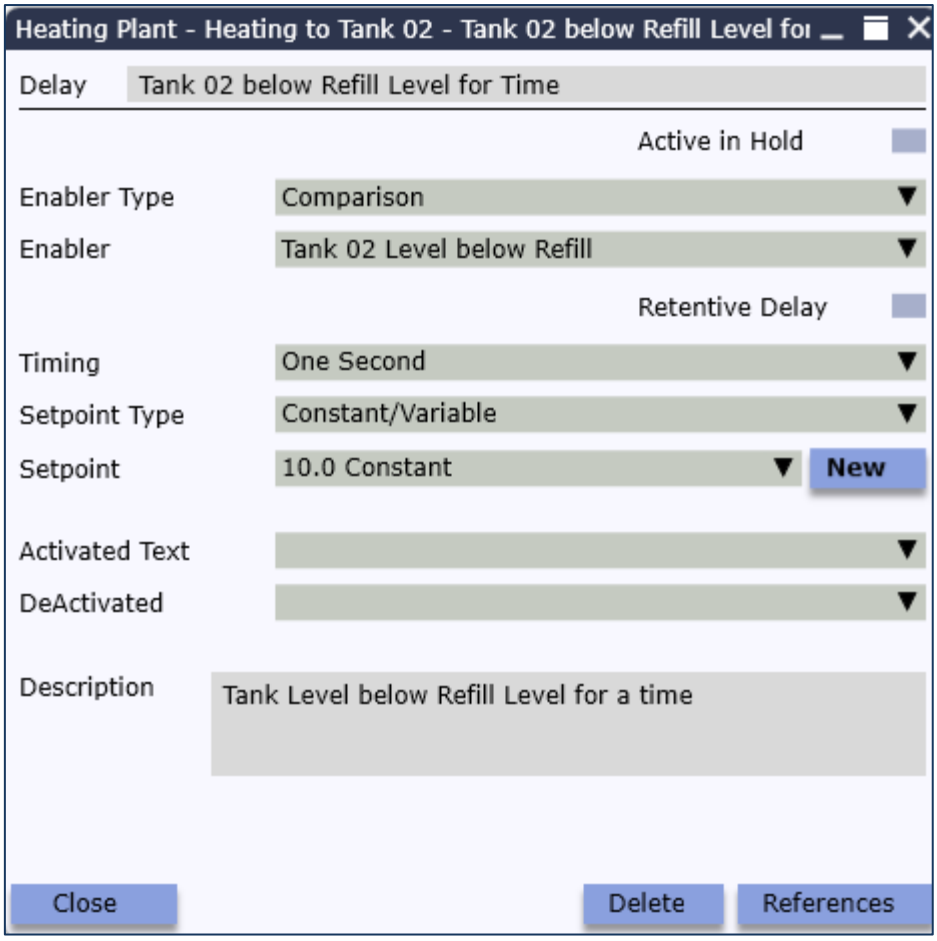
6.7 Configuration of Delays

A delay is added to the program by dragging the delay icon from the toolbox to the program delay component holder, or by right-clicking on the holder and selecting New or by duplicating an existing item.



List of Delays in a Program

The inserted delay must be given a unique name.



Delay Setup

6.7.1 Setup

The following are filled in for the comparison

1. The Enabler Type must be selected.

Where the Types are

- Comparisons
- Combinations
- Commands
- Digital Inputs
- Analog Input Value Alarms
- Digital Device Alarms
- Program is Active, or Running, or in Hold, or in Alarm, or in TimeHold.
- Step Time; Check performed on Step Time elapsing. Also known as Watchdog Time
- Program in a new Step
- Unit in Maintenance, Manual, or Selected

And Enablers may be configured on items being true or false where appropriate.

2. The Timing Timebase is selected,
   - 100 Ms
   - One Second
   - One Minute
   - One Hour

3. The Setpoint Type and Setpoint are Selected.
   - Analog Inputs
   - Analog Devices
   - Setpoints
   - Constants/Variables

In the example the Delay is True if the Comparison is true for 10 Seconds.

The Delay is usually an On Delay, where the Enabler has to be present continuously for the nominated time.

Selecting Retentive delay will cause the current time to be retained/held if the Enabler state is not present, and to continue counting when the Enabler returns. Care should be taken with this as the Delay can appear to become True in a shorter time, if the Enabler has become present again.

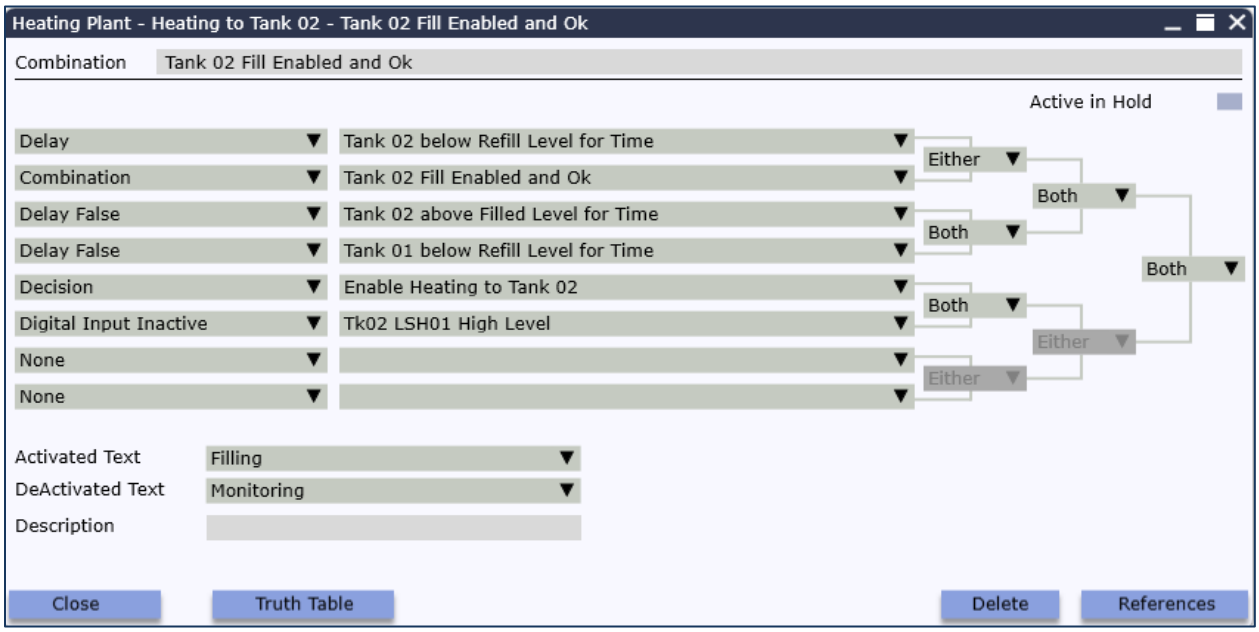
6.7.1.1 Delay Order

Ordering of Processing of Delays in PLC

This allows the Delays to be sequenced if necessary, for example if Delay Enablers are also Delays.

6.8 Configuration of Combinations

A combination is added to the program by dragging the combination icon from the toolbox to the Combination holder, or by right-clicking on the holder and selecting New or by duplicating an existing item.



Setup for a Combination

The example shows a Combination which is a latch: it becomes true on the Comparison Tank 02 below Refill Level for Time and stays true while other items remain in required state.

6.8.1 Boolean Gate Descriptions

The combination is made up of a series of Gates. Each gate can be used to evaluate a Boolean logic condition. A spreadsheet utility is provided in the help area to allow users to test the logic prior to confirming and downloading.

GATE	Description
BOTH	True if both inputs to gate are true.
EITHER	True if either input to gate is true.
NOT BOTH	True if both inputs to gate are false.
NEITHER	True if either input to gate is false
ONLY 1	True if both inputs to gate have different states.
SAME	True if both inputs to the gate have the same state.
A NOT B	True if input to first gate is true and the input to second gate is false.

6.8.2 Boolean Gate Operations

BOTH Gate - Both inputs to gate are true.

If state=1 of input X AND state=1 of input Y then Result=1.

Input X	Input Y	Result
0	0	0
0	1	0
1	0	0
1	1	1

EITHER Gate - Either input to gate is true.

If state=1 of input X OR state=1 of input Y then Result=1.

Input X	Input Y	Result
0	0	0
0	1	1
1	0	1
1	1	1

NOT BOTH Gate - Both inputs to gate are false.

If NOT state=1 of input X AND NOT state=1 of input Y then Result=1.

Input X	Input Y	Result
0	0	1
0	1	0
1	0	0
1	1	0

NEITHER Gate - Either input to gate is false

If NOT state=1 of input X OR NOT state=1 of Input Y then Result=1.

Input X	Input Y	Result
0	0	1
0	1	1
1	0	1
1	1	0

ONLY 1 Gate - Both inputs to gate have different states

If state=1 of input X AND NOT state=1 of input Y

OR if NOT state=1 of input X AND state=1 of input Y then Result=1.

Input X	Input Y	Result
0	0	0
0	1	1
1	0	1
1	1	0

SAME Gate - Both inputs to the gate have the same state

If NOT state=1 of input X AND NOT state=1 of input Y

OR if state=1 of input X AND state=1 of input Y then result is 1.

Input X	Input Y	Result
0	0	1
0	1	0
1	0	0
1	1	1

A NOT B Gate - Input to first gate is true and the input to second gate is false

If state=1 of input X AND NOT state=1 of input Y then Result=1.

Input X	Input Y	Result
0	0	0
0	1	0
1	0	1
1	1	0

6.8.3 Setup

The following are filled in for each required row of the combination

The Gate Type – per table above.

The type of item to be checked, and the name of the item to be checked.

1. Active in Hold Selection

This is selected to allow the Result to be True if the Program is in Hold or Alarm.

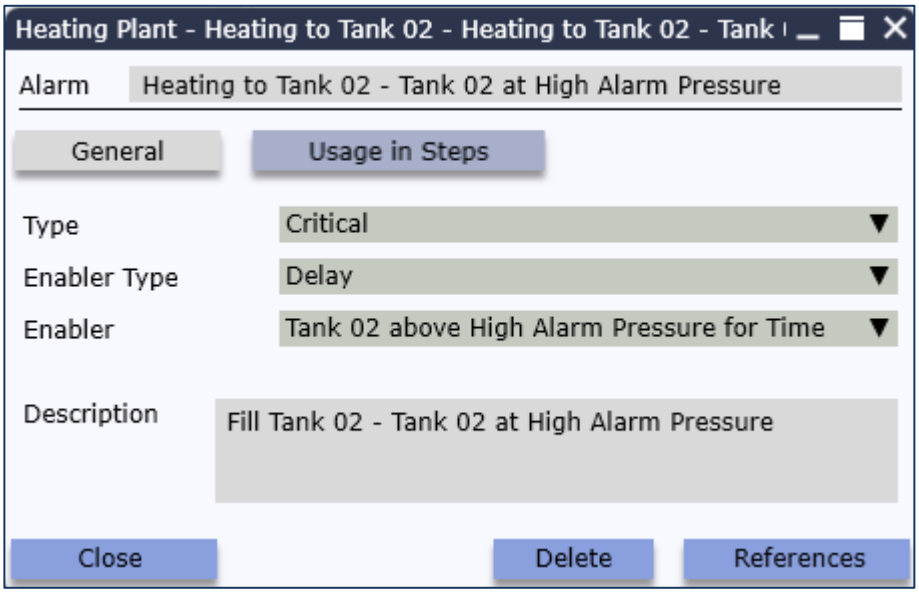
2. Texts and Description.

The desired Texts for Active and Inactive Status and a description for use in Documents.

6.9 Configuration of Alarms

Alarms are used to give warnings or to stop the program from performing unsafe or undesired operations.

An alarm is assigned to a program by dragging the alarm icon to the component holder or by right-clicking on the holder and selecting New or by duplicating an existing item.



Critical Alarm Configuration

6.9.1 Setup

The type of the Alarm is selected. The types are

- Critical alarm.
- Non Critical alarm.
- Event.

A Critical Alarm will cause the Program to go into Alarm and Hold. This must be Reset before the Program can Restart.

A Non Critical Alarm is a Warning, it will not cause the Program to go into Hold. It will be registered at HMI/Scada and must be acknowledged there.

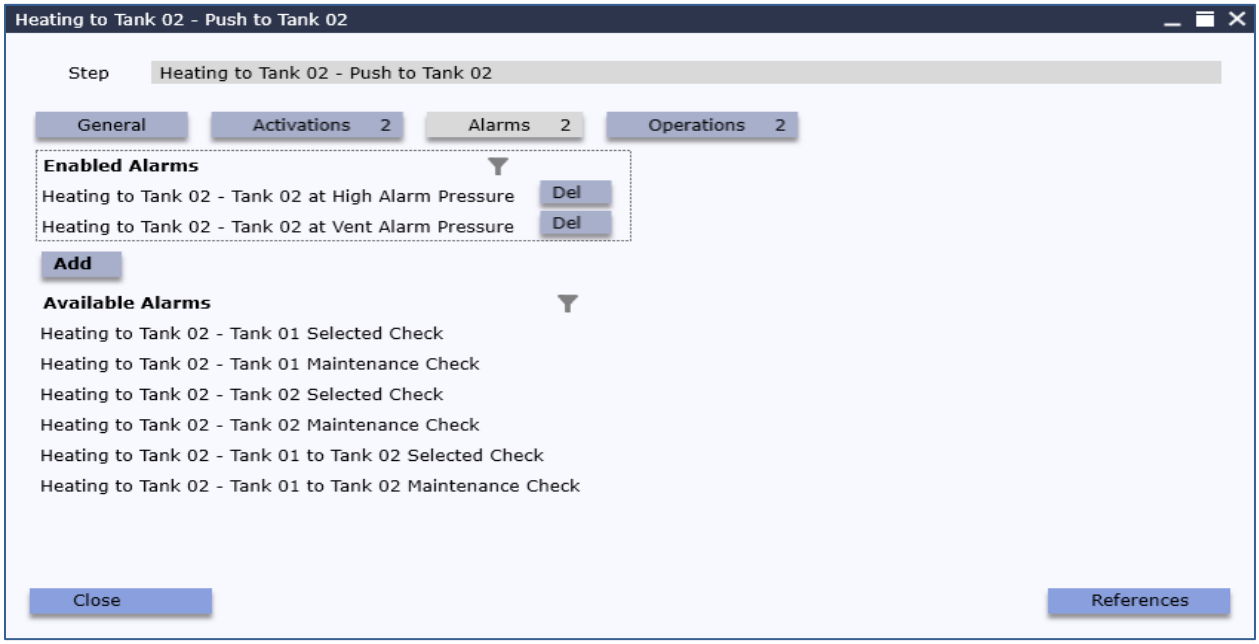
An Event may be generated just for logging, for Audit or Reports.

2. The type of the Alarm enabler is selected. The possible Alarm Enabler item types are
   - Comparisons
   - Combinations
   - Commands
   - Digital Inputs
   - Analog Input Value Alarms
   - Digital Device Alarms
   - Program is Active, or Running, or in Hold, or in Alarm, or in TimeHold.
   - Step Time; Check performed on Step Time elapsing. Also known as Watchdog Time
   - Program in a new Step
   - Unit in Maintenance, Manual, or Selected

Alarm may be configured on items being true or false where appropriate.

3. The “Description” section is used to enter a description for documentation purposes.

An Alarm may be Added to or Removed from Steps in the Usage in Steps section



Alarm Usage in Steps

6.10 Configuration of Write Value

Write Values are used to perform mathematical functions in the program. A Write Value operation is added to the program by dragging the icon from the toolbox to the program and configuring or by right-click and New on the container, or by duplication of an existing.

Setup for a Write Value type

This write causes the value 'Tank 02 Volume Transferred' to be incremented each time the Pulse on the Flowmeter 'FP01 Volume Pulse' is present.

6.10.1 Setup

1. The type of the Write is chosen. The possible types are

Arithmetic

- Add Two Values
- Subtract From Value
- Multiply By Value
- Divide By Value
- Transfer Value
- Absolute Value
- Average Value
- Periodic Value Change

Boolean

- Set Item
- Reset Item

Trigonometric

- Square
- Square Root
- Exponential
- Log Natural
- Sine
- Cosine
- Tan
- ArcSine
- ArcCosine
- ArcTan

2. The Operand Types and Operand Items for Source 1, Source 2 and Target are filled in.

The Source can be an Analog Input, an Analog Device, a Variable or a Setpoint.

The Target can be an Analog Device, a Variable, an Analog Input Alarm SP, or a PID Loop, or a PID Loop Gain (P) setting, or a PID Loop Integral (I) Setting.

3. The Enabler is configured.

The Enabler type and item are chosen from the list and the Enabler Rule is one of
For Steps;

- Always During Step
- Step Start
- Step End

For other items:

- On True - when the enabling object becomes true
- On False - when the enabling object becomes false
- While True - while the enabling object is true
- While False - while the enabling object is false

Where the Items are

- Comparisons
- Combinations
- Commands
- Digital Inputs
- Analog Input Value Alarms
- Digital Device Alarms
- Program is Active, or Running, or in Hold, or in Alarm, or in TimeHold.
- Step Time; Check performed on Step Time elapsing. Also known as Watchdog Time
- Program in a new Step
- Unit in Maintenance, Manual, or Selected

And Enablers may be configured on items being true or false where appropriate.

The Description section is used to enter a long description of the alarm for documentation purposes. The Write Value is enabled in steps by using the “Usage in steps” Section. Here steps are Added/Removed to the “Steps Using this Write” window.

6.10.1.1 Transfer Product Id

Transfer value additionally has two unique Source and Target types:

- Product ID of a Program
- Product ID of a Unit

These may be used to Write a valid Product ID value to a Program or Unit.

6.10.2 Write type Average Value

An Average type Write Value is composed of Source and Target Item, where the Source is the item to be sampled, and the Target is the result of the Averaging of Samples.
The Source can be an Analog Input, an Analog Device, or a Variable, and the Target can be a Variable.

There are settings for the Sampling Period type (Seconds or Minutes) and the Repeat Interval (as the Number of Seconds or Minutes) and the Number of Samples to be counted for the Average.

The Average and Sampling is unconditional, it always occurs during a Step.

6.10.3 Write type Periodic Value Change

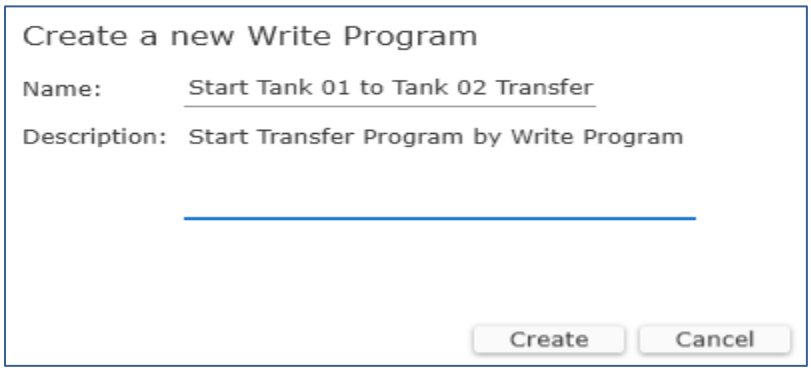
In a Periodic Value Change Write the Source 1 item is incremented by the Source 2 item each time period.

There are settings for the Time Period type (Seconds or Minutes) and the Repeat Interval (as the Number of Seconds or Minutes) .

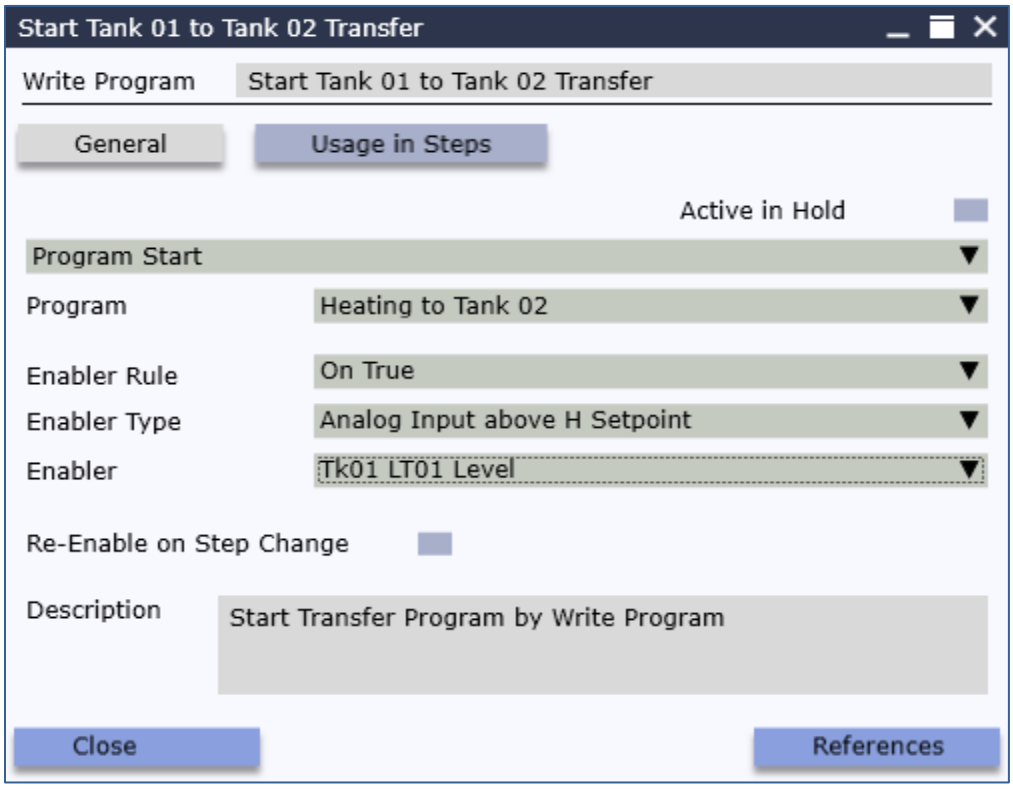
6.11 Configuration of Write Program

Write Program are used to change the Status or the Step of a Program.

A Write Program operation is added to the program by dragging the icon from the toolbox to the program and configuring or by right-click and New on the container, or by duplication of an existing write.



New Write to Program



Configured Write to Program

The Program Heating to Tank 02 is started if the Tk01 LT01 goes above its High Alarm SP.

6.11.1 Setup

1. The type of the Write is chosen. The possible types are

Arithmetic

- Program Start – new Start or Resume
- Program End
- Program Step On – to Selected Step
- Program Hold

2. The Operand Types and Operand Items for Source 1, Source 2 and Target are filled in.

The Source can be an Analog Input, an Analog Device, a Variable or a Setpoint.

The Target can be an Analog Device, a Variable, an Analog Input Alarm SP, or a PID Loop, or a PID Loop Gain (P) setting, or a PID Loop Integral (I) Setting.

3. The Enabler is configured.

The Enabler type and item are chosen from the list and the Enabler Rule is one of
For Steps;

- Always During Step
- Step Start
- Step End

For other items:

- On True - when the enabling object becomes true
- On False - when the enabling object becomes false
- While True - while the enabling object is true
- While False - while the enabling object is false

Where the Items are

- Comparisons
- Combinations
- Commands
- Digital Inputs
- Analog Input Value Alarms
- Digital Device Alarms
- Program is Active, or Running, or in Hold, or in Alarm, or in TimeHold.

- Step Time; Check performed on Step Time elapsing. Also known as Watchdog Time
- Program in a new Step
- Unit in Maintenance, Manual, or Selected

And Enablers may be configured on items being true or false where appropriate.

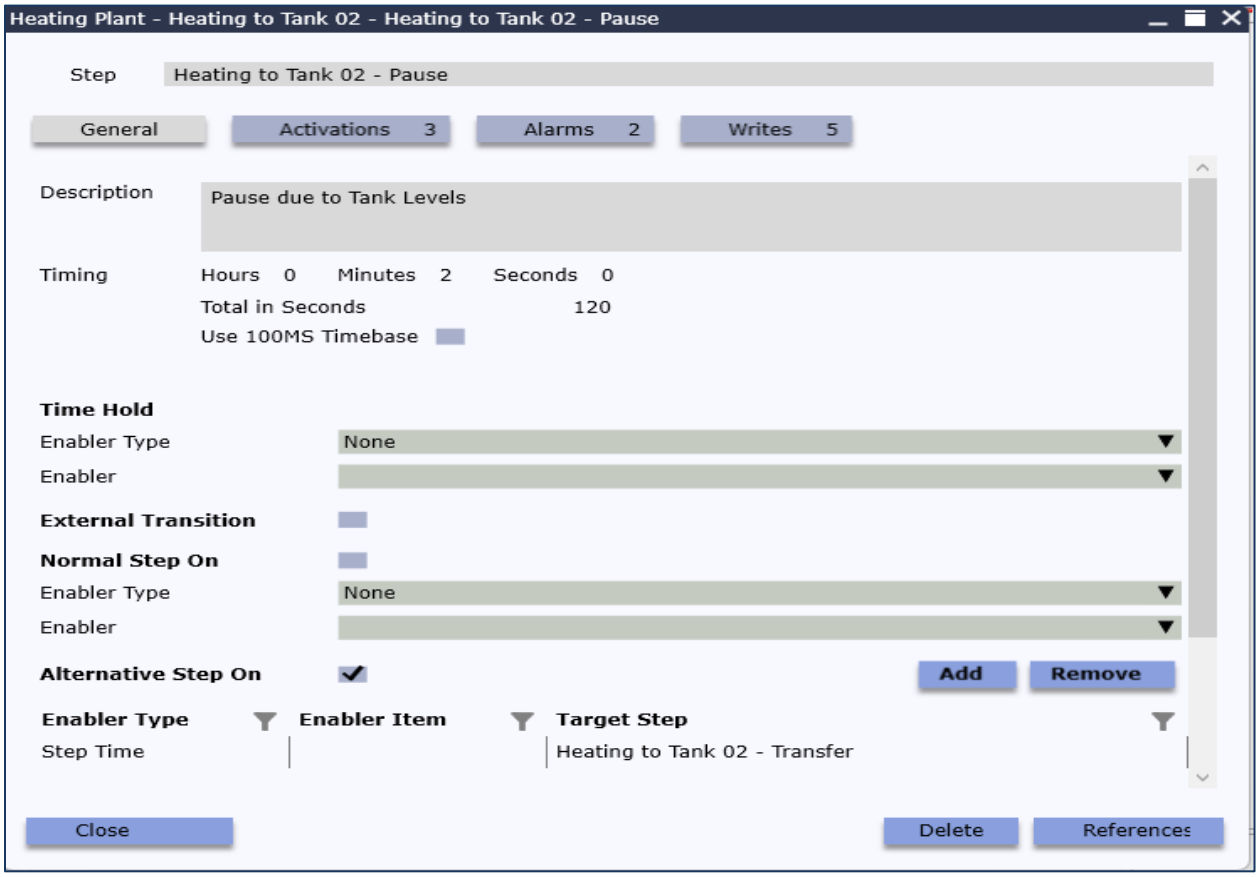
The Description section is used to enter a long description of the alarm for documentation purposes. The Write Value is enabled in steps by using the “Usage in Steps” section. Here steps are Added/Removed to the “Steps Using this Write” window.

Care must be taken to ensure correct operation when writing to other programs.

6.12 Configuration of Steps

Alarms and Operations are enabled in required steps. Step Transitions are configured also.

6.12.1 Properties



Step Properties showing Selection of Alternative Step On

The above Properties Section contains the following:

Field	Description
Description	This is a basic description which will appear in the documentation.
Timing	Each step has an allocated time. Generally, this time is used as a step duration, in which case the program will move to the next step (see step order) when the duration time has elapsed. Step Time may be used as a watch-dog timer in an Alarm. Step time counts down when Program is not in Hold or TimeHold.
Track Program Route	Product Mismatch Check & Route Enabled Check alarms are added to the Step.
Time Hold	Step Time counting will be paused if the Enabler is true.
External Transition	This is selected when a Write in another program is used to end the Step.
Normal Step On	Selection for step-on to the next step in the Step Order list.

Alternative Step On	Program will step to configure target step if the enabler is present.

6.12.2 Configuring Step On-Transitions

The following types of Step-On transitions may be configured:

1. Normal Step On transition
   This causes the program to Step-on to next step in the Step Order.
2. Alternate Step On transition
   Causes the program to go to another step other than the next in Step Order.
   This may be useful for situations such as a recirculation requirement on a heat exchanger.
   The order of Alternate Step On checks may be altered, to give priority in case two happen in the same PLC scan.
3. External Step On
   This means the program will not step on automatically, it must be stepped on by a write or by Operator at HMI.

When a program leaves a step - Activations, Operations and Alarm monitoring on items configured for the step are finished. The program may return to the step again per Recipe or an Operation or Alternate Step On.

Normal and Alternate Step On transitions may be enabled by the following:

- Comparisons
- Combinations
- Step Time
- Digital inputs
- Analog High-High Alarms
- Analog High Alarms
- Analog Low Alarms
- Analog Low-Low Alarms
- Valve Activated / Deactivated
- Motor Activated / Deactivated
- Valve Error
- Motor Error
- Digital Output Activated / Deactivated
- Analog Input WireBreak

These items may be tested for True or False state.
Steps in Step holder are listed in default Step Order.

6.12.3 Enabling Comparisons and Combinations and Delays

These items are automatically enabled in all steps while the Program is Active.

6.12.4 Enabling Device Activations

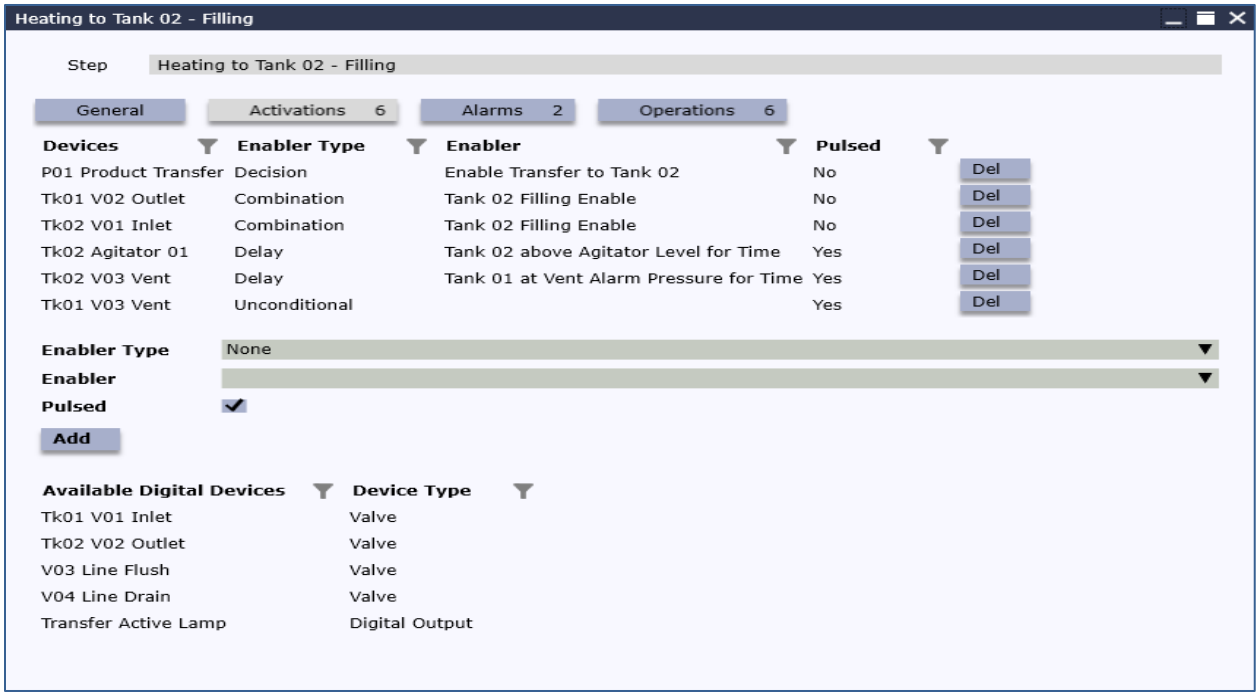
Required Digital Devices (valves, motors, digital outputs) may be activated in a step. Only Devices in Units that have been added to the Program Equipment are available for Automatic Activation. The PLC program will automatically monitor for all device errors in Equipment Units of devices being activated.

The devices may be activated during the step in one of the following ways:

1. Always or Unconditional
2. Pulsed, according to the device pulse time and pulse cycle time.
3. Activated conditionally on one of the following Enablers;
    - Comparison
    - Combination
    - Alarm
    - Digital input
    - Analog High-High Alarm
    - Analog High Alarm
    - Analog Low Alarm
    - Analog Low-Low Alarm
    - Step time
    - Valves Activated / Deactivated
    - Motors Activated / Deactivated
    - Digital Output Activated / Deactivated
    - Valve Alarm
    - Motor Alarm
    - Analog Input WireBreak

    The above items can be used for a true or false state where appropriate.

4. Conditionally Pulsed, according to the device pulse time and pulse cycle time using the above enablers.

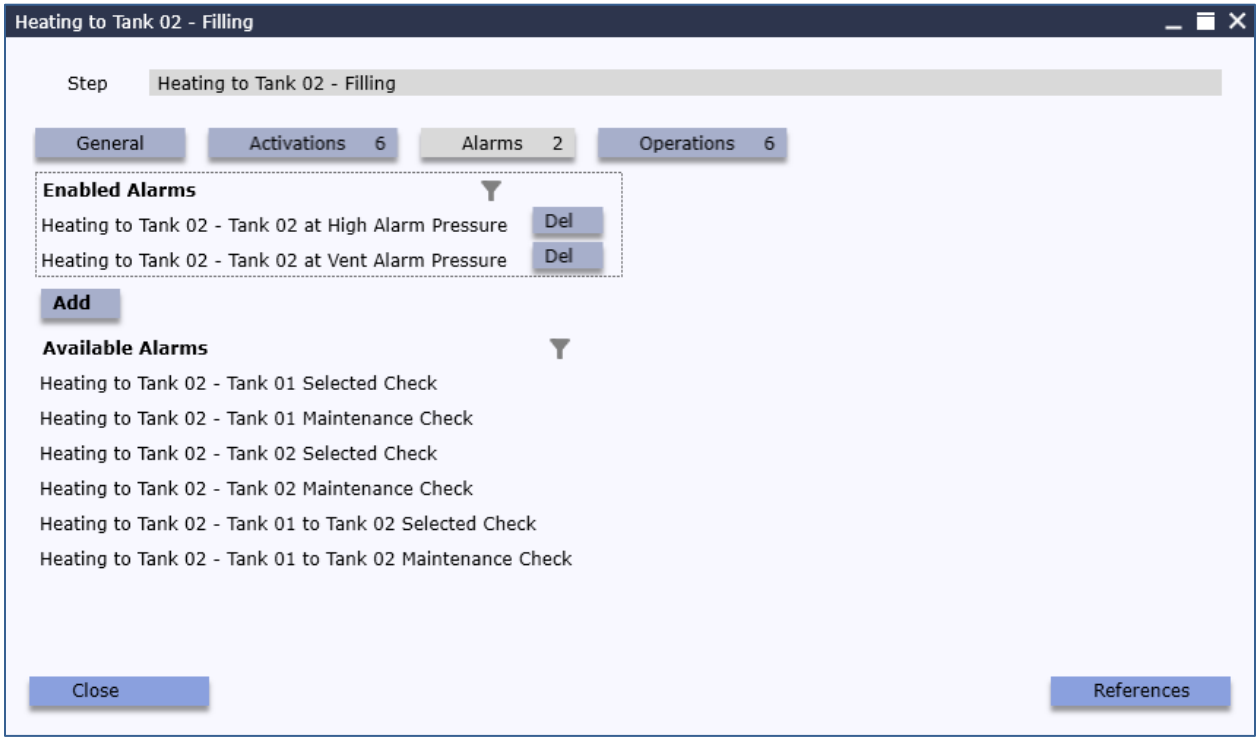


Activations List in a Step

The activations section shows activations for the Step, which may be accessed using the Activations button. List of Activations for a device are also available in the panel for Valve Motor or Digital Output.

6.12.5 Enabling of Alarms

This section allows Alarms to be enabled in a step. An Alarm may be configured at any time and subsequently added to a step.



Alarms List in a Step

An Alarm is enabled in a step by selecting it and adding it to the “Enabled Alarms”.

An Alarm may be removed from a step also by clicking on the Del button.

The system automatically assigns unit based alarms (Unit Selected and Unit Maintenance) to each program for each unit that is added to the Equipment Unit component holder. These alarms are automatically assigned to Step 0. These alarms may be added to other steps also and may be removed from any step.

Similarly, the System also assigns two Tracking Alarms if the Tracking Program Routes checkbox is ticked. This applies to any Step that has this ticked, the Alarms are only created once per Program.

6.12.6 Enabling of Writes - Operations

Configured Writes may be enabled for required Steps; the Write will be enabled for implementation while the program is in the Step.

Writes List in a Step

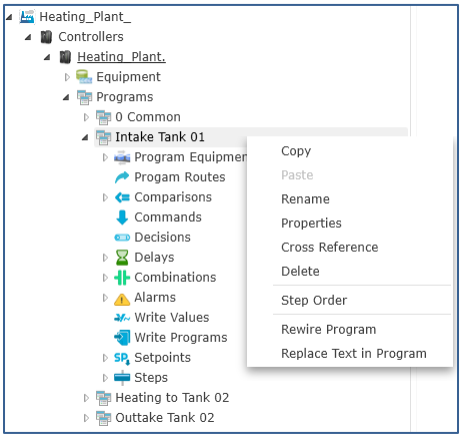
Available Writes are already configured in the program. The Write is enabled for use in the step by selecting it and clicking the Add button, adding it to the “Enabled Writes” section.

A Write may be removed by clicking on the Del button beside the Write.

The Order of Writes may be changed using the Move Up and Move Down buttons. The Order can be used when it is important that one write is processed before another, in the case of an equation, for example.

6.13 Programs Functions

These functions may be accessed on right-click on the program name.



Program Menu Options

6.13.1 Copy

A Program may be copied and pasted. This is very useful for module type programs where a single program controls a single unit. The program may be pasted within the same controller or in another controller, or in another controller in another project. If a component name is going to be duplicated, then it will be renamed by appending "– Copy" to the name.

6.13.2 Rename

A program may be renamed here.

6.13.3 Properties

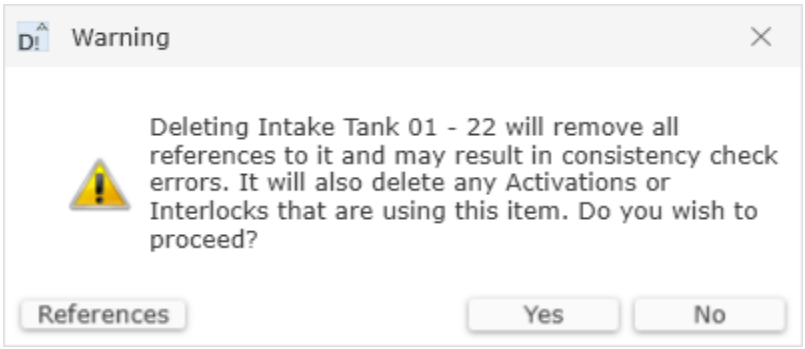
The program properties may be shown by selecting Properties.

6.13.4 Cross Reference

Any reference to the program may be found here. The references are in Write Programs or Program status check.

6.13.5 Delete

The program may be deleted here. References to the program will be automatically deleted. This may mean that objects which did reference the deleted program may have to be manually changed or deleted.

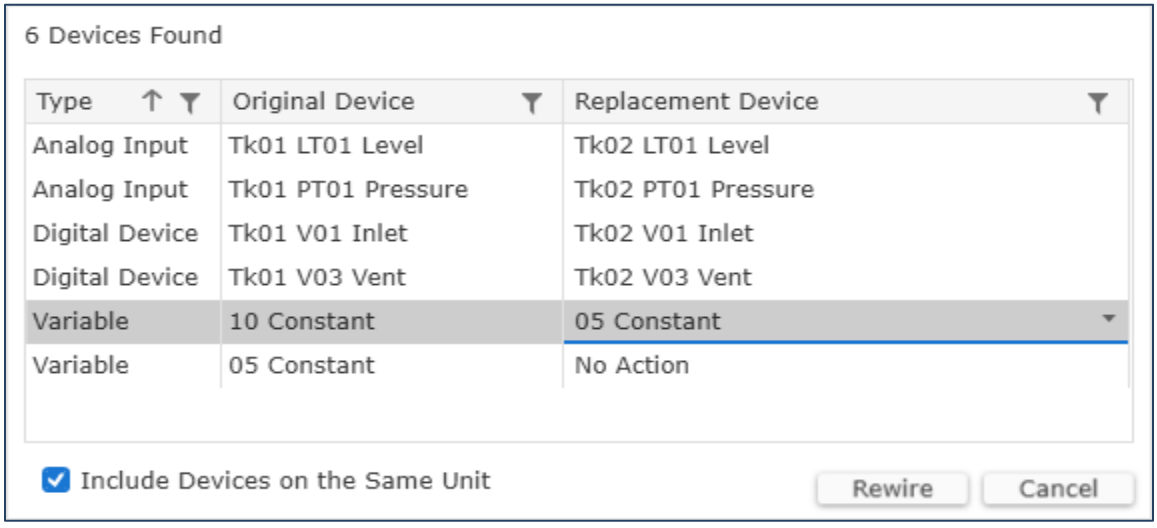


6.13.6 Step Order

The Step Order may be accessed here. The step order is described in Program Selections.

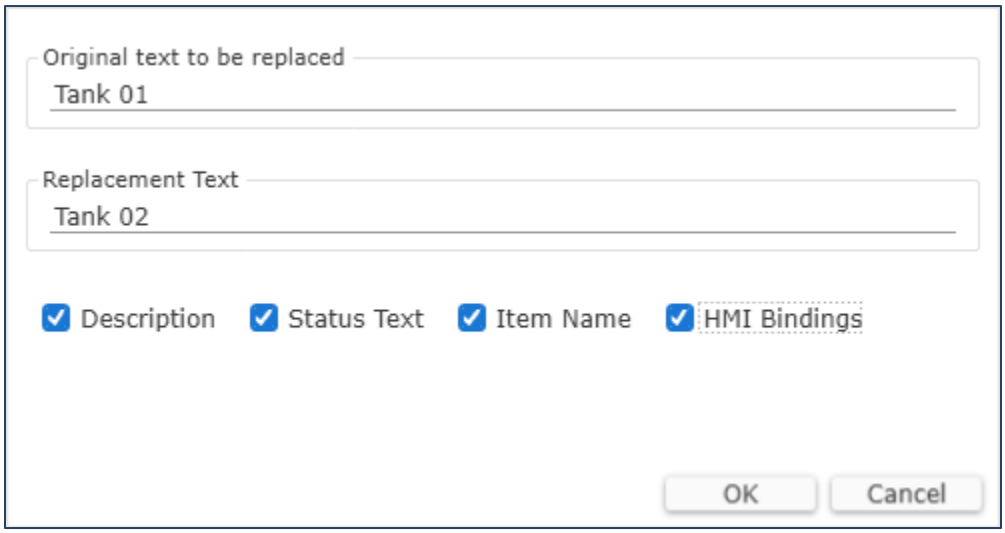
6.13.7 Rewire

The Rewire Function allows items to be changed in a group, within a program. This is used, for example, when a program is copied and is to be changed to work with different equipment.



Replacement devices are selected using dropdown lists. When all required replacement devices are selected then the Rewire may be carried out using the Rewire button.

6.13.8 Replace Text in Program



This function allows text to be changed for the following aspects

Item Name - the text will be replaced within the names of objects in the program,

Description - the text will be replaced in descriptions

Status Text - the text will be replaced in Status for display at HMI

HMI Bindings - HMI Bindings using the object will change to use renamed bindings. These should be checked after the replace function is carried out.

7 Program Selections

7.1 Setpoints

Setpoints are used in settings in Comparisons, Delays and Write Values. Setpoints are in a container in the Program, and can also be seen in a Table. Setpoints may be changed in Recipes.

Container of Setpoints in a Step

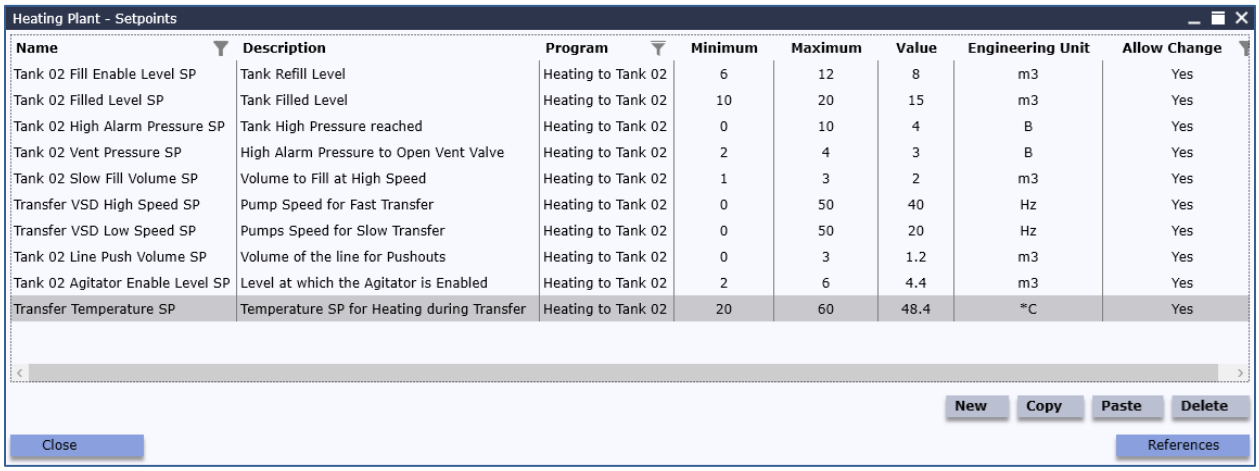


Table of Setpoints

The minimum, maximum and default values for each Setpoint may be modified. These values will be applied as limits for operator setpoint entry in HMI controls.

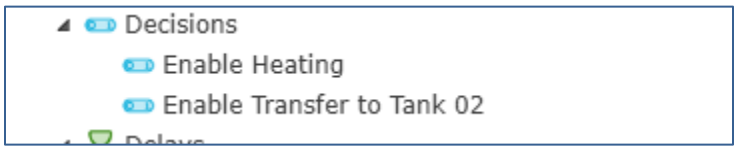
Setpoints may be deleted by selecting clicking on Delete in the table, or by right-clicking and selecting remove in the container. If a Setpoint is in use it cannot be deleted.

Setpoints may be renamed by selecting and right-click and Rename in the container.

Allow Change enables that Setpoints may be changed, or not, when a program is Active, and this may be changed in the table.

7.2 Decisions

These are digital On / Off type selections that can be accessed in HMI. The initial state of the Decisions may be changed in a Recipe.



Container of Decisions in a Step

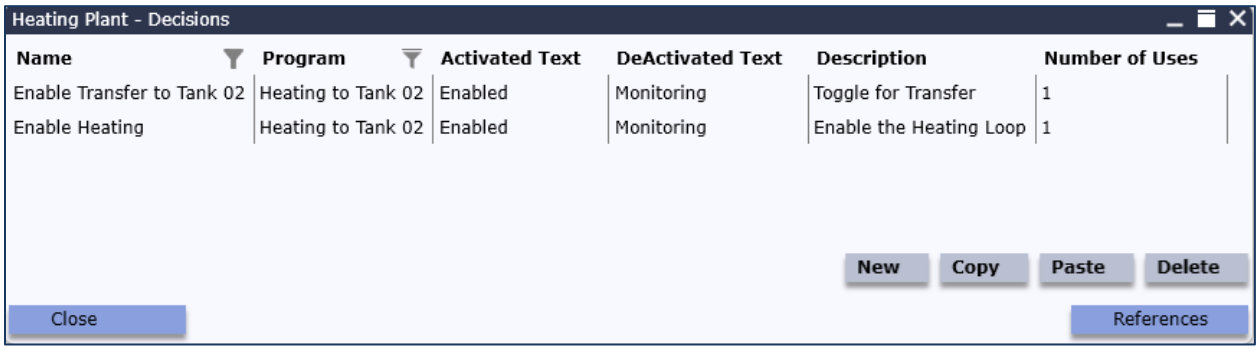


Table of Decisions

Decisions may be accessed by clicking on Decisions container.

Decisions may be deleted by selecting clicking on Delete in the table, or by right-clicking and selecting remove in the container. If a Decision is in use it cannot be deleted.
Decisions may be renamed by selecting and right-click and Rename in the container.
Allow Change enables that Decisions may be changed, or not, when a program is Active, and this may be changed in the table.

7.3 Step Order

The Step Order refers to the order in which a Program normally will proceed through the Steps when the Normal Step Ons are used.
The Step Order for a program may be accessed by right-click on Steps container or by clicking on Step Order in the Step Properties.

Accessing the Step Order from Program properties

Step Order Panel

The step order determines the order of processing of steps to carry out the default sequence using Normal Step on transitions.
A step may be inserted in more than one location in the step sequence. Each step must be used at least once in the program. The step order can be modified by selecting the step to be moved in the sequence and clicking on “Move Up” or “Move Down”.
Clicking on a Step will cause the Cross references for the Step to update at the bottom of the screen. The Section field will show the relevant Cross reference / Usage information for the Step.

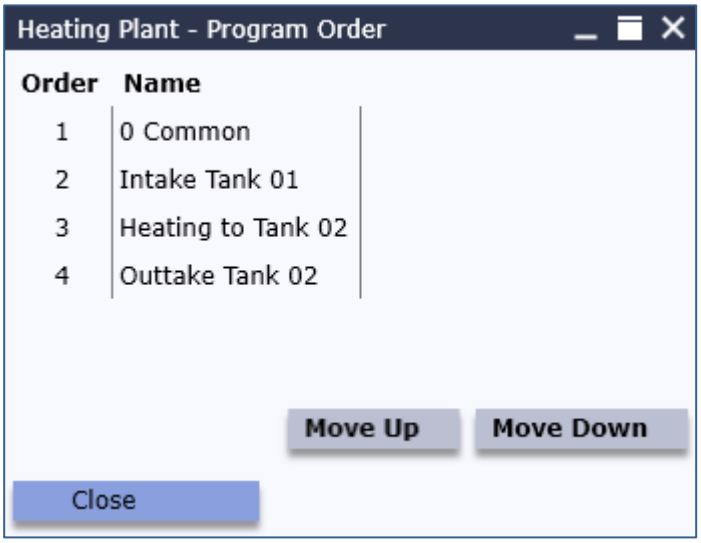
8 General Model Items

8.1 Consistency Check

The consistency check examines the project to confirm that devices are used and that addresses are unique and conform to PLC rules. The check must be performed before a download to a PLC. Consistency check for documents is optional.
Items listed in the Consistency Check may be accessed by clicking the row in the Check.

A PLC cannot be downloaded if there are Errors, but may be downloaded if there are warnings, and users should take care with any downloads to avoid Errors or any unwanted actions.

8.2 Program Order



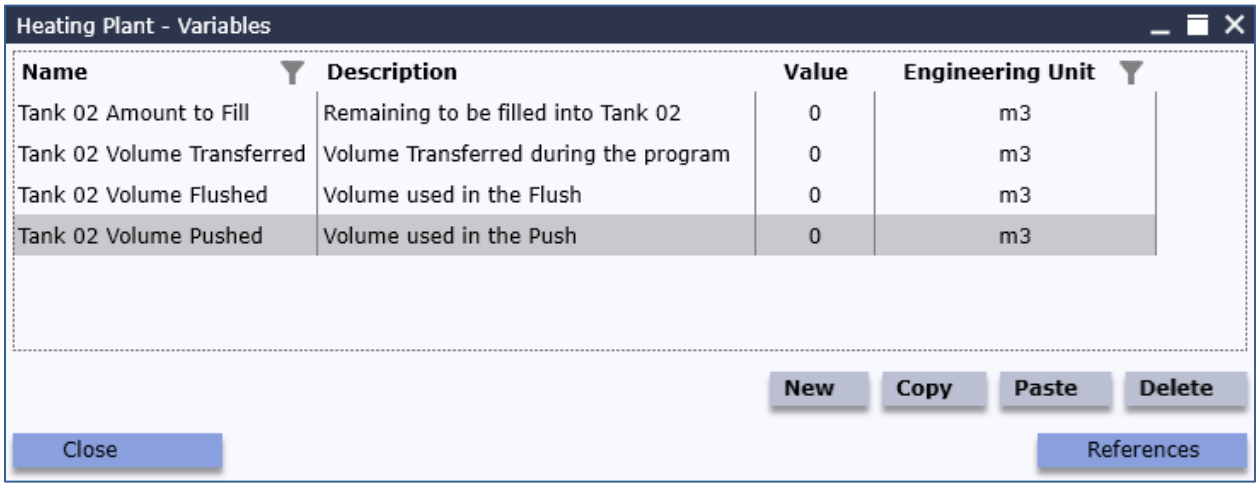
Program Order panel

The configured programs are placed in order for processing by the PLC.

All configured programs must appear in the list.

8.3 Variables

Variables are common across all programs and may be read or written by all programs. Variables may be modified by clicking on or right-clicking on the variable row.

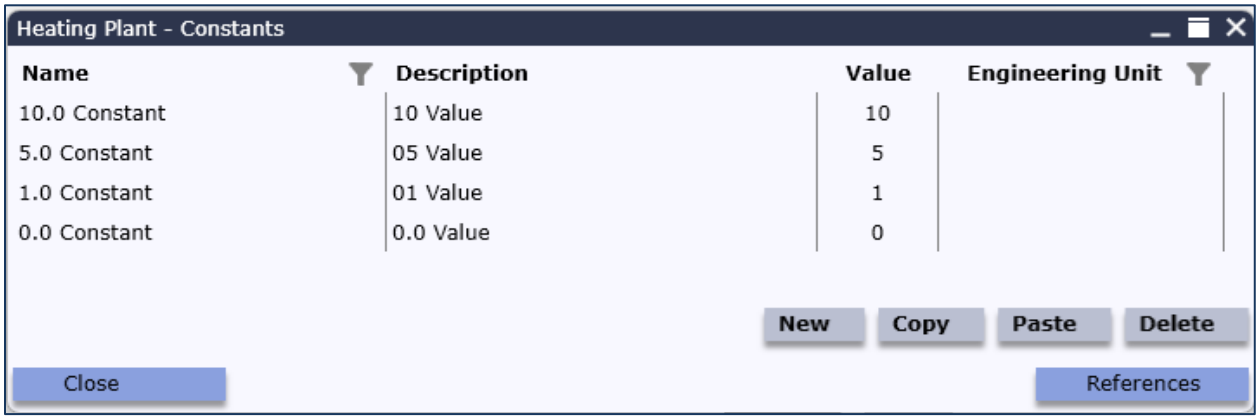


Variables List

Accord systems may be configured to interact with other PLC code using Variables. This may also apply to Inter PLC communications. PLC Addresses for Variables are obtained from Accord (Device Report) following Full Download to a PLC. The user may write to, or read from, an address by writing PLC code. Accord PLC Libraries system only uses the Data Areas it has configured and will not interfere with any other PLC code or data. Users should only interface other PLC code using Variables.

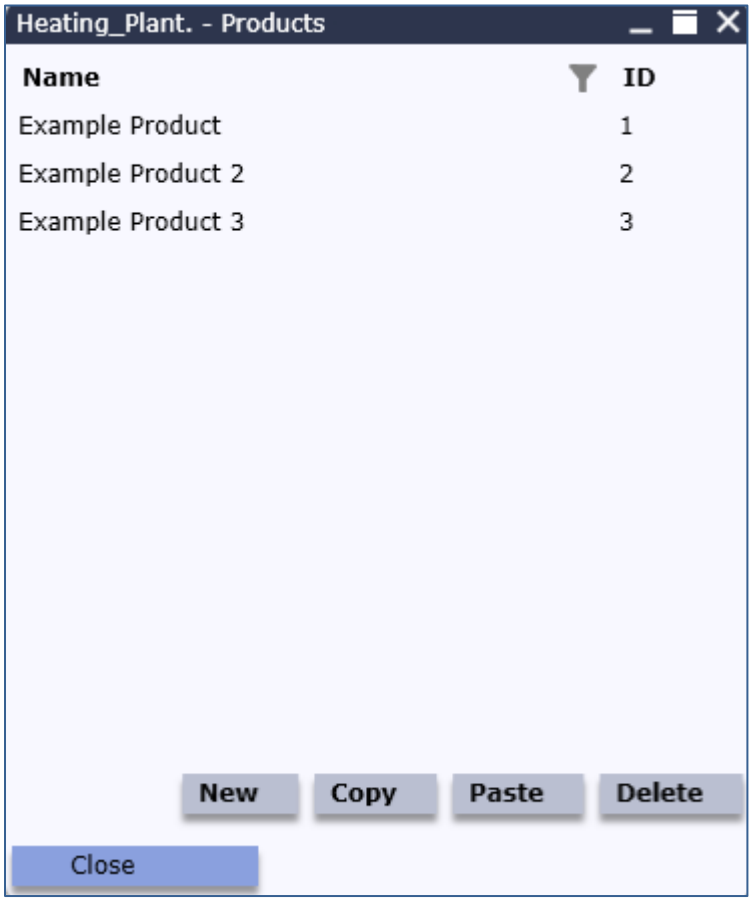
8.4 Constants

These are Preset Values that cannot be changed from Operations or HMI.



8.5 Product Id

Configured Product Ids are available in all Programs. Products can be created through the Products List Grid by selecting New, or by right-clicking the Products component holder and selecting New. They are used in Program Routing and may be assigned to a Program or Units.

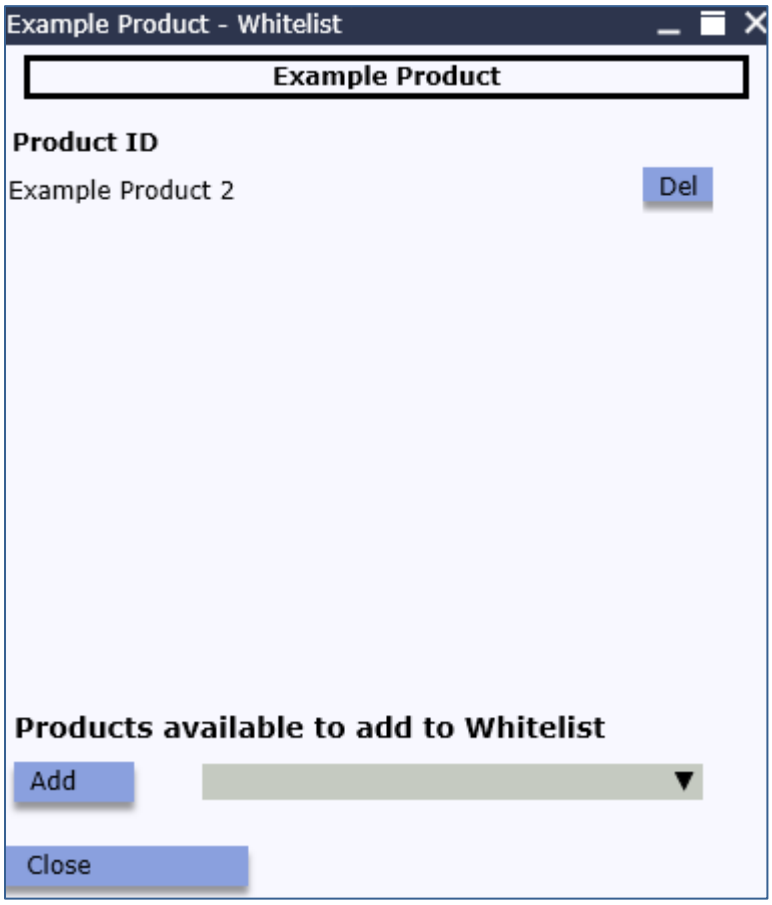


Products List Grid

Product properties are obtained by clicking on the product name. the Whitelist for the product Id can then be configured in Properties.

8.5.1 Whitelisted Products

These are Products that are compatible, and may follow each other in a Route.



Product Properties

Whitelist Products are added using the dropdown menu and clicking Add, and can be removed using the Del button.

9 Documents Generation

Accord Designer provides the printing of documentation which matches the Model. This documentation is printed to MS Word and is valid for use in Design and Testing stages of projects. The Documents Menu presents all the auto-generated Documents. It also provides viewing the Audit Trail for loaded Model.

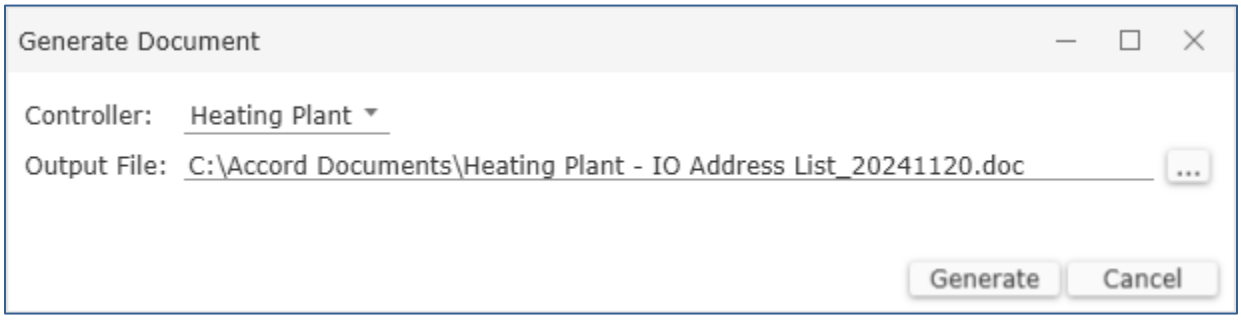
Designer provides automatic generation of the following Documents per menu list

1. I/O Address List
2. Equipment Software Design Specification
3. Process Description
4. Functional Design Specification
5. Program Software Design Specification

Documents are generated by Designer to MS Word .doc format, to templates and are accurate to the model. They should be formatted for presentation after generation.

9.1 Generating Process Model Documents

To generate a document, click the Documents menu in the top menu bar and select the required document. The document will begin to generate to MS Word. Note use of copy-paste in other applications while document is generating may affect the document.

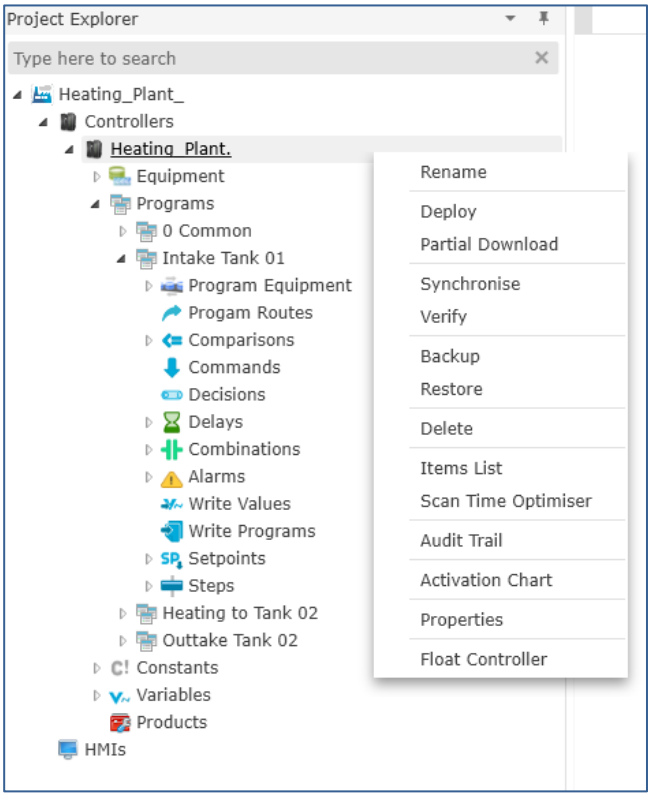


Document Print Setup

10 Project and Edit Menus

10.1 Controller / Model Menu

This menu is accessed by right-clicking on the Controller.



Model Menu

10.1.1 Rename

This allows the controller / process Model to be renamed.

10.1.2 Deploy

This allows the Process Model configuration data to be downloaded to the Controller (PLC or emulator) which is configured in Properties.

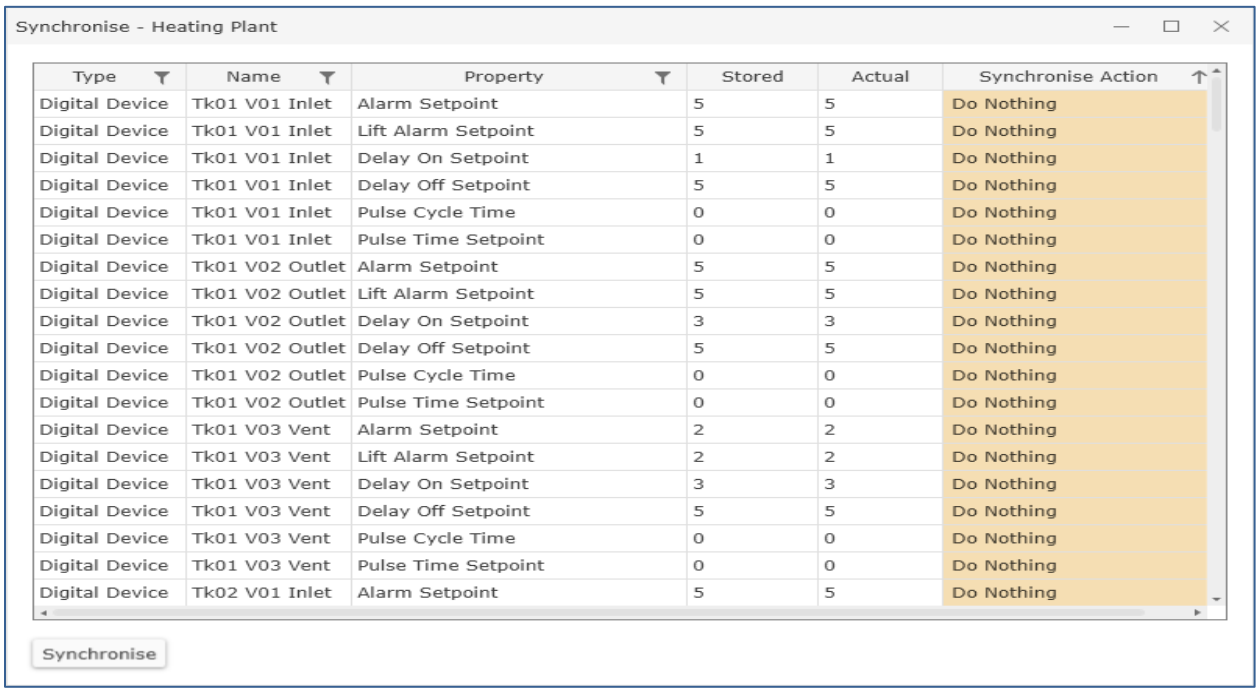
10.1.3 Partial Download

This allows the changes made since the last Deployment to be downloaded to the Controller.

Stages of downloads are shown in a progress status panel.

10.1.4 Synchronise

This allows for recovery of all current values from the PLC to the Model.

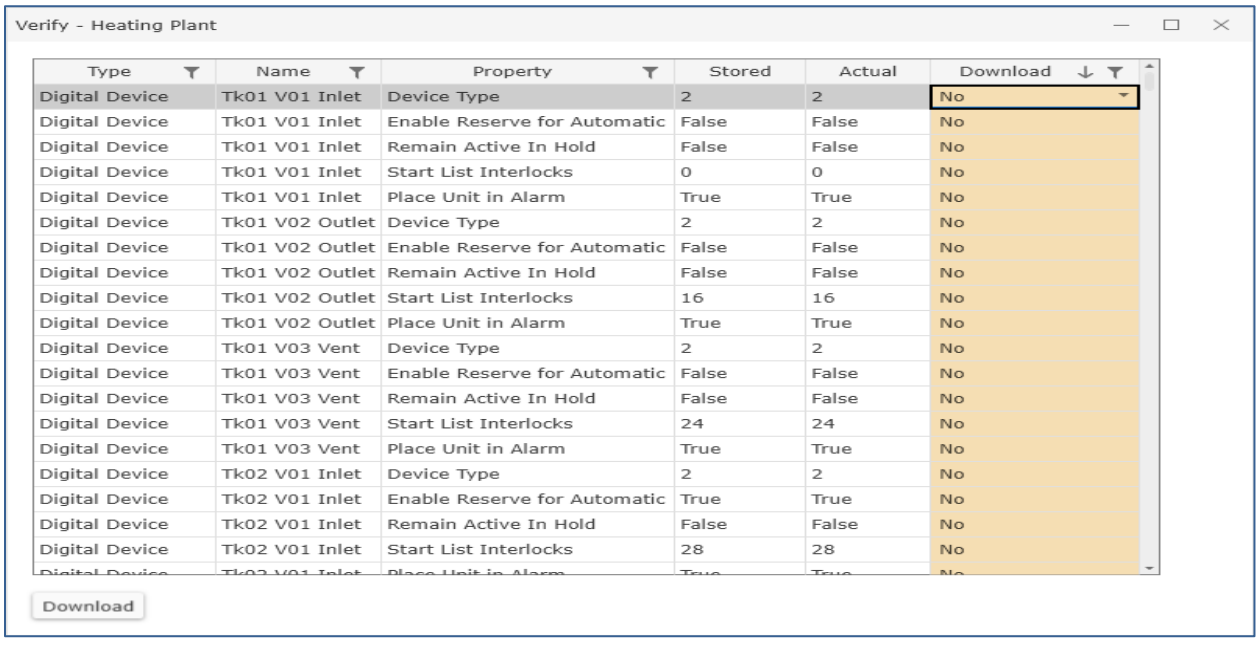


Type	Name	Property	Stored	Actual	Synchronise Action
Digital Device	Tk01 V01 Inlet	Alarm Setpoint	5	5	Do Nothing
Digital Device	Tk01 V01 Inlet	Lift Alarm Setpoint	5	5	Do Nothing
Digital Device	Tk01 V01 Inlet	Delay On Setpoint	1	1	Do Nothing
Digital Device	Tk01 V01 Inlet	Delay Off Setpoint	5	5	Do Nothing
Digital Device	Tk01 V01 Inlet	Pulse Cycle Time	0	0	Do Nothing
Digital Device	Tk01 V01 Inlet	Pulse Time Setpoint	0	0	Do Nothing
Digital Device	Tk01 V02 Outlet	Alarm Setpoint	5	5	Do Nothing
Digital Device	Tk01 V02 Outlet	Lift Alarm Setpoint	5	5	Do Nothing
Digital Device	Tk01 V02 Outlet	Delay On Setpoint	3	3	Do Nothing
Digital Device	Tk01 V02 Outlet	Delay Off Setpoint	5	5	Do Nothing
Digital Device	Tk01 V02 Outlet	Pulse Cycle Time	0	0	Do Nothing
Digital Device	Tk01 V02 Outlet	Pulse Time Setpoint	0	0	Do Nothing
Digital Device	Tk01 V03 Vent	Alarm Setpoint	2	2	Do Nothing
Digital Device	Tk01 V03 Vent	Lift Alarm Setpoint	2	2	Do Nothing
Digital Device	Tk01 V03 Vent	Delay On Setpoint	3	3	Do Nothing
Digital Device	Tk01 V03 Vent	Delay Off Setpoint	5	5	Do Nothing
Digital Device	Tk01 V03 Vent	Pulse Cycle Time	0	0	Do Nothing
Digital Device	Tk01 V03 Vent	Pulse Time Setpoint	0	0	Do Nothing
Digital Device	Tk02 V01 Inlet	Alarm Setpoint	5	5	Do Nothing

Synchronise Panel

10.1.5 Verify

This verifies that all settings values, which should only be written by Accord, not have changed in PLC. Any discrepancies should be investigated.



Type	Name	Property	Stored	Actual	Download
Digital Device	Tk01 V01 Inlet	Device Type	2	2	No
Digital Device	Tk01 V01 Inlet	Enable Reserve for Automatic	False	False	No
Digital Device	Tk01 V01 Inlet	Remain Active In Hold	False	False	No
Digital Device	Tk01 V01 Inlet	Start List Interlocks	0	0	No
Digital Device	Tk01 V01 Inlet	Place Unit in Alarm	True	True	No
Digital Device	Tk01 V02 Outlet	Device Type	2	2	No
Digital Device	Tk01 V02 Outlet	Enable Reserve for Automatic	False	False	No
Digital Device	Tk01 V02 Outlet	Remain Active In Hold	False	False	No
Digital Device	Tk01 V02 Outlet	Start List Interlocks	16	16	No
Digital Device	Tk01 V02 Outlet	Place Unit in Alarm	True	True	No
Digital Device	Tk01 V03 Vent	Device Type	2	2	No
Digital Device	Tk01 V03 Vent	Enable Reserve for Automatic	False	False	No
Digital Device	Tk01 V03 Vent	Remain Active In Hold	False	False	No
Digital Device	Tk01 V03 Vent	Start List Interlocks	24	24	No
Digital Device	Tk01 V03 Vent	Place Unit in Alarm	True	True	No
Digital Device	Tk02 V01 Inlet	Device Type	2	2	No
Digital Device	Tk02 V01 Inlet	Enable Reserve for Automatic	True	True	No
Digital Device	Tk02 V01 Inlet	Remain Active In Hold	False	False	No
Digital Device	Tk02 V01 Inlet	Start List Interlocks	28	28	No

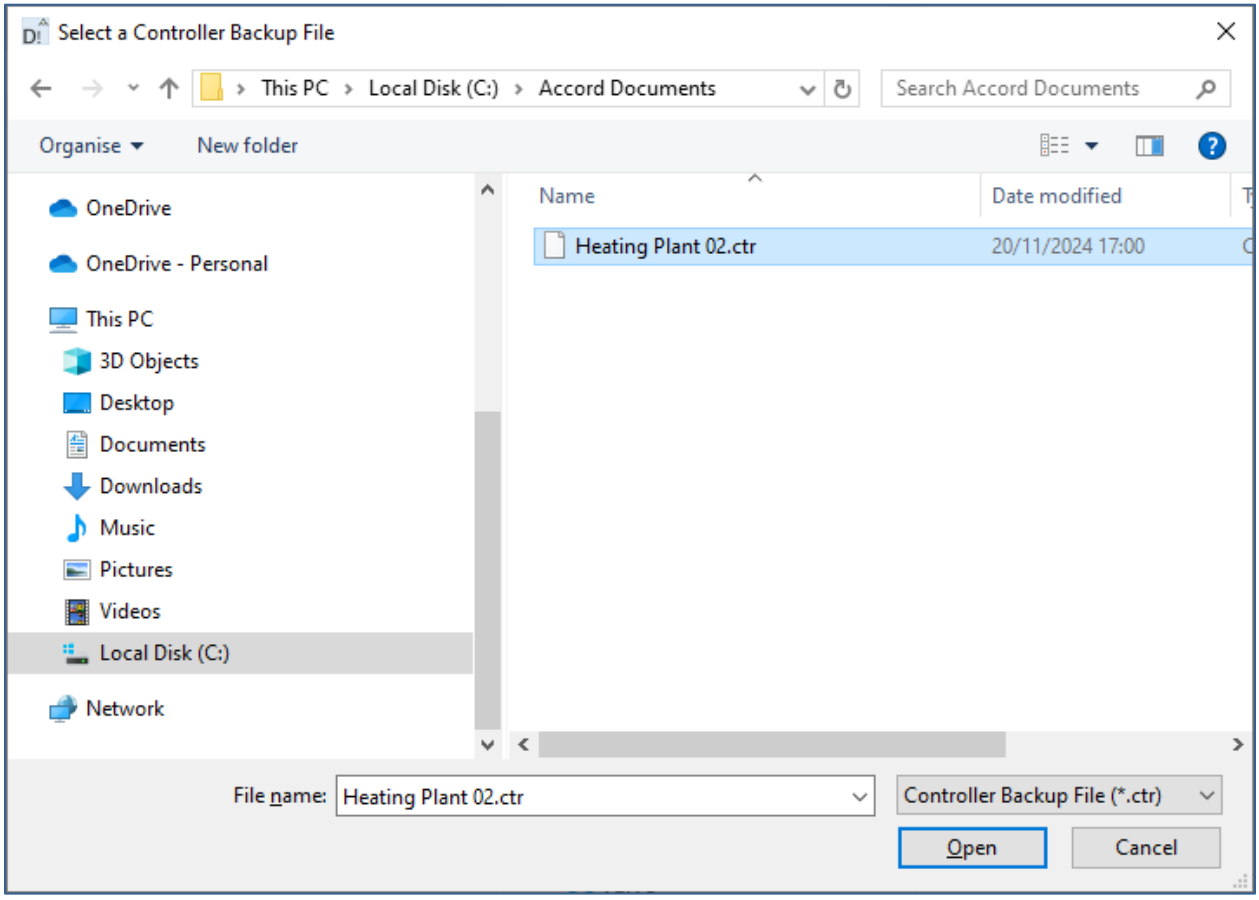
Verify Panel

10.1.6 Backup

This allows the Model to be stored as a .ctr file on nominated folder.

10.1.7 Restore

This allows a stored .ctr file to be restored as a full model in the project.



Storage of Controller Backup file

10.1.8 Copying a Controller

A Controller may be duplicated by being backed up to a .ctr file and restored to a new controller.

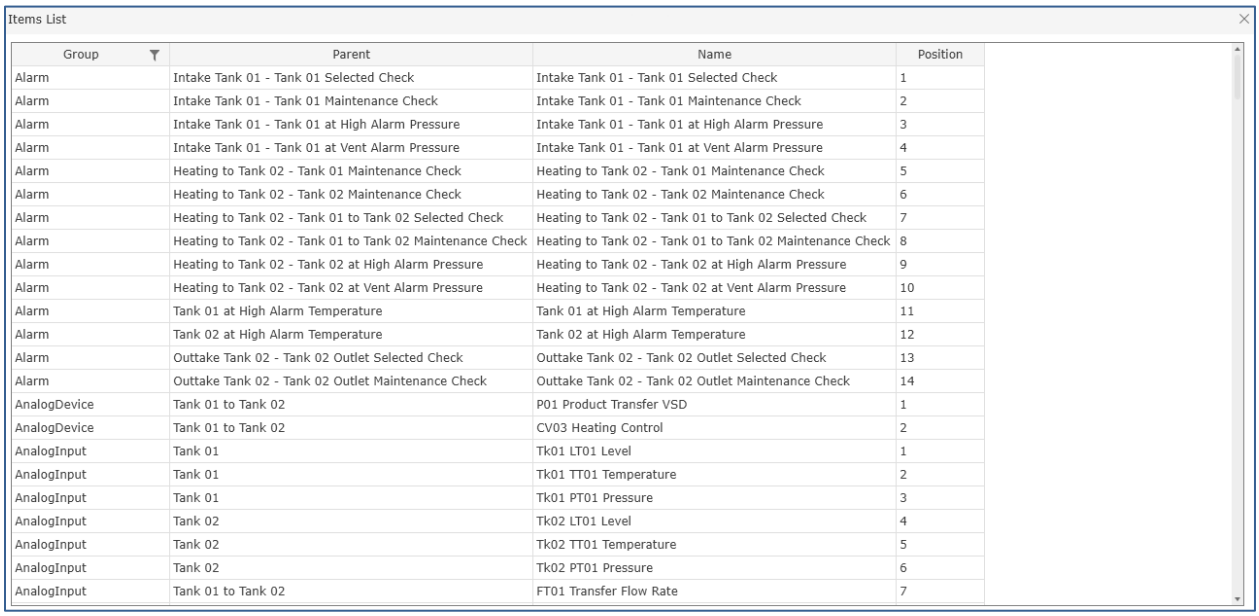
Right-click on the Controller and back up to .ctr file, e.g., Heating Plant 240802.ctr
Make new Controller in the new project.
Right-click on new Controller and Restore from the .ctr file. The system will prompt for confirmation and on confirm will generate the new Controller.

10.1.9 Deleting Controller - Remove

To delete a Controller/Model - click on the Model menu and click on Remove.

10.1.10 Items List

This produces a filterable table of devices with index positions.

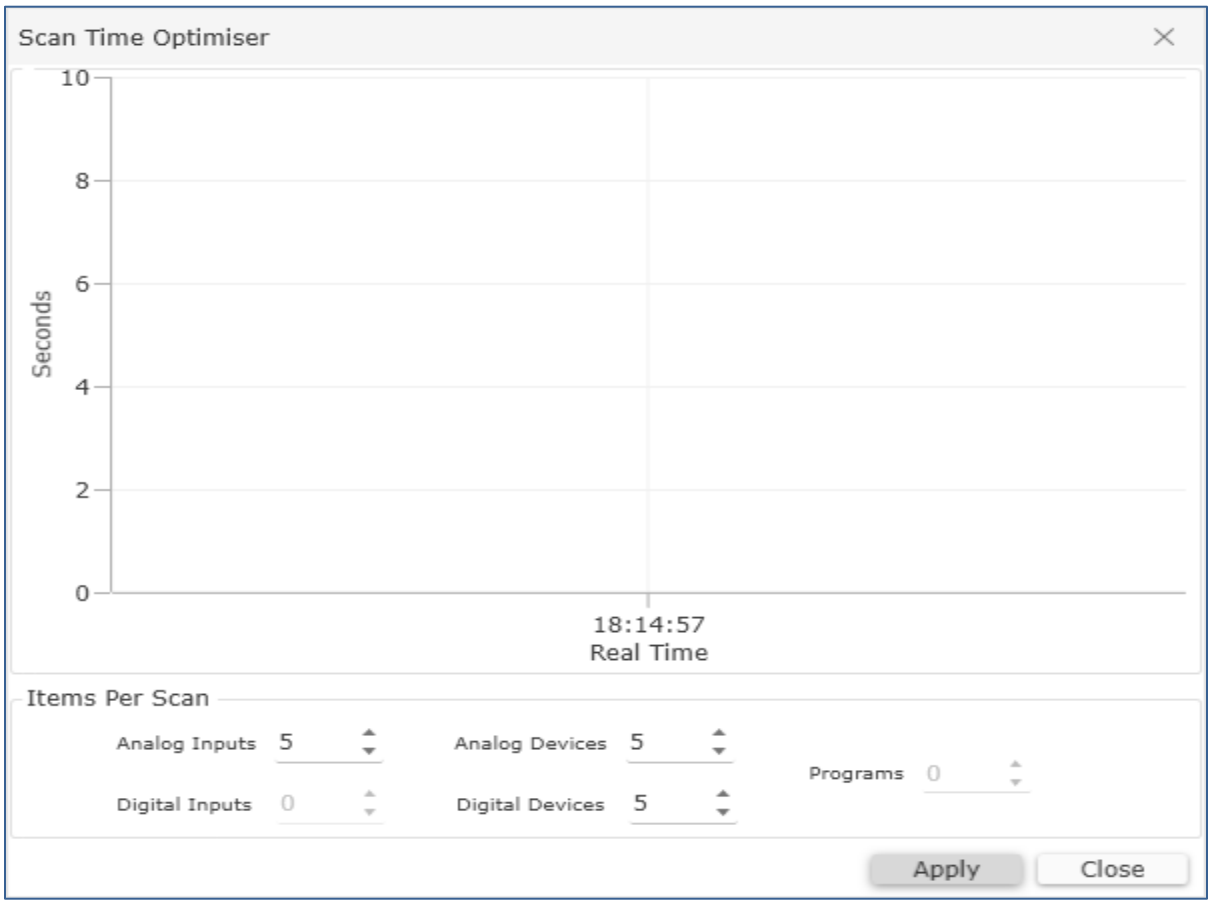

Items List

Group	Parent	Name	Position
Alarm	Intake Tank 01 - Tank 01 Selected Check	Intake Tank 01 - Tank 01 Selected Check	1
Alarm	Intake Tank 01 - Tank 01 Maintenance Check	Intake Tank 01 - Tank 01 Maintenance Check	2
Alarm	Intake Tank 01 - Tank 01 at High Alarm Pressure	Intake Tank 01 - Tank 01 at High Alarm Pressure	3
Alarm	Intake Tank 01 - Tank 01 at Vent Alarm Pressure	Intake Tank 01 - Tank 01 at Vent Alarm Pressure	4
Alarm	Heating to Tank 02 - Tank 01 Maintenance Check	Heating to Tank 02 - Tank 01 Maintenance Check	5
Alarm	Heating to Tank 02 - Tank 02 Maintenance Check	Heating to Tank 02 - Tank 02 Maintenance Check	6
Alarm	Heating to Tank 02 - Tank 01 to Tank 02 Selected Check	Heating to Tank 02 - Tank 01 to Tank 02 Selected Check	7
Alarm	Heating to Tank 02 - Tank 01 to Tank 02 Maintenance Check	Heating to Tank 02 - Tank 01 to Tank 02 Maintenance Check	8
Alarm	Heating to Tank 02 - Tank 02 at High Alarm Pressure	Heating to Tank 02 - Tank 02 at High Alarm Pressure	9
Alarm	Heating to Tank 02 - Tank 02 at Vent Alarm Pressure	Heating to Tank 02 - Tank 02 at Vent Alarm Pressure	10
Alarm	Tank 01 at High Alarm Temperature	Tank 01 at High Alarm Temperature	11
Alarm	Tank 02 at High Alarm Temperature	Tank 02 at High Alarm Temperature	12
Alarm	Outtake Tank 02 - Tank 02 Outlet Selected Check	Outtake Tank 02 - Tank 02 Outlet Selected Check	13
Alarm	Outtake Tank 02 - Tank 02 Outlet Maintenance Check	Outtake Tank 02 - Tank 02 Outlet Maintenance Check	14
AnalogDevice	Tank 01 to Tank 02	P01 Product Transfer VSD	1
AnalogDevice	Tank 01 to Tank 02	CV03 Heating Control	2
AnalogInput	Tank 01	Tk01 LT01 Level	1
AnalogInput	Tank 01	Tk01 TT01 Temperature	2
AnalogInput	Tank 01	Tk01 PT01 Pressure	3
AnalogInput	Tank 02	Tk02 LT01 Level	4
AnalogInput	Tank 02	Tk02 TT01 Temperature	5
AnalogInput	Tank 02	Tk02 PT01 Pressure	6
AnalogInput	Tank 01 to Tank 02	FT01 Transfer Flow Rate	7

Items List

10.1.11 Scan Time Optimiser

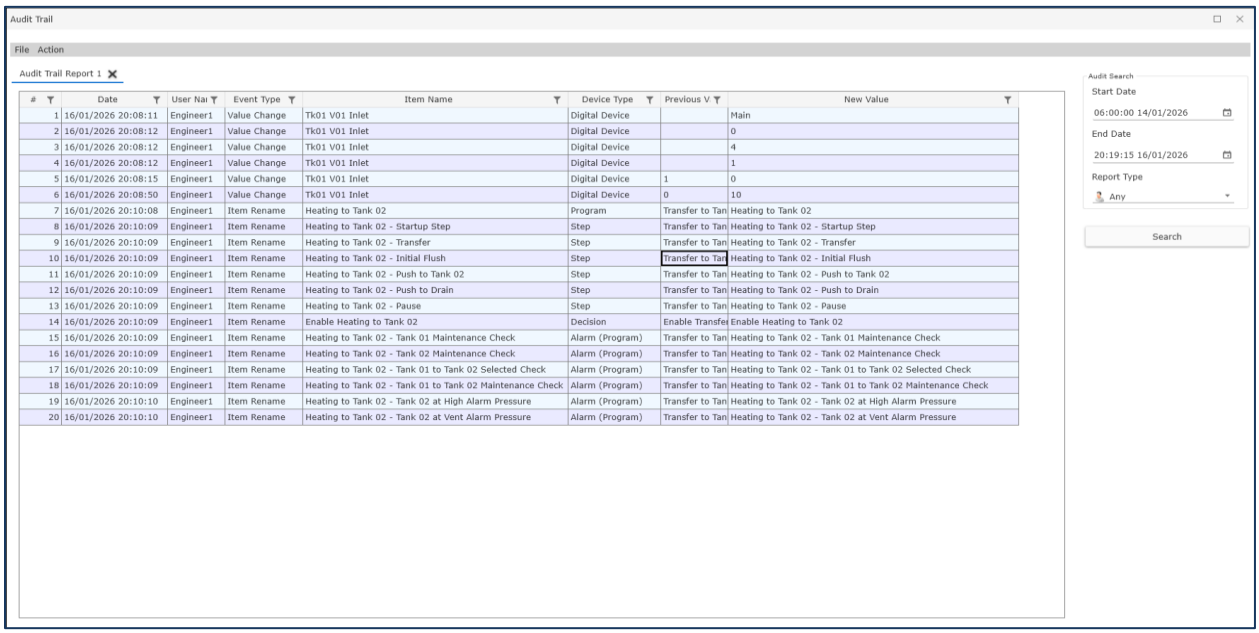
This allows Devices per PLC Scan to be changed for Digital Devices, and Analog Inputs and Devices. This may be used to reduce a PLC Scan Time.



Scan Time Optimiser

10.1.12 Audit Trail

This displays a list of changes in the Controller/Model between selected dates.

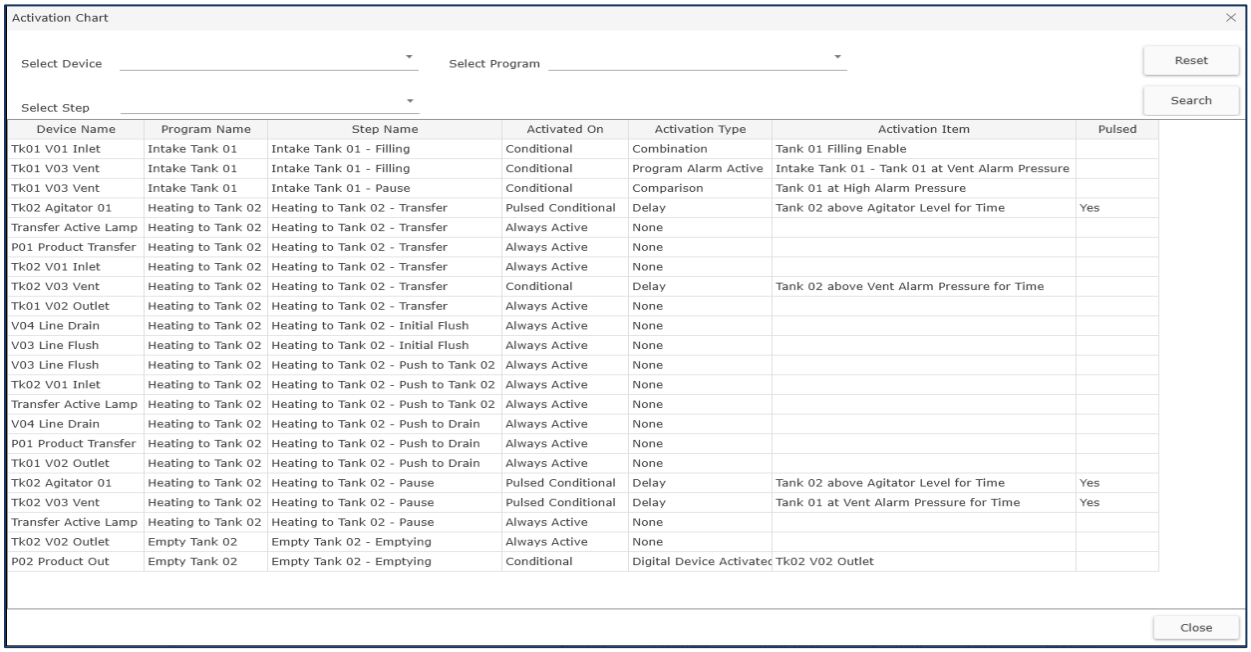


#	Date	User Nai	Event Type	Item Name	Device Type	Previous V	New Value
1	16/01/2026 20:08:11	Engineer1	Value Change	Tk01 V01 Inlet	Digital Device		Main
2	16/01/2026 20:08:12	Engineer1	Value Change	Tk01 V01 Inlet	Digital Device		0
3	16/01/2026 20:08:12	Engineer1	Value Change	Tk01 V01 Inlet	Digital Device		4
4	16/01/2026 20:08:12	Engineer1	Value Change	Tk01 V01 Inlet	Digital Device		1
5	16/01/2026 20:08:15	Engineer1	Value Change	Tk01 V01 Inlet	Digital Device	1	0
6	16/01/2026 20:08:50	Engineer1	Value Change	Tk01 V01 Inlet	Digital Device	0	10
7	16/01/2026 20:10:08	Engineer1	Item Rename	Heating to Tank 02	Program	Transfer to Tan	Heating to Tank 02
8	16/01/2026 20:10:09	Engineer1	Item Rename	Heating to Tank 02 - Startup Step	Step	Transfer to Tan	Heating to Tank 02 - Startup Step
9	16/01/2026 20:10:09	Engineer1	Item Rename	Heating to Tank 02 - Transfer	Step	Transfer to Tan	Heating to Tank 02 - Transfer
10	16/01/2026 20:10:09	Engineer1	Item Rename	Heating to Tank 02 - Initial Flush	Step	Transfer to Tan	Heating to Tank 02 - Initial Flush
11	16/01/2026 20:10:09	Engineer1	Item Rename	Heating to Tank 02 - Push to Tank 02	Step	Transfer to Tan	Heating to Tank 02 - Push to Tank 02
12	16/01/2026 20:10:09	Engineer1	Item Rename	Heating to Tank 02 - Push to Drain	Step	Transfer to Tan	Heating to Tank 02 - Push to Drain
13	16/01/2026 20:10:09	Engineer1	Item Rename	Heating to Tank 02 - Pause	Step	Transfer to Tan	Heating to Tank 02 - Pause
14	16/01/2026 20:10:09	Engineer1	Item Rename	Enable Heating to Tank 02	Decision	Enable Transfe	Enable Heating to Tank 02
15	16/01/2026 20:10:09	Engineer1	Item Rename	Heating to Tank 02 - Tank 01 Maintenance Check	Alarm (Program)	Transfer to Tan	Heating to Tank 02 - Tank 01 Maintenance Check
16	16/01/2026 20:10:09	Engineer1	Item Rename	Heating to Tank 02 - Tank 02 Maintenance Check	Alarm (Program)	Transfer to Tan	Heating to Tank 02 - Tank 02 Maintenance Check
17	16/01/2026 20:10:09	Engineer1	Item Rename	Heating to Tank 02 - Tank 01 to Tank 02 Selected Check	Alarm (Program)	Transfer to Tan	Heating to Tank 02 - Tank 01 to Tank 02 Selected Check
18	16/01/2026 20:10:09	Engineer1	Item Rename	Heating to Tank 02 - Tank 01 to Tank 02 Maintenance Check	Alarm (Program)	Transfer to Tan	Heating to Tank 02 - Tank 01 to Tank 02 Maintenance Check
19	16/01/2026 20:10:10	Engineer1	Item Rename	Heating to Tank 02 - Tank 02 at High Alarm Pressure	Alarm (Program)	Transfer to Tan	Heating to Tank 02 - Tank 02 at High Alarm Pressure
20	16/01/2026 20:10:10	Engineer1	Item Rename	Heating to Tank 02 - Tank 02 at Vent Alarm Pressure	Alarm (Program)	Transfer to Tan	Heating to Tank 02 - Tank 02 at Vent Alarm Pressure

Audit Trail

10.1.13 Activation Chart

This displays a filterable list of Device activations and associated Enablers.



Device Name	Program Name	Step Name	Activated On	Activation Type	Activation Item	Pulsed
Tk01 V01 Inlet	Intake Tank 01	Intake Tank 01 - Filling	Conditional	Combination	Tank 01 Filling Enable	
Tk01 V03 Vent	Intake Tank 01	Intake Tank 01 - Filling	Conditional	Program Alarm Active	Intake Tank 01 - Tank 01 at Vent Alarm Pressure	
Tk01 V03 Vent	Intake Tank 01	Intake Tank 01 - Pause	Conditional	Comparison	Tank 01 at High Alarm Pressure	
Tk02 Agitator 01	Heating to Tank 02	Heating to Tank 02 - Transfer	Pulsed Conditional	Delay	Tank 02 above Agitator Level for Time	Yes
Transfer Active Lamp	Heating to Tank 02	Heating to Tank 02 - Transfer	Always Active	None		
P01 Product Transfer	Heating to Tank 02	Heating to Tank 02 - Transfer	Always Active	None		
Tk02 V01 Inlet	Heating to Tank 02	Heating to Tank 02 - Transfer	Always Active	None		
Tk02 V03 Vent	Heating to Tank 02	Heating to Tank 02 - Transfer	Conditional	Delay	Tank 02 above Vent Alarm Pressure for Time	
Tk01 V02 Outlet	Heating to Tank 02	Heating to Tank 02 - Transfer	Always Active	None		
V04 Line Drain	Heating to Tank 02	Heating to Tank 02 - Initial Flush	Always Active	None		
V03 Line Flush	Heating to Tank 02	Heating to Tank 02 - Initial Flush	Always Active	None		
V03 Line Flush	Heating to Tank 02	Heating to Tank 02 - Push to Tank 02	Always Active	None		
Tk02 V01 Inlet	Heating to Tank 02	Heating to Tank 02 - Push to Tank 02	Always Active	None		
Transfer Active Lamp	Heating to Tank 02	Heating to Tank 02 - Push to Tank 02	Always Active	None		
V04 Line Drain	Heating to Tank 02	Heating to Tank 02 - Push to Drain	Always Active	None		
P01 Product Transfer	Heating to Tank 02	Heating to Tank 02 - Push to Drain	Always Active	None		
Tk01 V02 Outlet	Heating to Tank 02	Heating to Tank 02 - Push to Drain	Always Active	None		
Tk02 Agitator 01	Heating to Tank 02	Heating to Tank 02 - Pause	Pulsed Conditional	Delay	Tank 02 above Agitator Level for Time	Yes
Tk02 V03 Vent	Heating to Tank 02	Heating to Tank 02 - Pause	Pulsed Conditional	Delay	Tank 01 at Vent Alarm Pressure for Time	Yes
Transfer Active Lamp	Heating to Tank 02	Heating to Tank 02 - Pause	Always Active	None		
Tk02 V02 Outlet	Empty Tank 02	Empty Tank 02 - Emptying	Always Active	None		
P02 Product Out	Empty Tank 02	Empty Tank 02 - Emptying	Conditional	Digital Device Activatec	Tk02 V02 Outlet	

Activation Chart

10.1.14 Float Controller

This allows the Controller to float in the Window for flexibility.

10.2 Search Bar

The Search bar is at the top of the Project Explorer and returns full or partial matches for items.