Equipment Phases (EPH) for standardized automation of batch processes in the Chemical Industry

SIMATIC PCS 7 V9.0

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1 Introduction

The standardization of automation technology for process plants, e.g. in the chemical industry, is a major challenge. Different process steps and procedures, different equipment and flexibility in production make this task more challenging.

One solution is to structure the discontinuous plant according to the physical model of ISA-88 / IEC 61512. The lower four levels, i.e. plant, plant section, plant section and individual control unit, are specified here. A plant always consists of subsystems. The subsystems, in turn, can contain standardized equipment phases based on technical functions (Control Modules, abbreviated CM) and controlled via SFC. A technical function consists of both the user program and the physical setup.

1.1 Overview

This application example contains standardized automation functions in the form of Batch Equipment Phases, abbreviated Batch EPH, as Software Typicals, which are provided as multi-project in SIMATIC PCS 7.

The following advantages result from their use:

- Reduction of the skills required for application development
- Reduction of the project planning workload
- Standardized structures
- High degree of standardization and thus reduced upgrade costs
- Flexible structure and customization of partial automation solutions

The Batch EPH contain the SFC and CM instances required for the automation task for standardized start-up and operation of the plant section.

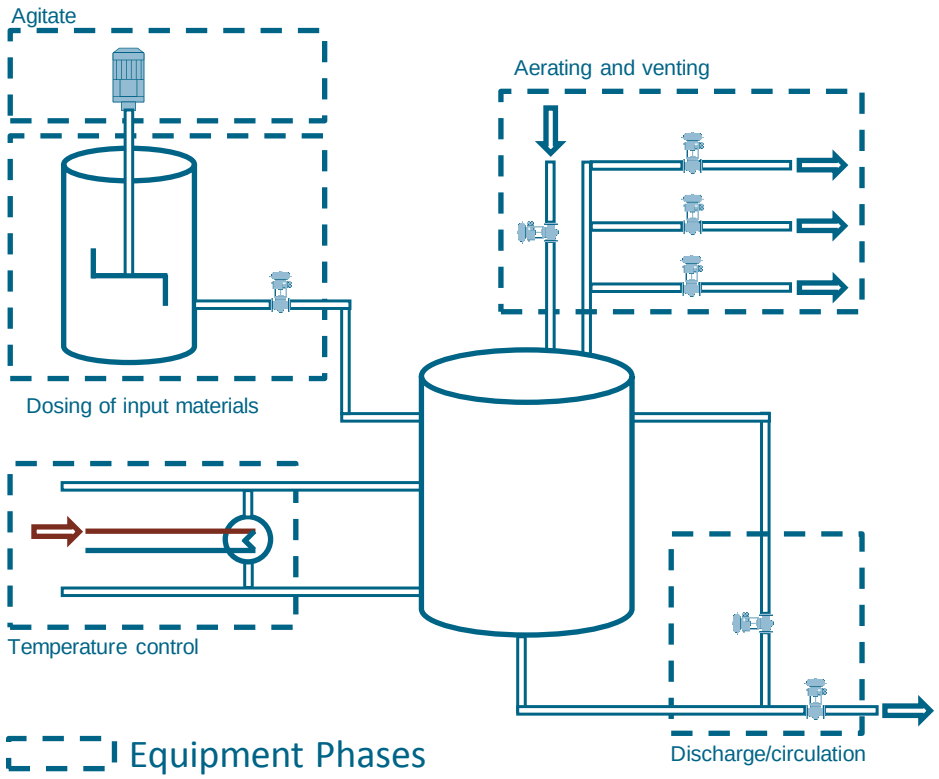
All typicals are designed independently of the automation hardware and are part of a preconfigured PCS 7 project including process visualization. Due to the hardware-independent project planning and the modular structure, Batch EPH can be integrated and used in PCS 7 projects as required.

All instantiated CMs are based on function blocks of the PCS 7 Advanced Process Library (APL) and can be prepared for the most common areas of application (hardware connection, locking logic) by selecting options.

Overview of the complete solution

The following figure shows an example of the standardized batch EPH as part of an automation component solution.

Figure 1-1: Structured set-up of a partial automation solution



Description

The concept of Batch EPH offers prefabricated and standardized components for creating an automation solution, e.g. dosing or temperature control.

The structure of the PCS 7 multi-project is implemented as follows:

- The component view contains one project for the automation system (AS) and one project for the operator station (OS).
- A hierarchy folder is created for each batch of EPH in the technological hierarchy.
- The master data library contains all used Control Modules Types (CMT) and SFC Types

In the AS project, all control and regulation functions are implemented in the form of CFC plans (Continuous Function Chart). In addition, the AS project contains a simulation that simulates a process, e.g. level change within a batch EPH.

The OS project contains the visualization with one process image per batch EPH and shows:

- The schematic representation
- Simulated process response
- SFC module for activating the process control (SFC)

Required knowledge

Basic knowledge of the following fields is required:

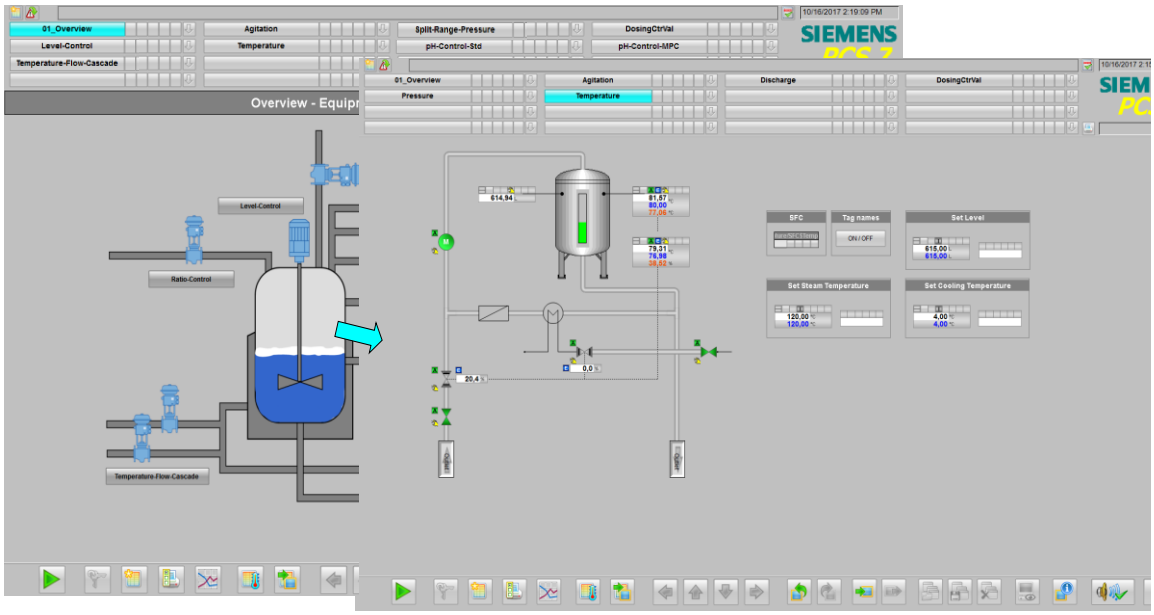
- Project planning with SIMATIC PCS 7, SFC operation, CMT technology and APL
- Basic knowledge of process technology

1.2 Principle of operation

The overview screen and the structure of a process screen of a Batch EPH are described below. The basic function and operation is described in chapter 3 and the detailed description of the parameters, SFC procedure and states in chapter 4.3.

Visualization interface

Figure 1-2



Overview image **Process image**

Overview image

The overview screen contains a schematic representation of a process engineering plant section in which all Batch EPH are contained in the example project.

The buttons can be used to switch to the respective process screen, which contains the functionality and the specific information of a batch EPH. The process images are shown in the form of a corresponding section of the P&I diagram of an installation.

Process image

The process screen provides the operator with an overview of the respective batch EPH and by activating the sequence chain, the behavior of the operating modes can be traced.

The process screen of a batch EPH consists of the following components:

- schematic representation (R&I)
- Simulation
- Screen modules for controlling the individual components (aggregates)
- SFC for starting up and operating the unit

1.3 Hardware and software components used

This application example was created with the following hardware and software components:

Component	Note
SIMATIC PCS 7 ES/OS IPC547G W7	For the PCS 7 V9.0 example project
SIMATIC PCS 7 V9.0	Part of SIMATIC PCS 7 ES/OS IPC547G W7
S7-PLCSIM	Not part of SIMATIC PCS 7 V9.0 SP1; additional licenses are required.
APL Library V9.0	Part of SIMATIC PCS 7 V9.0

Example files and projects

The following list contains all files and projects used in this example.

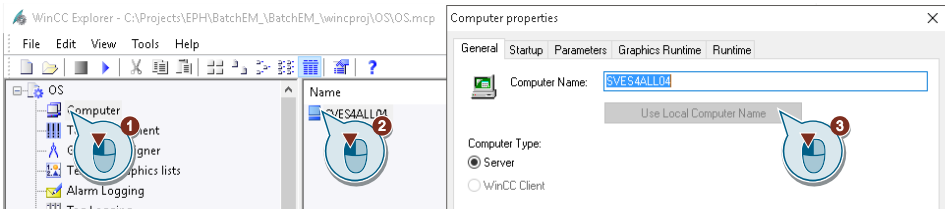
Component	Note
109740620_BatchEPH_PROJ_PCS7V90.zip	PCS 7 V9.0 Example project
109740620_BatchEPH_DOC_PCS7V90_en.pdf	This document

2 Preparation and commissioning

2.1 Preparation

The following instructions describe the commissioning of the Batch EPH by simulating the controller with the "S7-PLCSIM" program.
If you are using a real controller, you must first adjust the hardware settings in the HW configuration.

1. Copy the file "109740620_BatchEPH_PROJ_PCS7V90.zip" to any folder on the configuration computer and then open the SIMATIC Manager.
2. Click on "File > Retrieve" in the menu bar and select the file "109740620_BatchEPH_PROJ_PCS7V90.zip" and confirm with "Open".
3. Select the folder in which the project is to be saved and confirm with "OK". The project is retrieved.
4. Confirm the "Retrieve" dialog with "OK" and then click "Yes" in the dialog to open the project.
5. Right-click on "BatchEPH_OS > OS01 > WinCC Appl > OS" and click on "Open Object" in the context menu.
6. Confirm the dialog "Configured server not available" with "OK".
7. Open the properties of your computer in WinCC Explorer and click on the button "Use Local Computer Name" in the opened properties dialog.



8. Confirm the message "Change computer name" with "OK".
9. Click in WinCC Explorer on "File > Exit" and select "Exit WinCC Explorer and close project" in the following dialog.
10. Then confirm with "OK".
11. Open WinCC Explorer again as described in step 5.
12. Open the "Variable budget" by double-clicking.
13. Open "Variable Resources > SIMATIC S7 Protocol Suite > TCP/IP" in "WinCC Configuration Studio" and select "System Parameters" in the context menu.
14. Check the "Logical Device Name" setting in the "Unit" tab. When using the "S7-PLCSIM" program, "PLCSIM.TCPIP.1" is selected as the device name.
    A restart is required after a device name change.

Note If the OS cannot establish a connection to the AS (gray device symbols), select the logical device name "CP_H1_1:" and restart the OS Runtime.

2.2 Commissioning

The Batch EPH can be put into operation after starting the simulation.

S7-PLCSIM

Follow the instructions below to start the simulated controller:

1. In the menu, select "Tools > Simulate modules".
   The "S7-PLCSIM" dialog window opens.
2. Select the option "Open project from file" in the "Open project" dialog.
3. Select the file "BatchEPH.plc" from the path <Project Path>\EPH\BatchEM_\Batc_Prj\BatchEPH.plc>.
4. Select "Execute > Key switch position > RUN-P".
5. In the drop-down list, change "PLCSIM(MPI)" to "PLCSIM(TCP/IP)".
6. Switch to the component view of the SIMATIC Manager and select "BatchEPH_AS > AS01".
7. On the menu bar, click on "PLC > Download" and confirm the "Download" dialog with "Yes".
8. Confirm the "Stop target group" dialog with "OK" and the subsequent "Download" dialog with "Yes".

Activate OS (WinCC runtime)

To activate the OS, proceed according to the following instructions:

1. Right-click on the OS and select "Open Object" from the context menu.
2. To activate the OS (WinCC Runtime), select the menu item "File > Activate" in WinCC Explorer.
3. In the "System Login" dialog, enter "Equipment" as the "Login" user and "Phases" as the password and confirm with "OK".

Note

After a restart of PLCSIM, the simulation of the system is in the basic state, i.e. the tanks are empty and the input variables are reset to their initial values. In the basic status, several warning and alarm messages are triggered, which you can acknowledge.

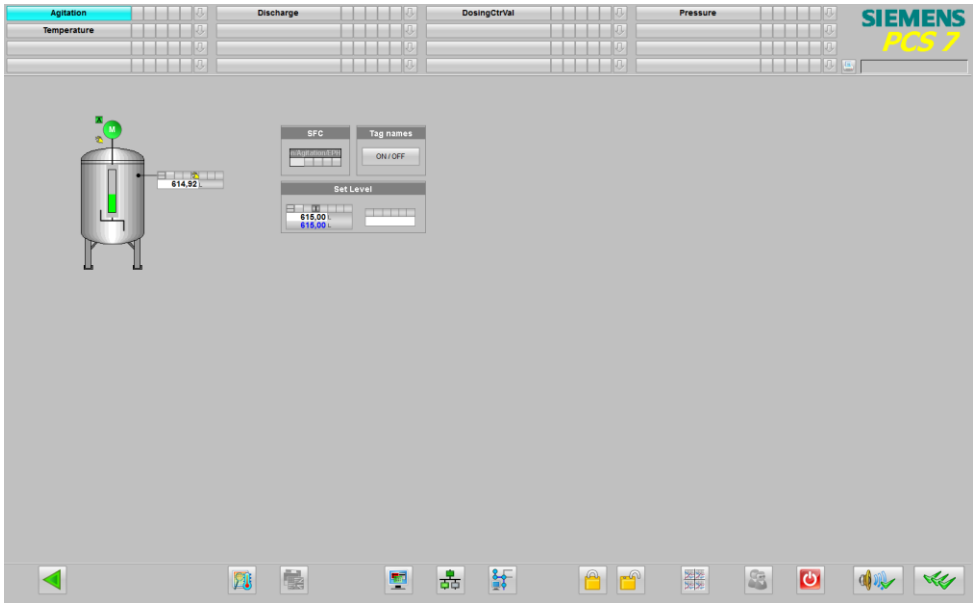
Instructions on how to start up the system from its initial state can be found in chapter 3.

3 Engineering EPH

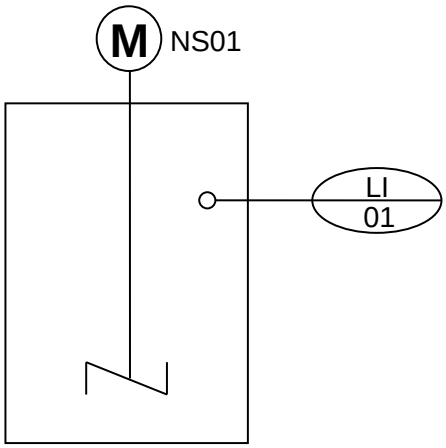
3.1 Agitation

In chemical processes, different substances are often mixed together in an agitator or products are stirred so that they do not harden.

This EPH is used to control an agitator, whereby the agitator has an ON/OFF motor.



3.1.1 Overview (R&I and components)



Designation	Template	Description
NS01	Mot	Engine
LI01	AMon	Level display

3.1.2 Control strategy

Without LEVEL monitoring

This mode of operation is used for agitating a product with an agitator, regardless of the level. The agitation process can be limited in time (e.g. when mixing substances) or continuous (e.g. to avoid product hardening). The duration of the agitation can be set via a setpoint. If the agitation process is limited in time, the operation stops after the agitation time has elapsed. In the case of an continuous agitation process, the operation is terminated by an operator or by a higher-level control system.

With Level monitoring

This mode of operation is used for agitating a product with an agitator, depending on the level. In contrast to the "Without Level Monitoring" mode of operation, the level is monitored when the mode of operation is started. The agitator is not switched on as long as the level in the tank does not correspond to the specified set point. If there is enough product in the tank, the agitation is started. The agitation process can be limited in time (e.g. when mixing substances) or continuous (e.g. to avoid product hardening). The duration of the agitation can be set via a setpoint. If the agitation process is limited in time, the operation stops automatically after the agitation time has elapsed. In the case of an continuous agitation process, the operation is terminated by an operation or a higher-level control.

Control parameter

Name	Unit	Operable state Running	Control strategy										Comment
			1	2	3	4	5	6	7	8	9	10	
Agitation_Time (SP_AGIT_TIME)	min		X	X									Agitation time
Level (SP_LEVEL)	l			X									Level (Setpoint)

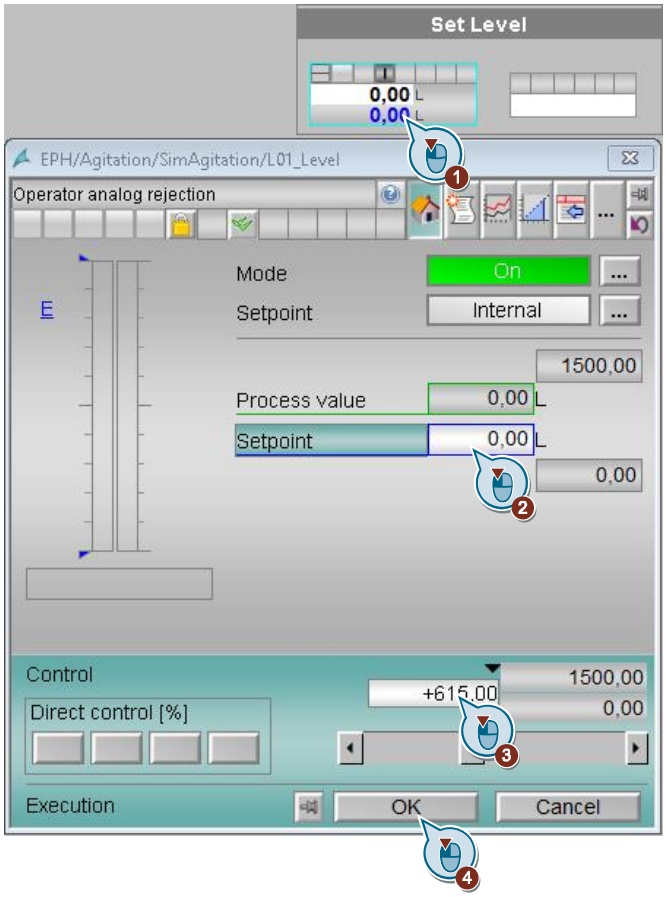
If the agitation_time = 0, then the agitation is continuous. If the value is greater than 0, it is agitated until the entered value is reached.

3.1.3 Operation

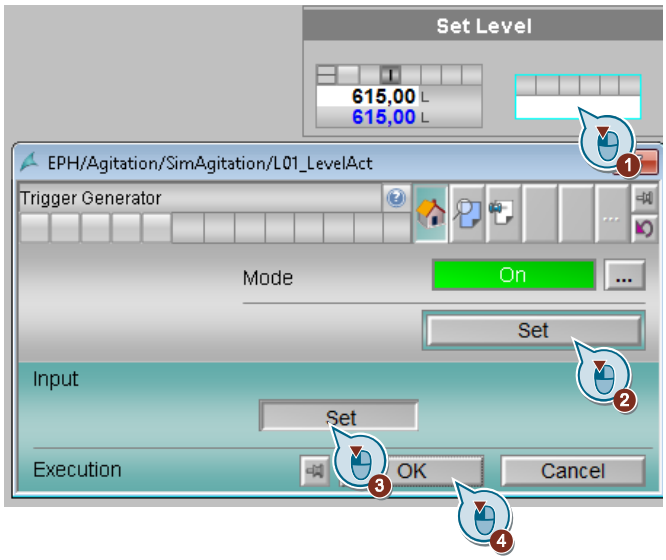
In the basic state and in the "Stop" state, the EPH can be switched to manual operation. This is not possible in the other states.

To select one of the modes and start the process, follow the instructions below:

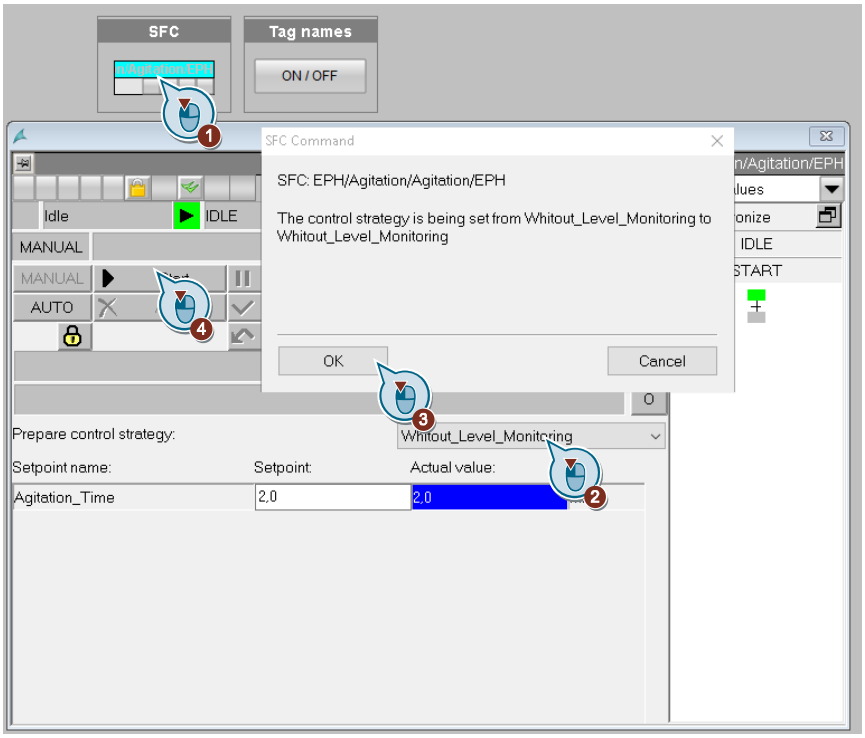
1. Enter the tank capacity of "615 liters".



2. Activate level simulation.



3. Open the SFC (1) and select the desired mode of operation (2). Confirm the "SFC Operation" dialog with "OK" (3). Start the operation with the "Start" button (4) and confirm the dialog with "OK".



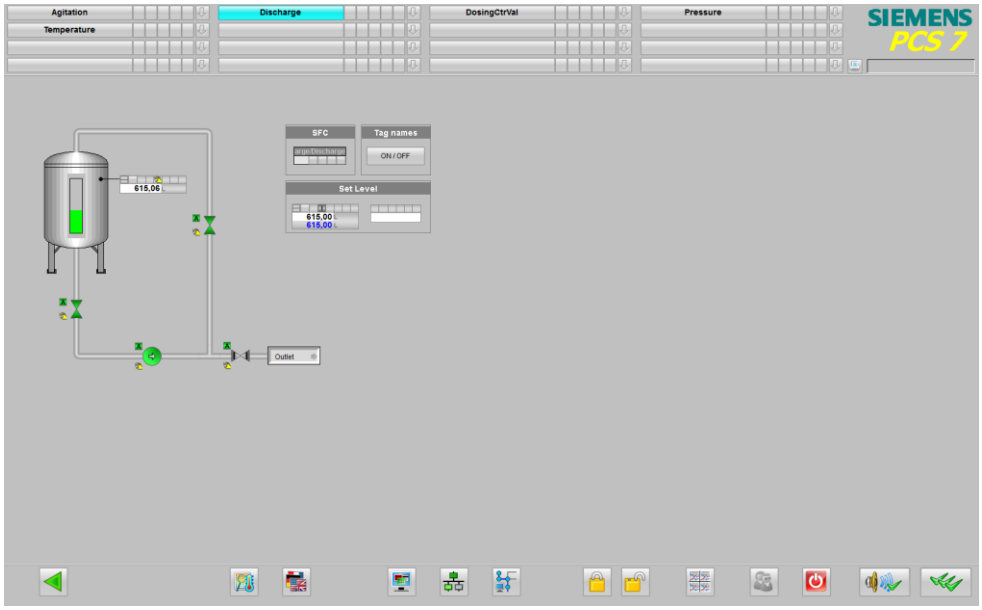
Note With the "Without_Level_Monitoring" mode, the agitation time is specified and displayed in minutes.

Note When "With_Level_Monitoring" is used, the agitation time in minutes and the level in liters are specified and displayed.

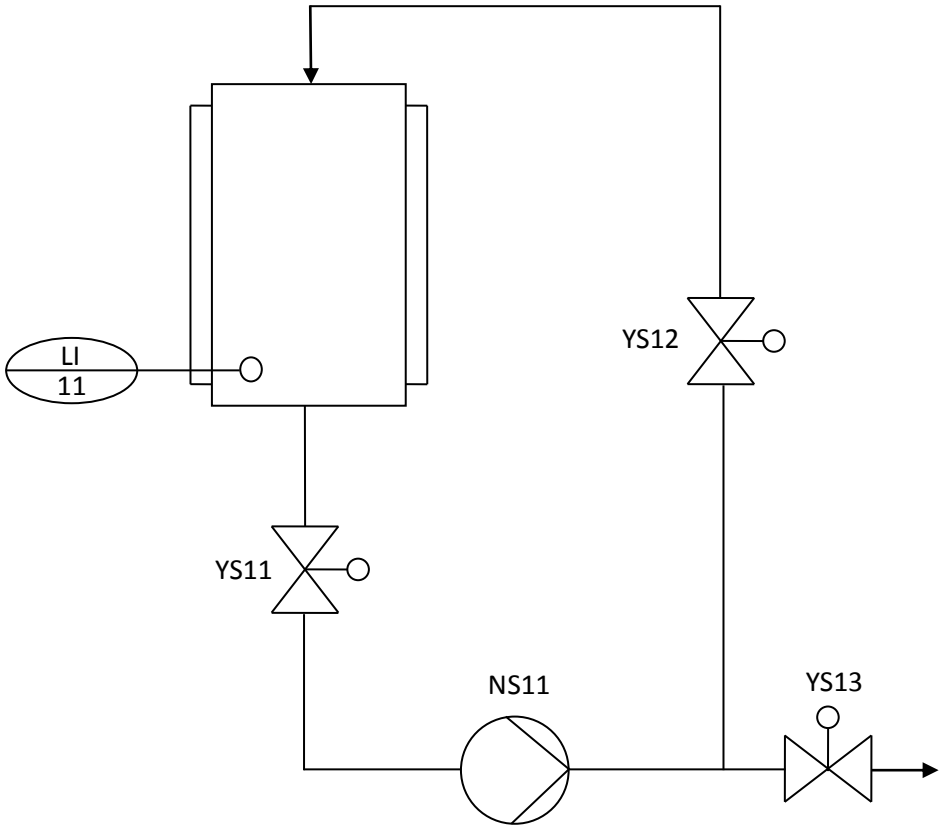
3.2 Discharge (dispensing / recirculation)

For the manufacture of various products it is important to transfer substances or products between tanks. A certain quantity or the complete content can be transferred. The product quality is maintained by pumping over the contents of the tank. A classic example of this is an input tank. The target tank into which the various substances or products are transferred is usually a reactor or an agitator.

During the transfer, this EPH controls the removal of product or input material from a tank.



3.2.1 Overview (R&I and components)



Designation	Template	Description
NS11	Mot	Pump
YS11	Val	Bottom drain valve
YS12	Val	recirculation valve
YS13	Val	Discharge valve
LI11	AMon	Level display

3.2.2 Control strategy

Discharge

The "Discharge" operating mode releases a certain quantity of a product from the tank; this quantity can be set via a setpoint value. As long as the quantity has not yet been delivered, the delivery route is kept open. Once the quantity is reached, the delivery path closes and the operating mode ends.

If the tank is empty before the request is withdrawn, a message is sent and the EPH "Discharge" goes to "Stop".

Control of the components during execution:

- Bottom drain valve "OPEN"
- Discharge valve "OPEN"
- Recirculation valve "CLOSED"
- Pump "ON"

Drain

The "Drain" operating mode empties the tank. At the "PV_Tank_Empty" input of the EPH, the signal for ending the emptying process is connected, in this example the lower warning limit of the level monitoring.

Control of the components during execution:

- Bottom drain valve "OPEN"
- Discharge valve "OPEN"
- Pump "ON"

Circulation

Special products or materials require constant movement to prevent them from depositing and hardening. For this purpose, the product is discharged from the tank for a user-defined time and pumped back into the tank.

Control of the components during execution:

- Bottom drain valve "OPEN"
- Recirculation valve "OPEN"
- Pump "ON"

The operating mode ends after the "Circulation_Time" has elapsed.

Control parameter

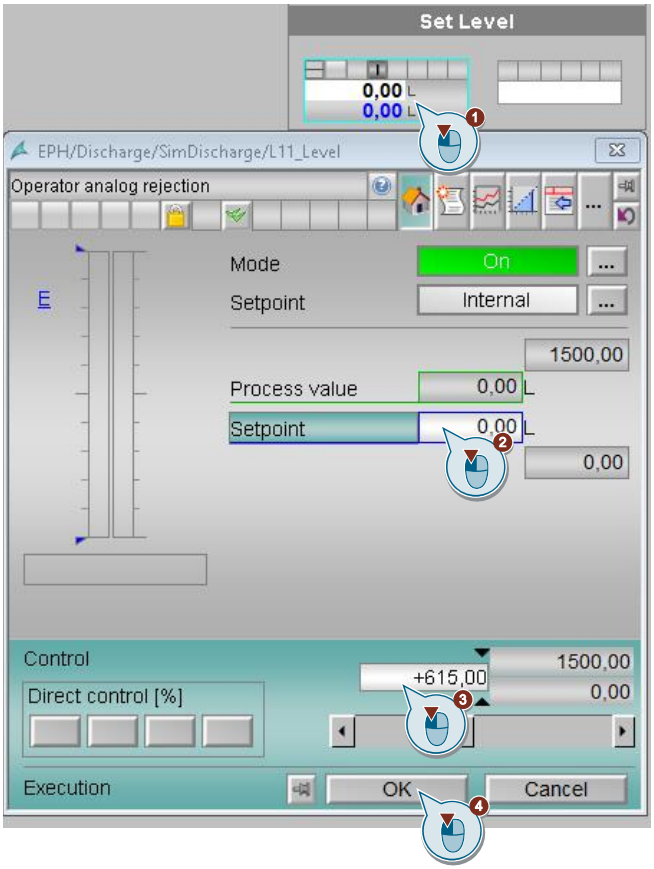
Name	Unit	Operable state Running	Control strategy										Comment
			1	2	3	4	5	6	7	8	9	10	
Circulation_Time (SP_CIRC_TIME)	min				x								Circulation time in minutes
Discharge_Amount	l		x										Quantity to be delivered

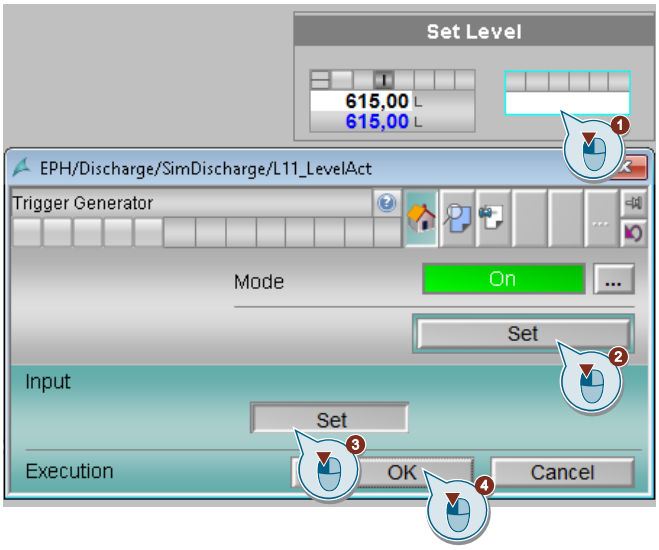
3.2.3 Operation

In the basic state and in the "Stop" state, the EPH can be switched to manual operation. This is not possible in the other states.

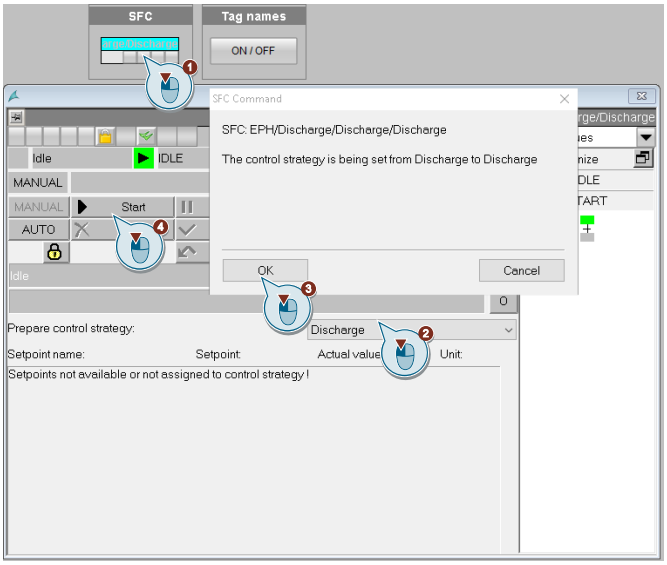
To select one of the modes and start the process, follow the instructions below:

1. Simulate tank capacity "615 liters".





2. Open the SFC (1) and select the desired mode of operation (2). Confirm the "SFC Operation" dialog with "OK" (3). Start the operation with the "Start" button (4) and confirm the dialog with "OK".



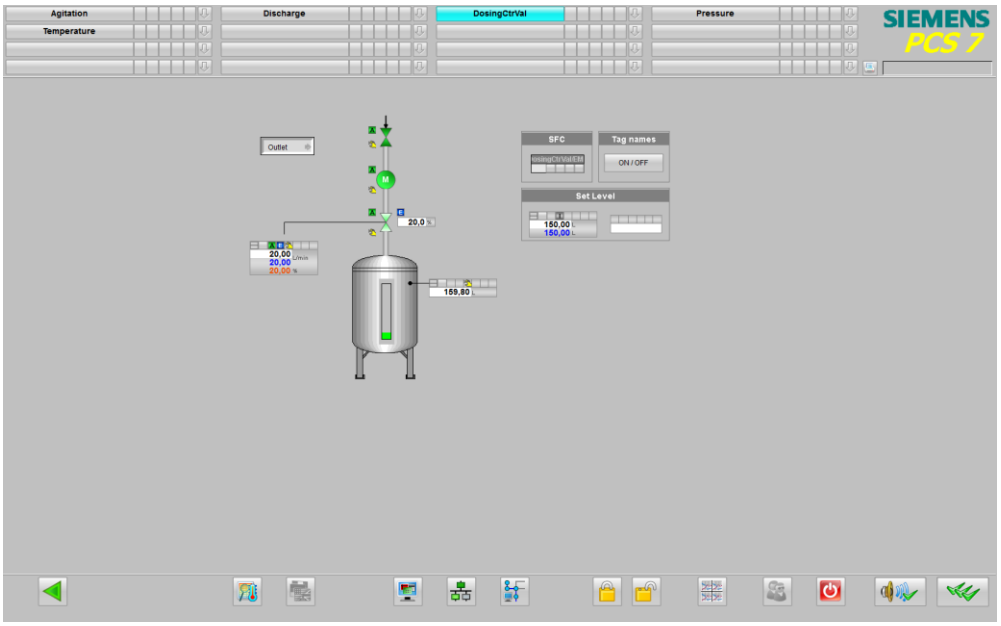
Note In the "Discharge" mode, the discharge amount is specified and displayed in liters.

Note In the "Circulation" mode, the pumping time ("Circulation_Time") is specified and displayed in minutes.

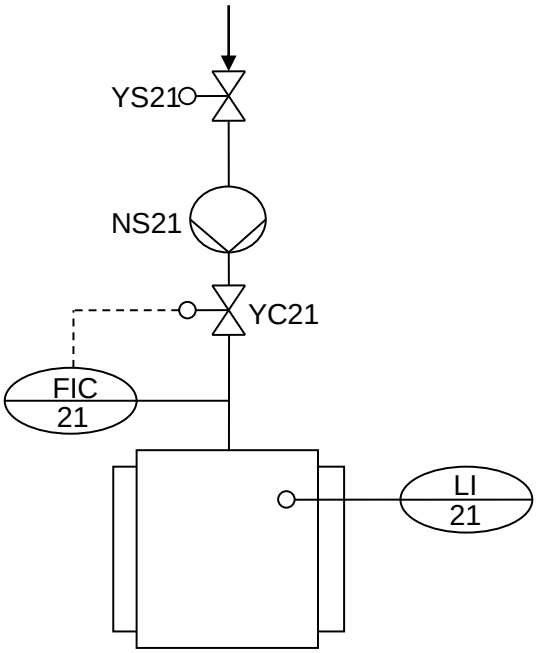
3.3 Dosing Control Valve

In order to manufacture different products, it is important to transfer substances or products between tanks. It can happen that the entire content or only a certain quantity from a tank is required. A classic example of such a tank is a supply container. The target container into which the various substances or products are transferred is usually a reactor or an agitator.

During the transfer, this EPH controls the dosing of an input material or product into a container or the filling of the container with product or input material.



3.3.1 Overview (R&I and components)



Designation	Template	Description
N211	Mot	Pump
YS21	Val	Shut-off valve
YC21	ValAn	Control valve
F21	Crtl	Flow controller
LI21	AMon	Level display

3.3.2 Control strategy

Dosing

It is necessary to dose exact amounts of material into a container for the manufacture of products. In order to achieve fast and precise dosing, this operating mode has a switchover from coarse dosing to fine dosing from a certain filling quantity.

Filling

This mode of operation is used to fill a container to a certain level. Such containers can be, for example, storage containers in which no products are mixed. The container is filled in order to have enough product or input material available for the further process. Another example is an agitator into which a product is filled in order to mix it.

To ensure that the filling process is fast, this mode of operation has a coarse filling function. The accuracy of filling is achieved by switching to fine filling above a certain filling quantity.

Rinsing

Since different products are often produced in one container, it must be cleaned before a product change. Reasons for this are for example preventing contamination of the product or avoiding unwanted reactions. This operating mode ensures that the container is filled with detergent when the control valve is fully open. The detergent must be discharged from the tank by another EPH or manually.

Level_Control

When removing the input material from a storage container, the container may be completely emptied. As a result, the storage container is not ready for direct transfer to a mixing container until enough product or input materials is available again after a waiting period.

In order to avoid these waiting times, this operating mode keeps the container level constant at a specified set level.

Control parameters (SP_)

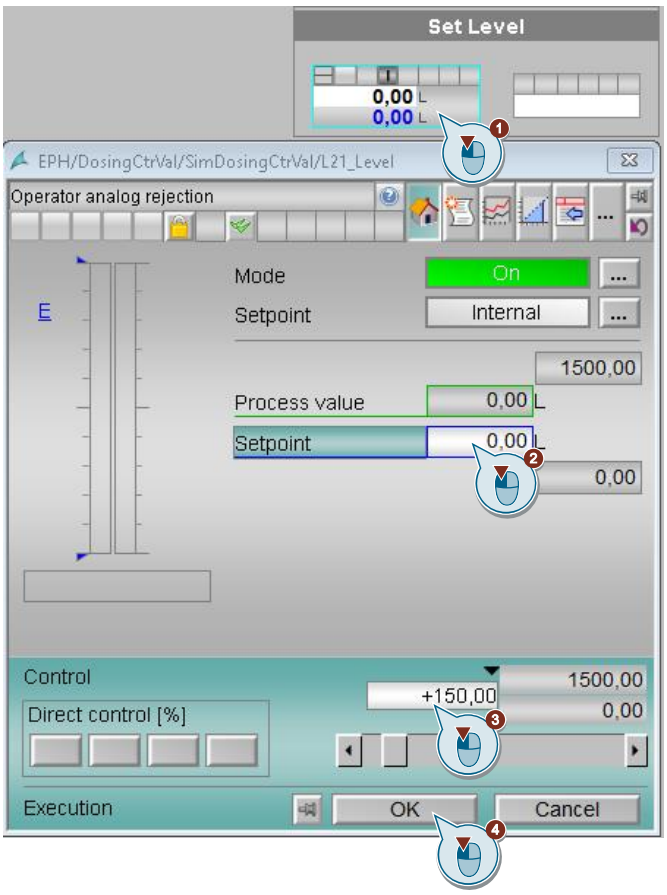
Name	Unit	Operable state Running	Control strategy										Comment
			1	2	3	4	5	6	7	8	9	10	
CoarseFlow (SP_FLOW)	l/min		X	X		X							Flow rate coarse dosing
FineFlow (SP_MIN_FLOW)	l/min		X	X		X							Flow rate fine dosing
Tolerance (SP_TOLERANCE)	l			X									Filling tolerance
Level (SP_LEVEL)	l			X		X							Level (Setpoint)
Amount (SP_AMOUNT)	l		X										dosing volume
Tank_Number (SP_TANK_NO)			X	X	X	X							Container number

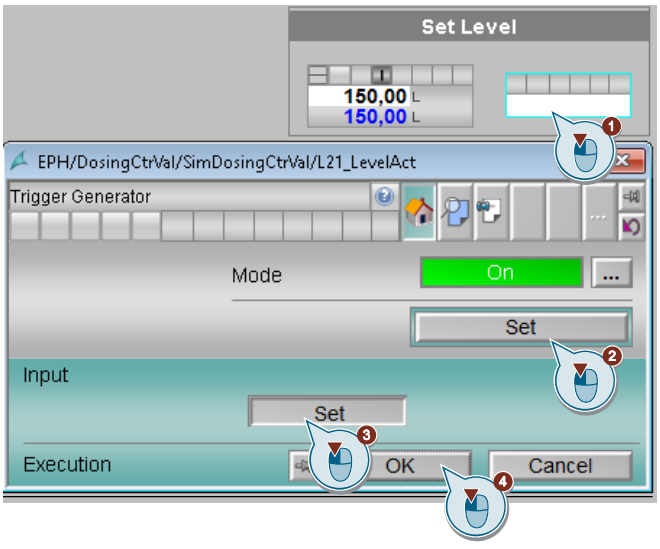
3.3.3 Operation

In the basic state and in the "Stop" state, the EPH can be switched to manual operation. This is not possible in the other states.

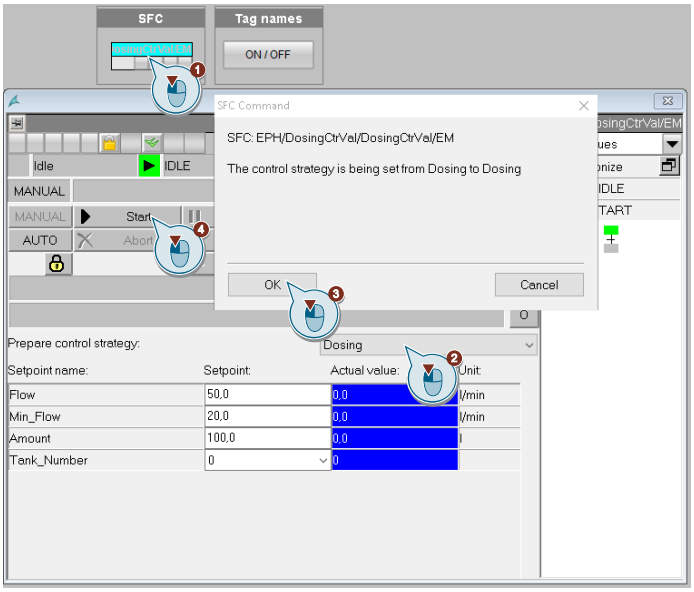
To select one of the modes and start the process, follow the instructions below:

1. Simulate tank capacity "150 liters".





2. Open the SFC (1) and select the desired mode of operation (2). Confirm the "SFC Operation" dialog with "OK" (3). Start the operation with the "Start" button (4) and confirm the dialog with "OK".



Note In the "Dosing" operating mode, the flow rates for coarse dosing ("CoarseFlow") and fine dosing ("FineFlow") are specified and displayed in liters/minutes, the dosing rate ("Amount") in liters and the tank number ("Tank_Number").

Note In the "Filling" operating mode, the flow rates for coarse dosing ("CoarseFlow") and fine dosing ("FineFlow") are specified and displayed in liters/minutes, the tolerance for filling ("Tolerance") in liters, the filling level ("Level") in liters and the tank number ("Tank_Number").

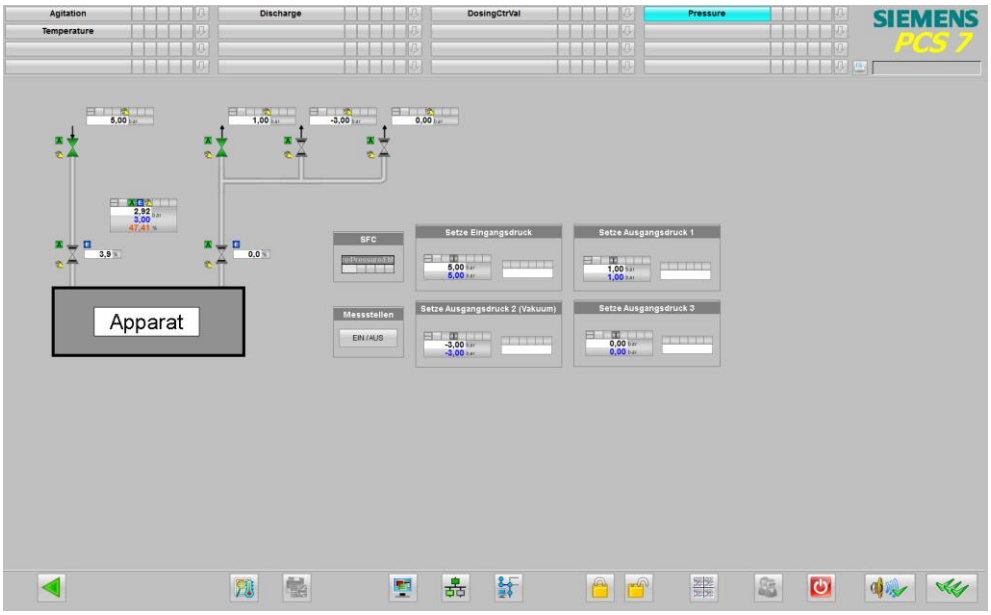
Note When "Rinsing" is used, the container number ("Tank_Number") is preset and displayed.

Note With the "Level_Control" operating mode, the flow rates for coarse dosing ("CoarseFlow") and fine dosing ("FineFlow") in liters/minutes, the filling level ("Level") in liters and the tank number ("Tank_Number") are specified and displayed.

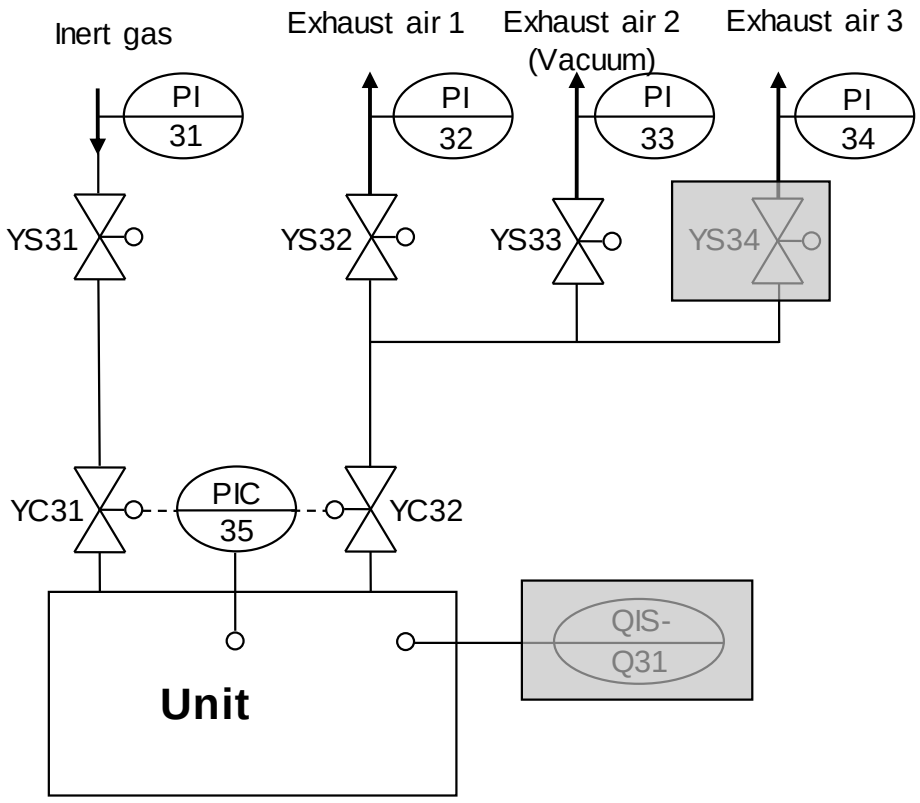
3.4 Pressure (aerating and venting)

In chemical processes it is often very important to avoid an explosive atmosphere in containers. For this purpose, the atmospheric oxygen or reactive or explosive gases are displaced in containers by adding inert gas. Another application is product displacement from a container by inert gas. Typical inert gases are nitrogen, argon or carbon dioxide.

This EPH uses six modes of operation to make the atmosphere in containers inert, to displace the product from the container or to maintain the pressure in the container.



3.4.1 Overview (R&I and components)



Designation	Template	Description
P31	AMon	Pressure display
P32	AMon	Pressure display
P33	AMon	Pressure display
P35	Ctrl	Pressure control
YS31	Val	Inert gas valve 1
YS32	Val	Valve exhaust air 1
YS33	Val	Valve exhaust air 2 vacuum
YS34	Val	Valve exhaust air 3 (optional)
YC31	ValAn	Control valve
YC32	ValAn	Control valve
Q31	AMon	Oxygen display (optional)

3.4.2 Control strategy

Inerting

In this mode of operation, the concentration of a reactive or explosive gas is reduced by pressing on the container with inert gas. The container is pressed on with inert gas until a certain pressure is reached. The container is then expanded by opening the exhaust air valves. The process can be repeated several times.

Flushing

In this mode of operation, the concentration of a reactive or explosive gas is reduced by flushing the tank with inert gas. The supply air valve and a pre-selected exhaust air valve are opened for this purpose. Then inert gas is fed into the container. Flushing continues until the oxygen concentration has fallen below 5%. If no oxygen measurement is available, the rinsing is terminated when an adjustable rinsing time has elapsed. The supply and exhaust air valves are then closed again.

Inerting with open outlet

The operation fulfils two functions. On the one hand it can push product out of a container by inert gas and on the other hand it can inert an empty apparatus and the connected product line.

For both processes, a product line must first be opened. The inert gas is then filled into the tank via the supply air valve. When the product line is closed again, the operation is also stopped.

Ventilating

The operating mode is used to vent a container. However, this is done without the help of inert gas.
A preselected exhaust duct is opened and closed again after a certain time.

Evacuating

In this mode of operation, the container is evacuated via the vacuum line up to a specified pressure. The evacuation is time-monitored.

Pressure Control

The operating mode is used to coat the container with inert gas. For this purpose, the container is kept at a preset pressure by means of a split-range control.

Control parameters (SP_)

Name	Unit	Operable state Running	Control strategy										Comment
			1	2	3	4	5	6	7	8	9	10	
Inerting_Pressure (SP_INERT_PRES)	bar		X										contact pressure set point
Release_Pressure (SP_RELEASE_PRES)	mbar		X			X		X					Pressure to which release is to be applied
Flushing_Time (SP_FLUSHING_TIME)	min			X		X							flushing time
Monitoring_Time (SP_MONITOR_TIME)	min		X	X				X					Monitoring time (monitoring pressure changes over time)
Expansion_Pipe (SP_EXPAN_PIPE)			X	X		X							Selection of the exhaust air duct
Number_of_Inertisations (SP_NO_INERT)			X										Number of container pressurizations with inert gas
Hold_Pressure (SP_HOLD_PRES)	mbar				X		X						Tank pressure set point

Note

The "Expansion_Pipe" setpoint is an enumeration. Three states are possible:

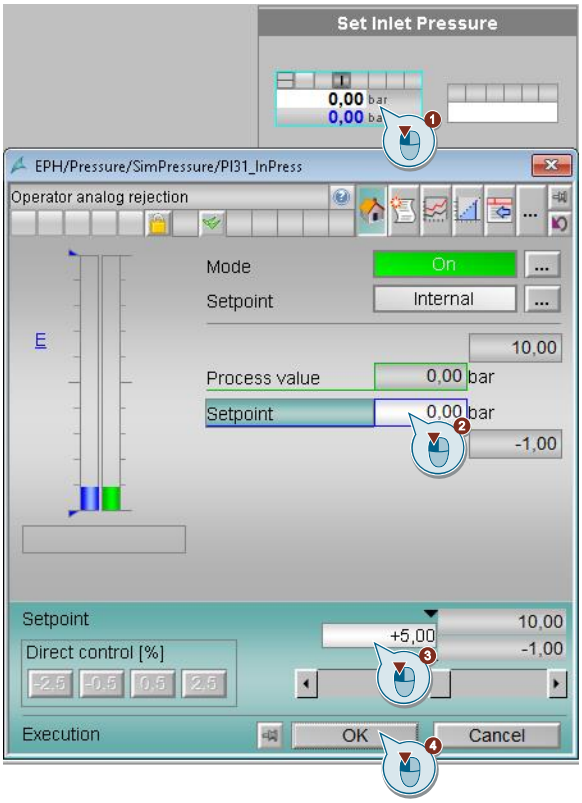
1. Expansion pipe 1 preselected
2. Expansion pipe 2 preselected
3. Expansion pipe 3 preselected

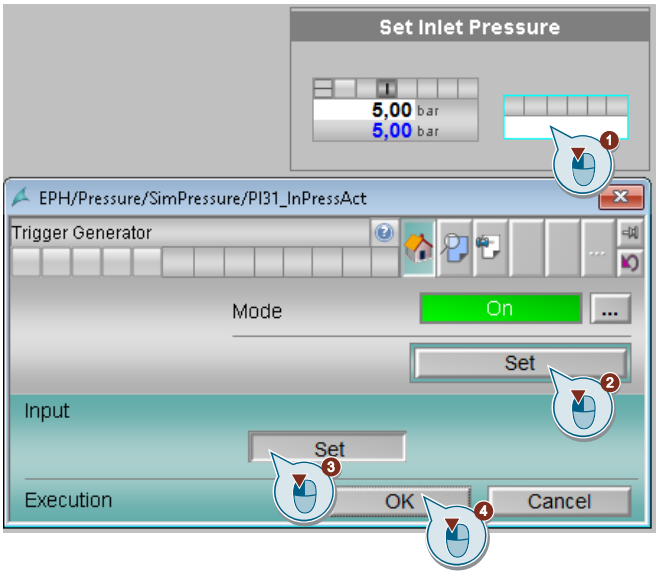
3.4.3 Operation

In the basic state and in the "Stop" state, the EPH can be switched to manual operation. This is not possible in the other states.

To select one of the modes and start the process, follow the instructions below:

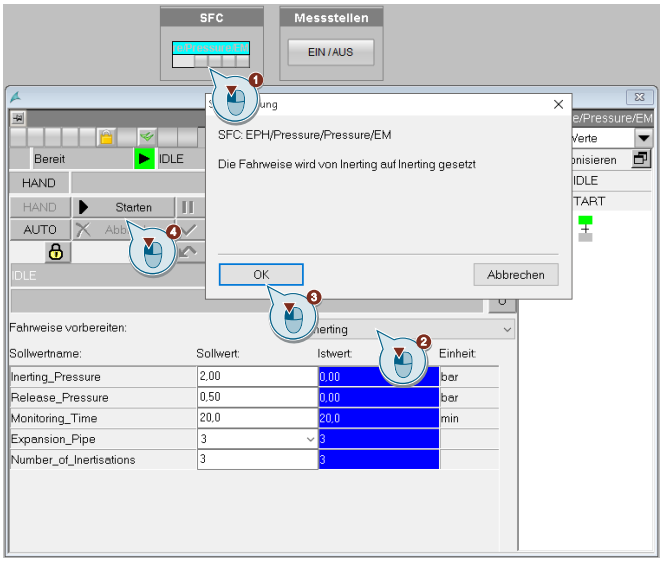
1. Pre-simulate "5 bar" inlet pressure.





2. Switch to vacuum pressure and simulate "-3 bar" of pressure.

3. Open the SFC (1) and select the desired mode of operation (2). Confirm the "SFC Operation" dialog with "OK" (3). Start the operation with the "Start" button (4) and confirm the dialog with "OK".



Note With the "Inerting" mode of operation, the contact pressure ("Inerting_Pressure") and the pressure to be relieved ("Release_Pressure") in bar, the monitoring time ("Monitoring_Time") in minutes, the selection of the exhaust pipe ("Expansion_Pipe") and the number of flushes are specified and displayed.

Note In the "Flushing" mode, the flushing time and monitoring time in minutes and the selection of the exhaust air pipe ("Expansion_Pipe") are specified and displayed.

Note With the "Inerting_with_OpenOutlet" mode, the pressure is preset and displayed in bar until you also want to release ("Release_Pressure").

Note When operating the "Ventilation" mode, the pressure is set and displayed until the pressure is to be released ("Release_Pressure") in bar, the flushing time ("Flushing_Time") in minutes and the selection of the exhaust air pipe ("Expansion_Pipe").

Note In the "Pressure_Control" mode, the pressure to be held ("Hold_Pressure") is preset and displayed in bar.

Note With the "Evacuation" mode, the pressure is set and displayed in bar and the monitoring time in minutes until the pressure is to be released ("Release_Pressure").

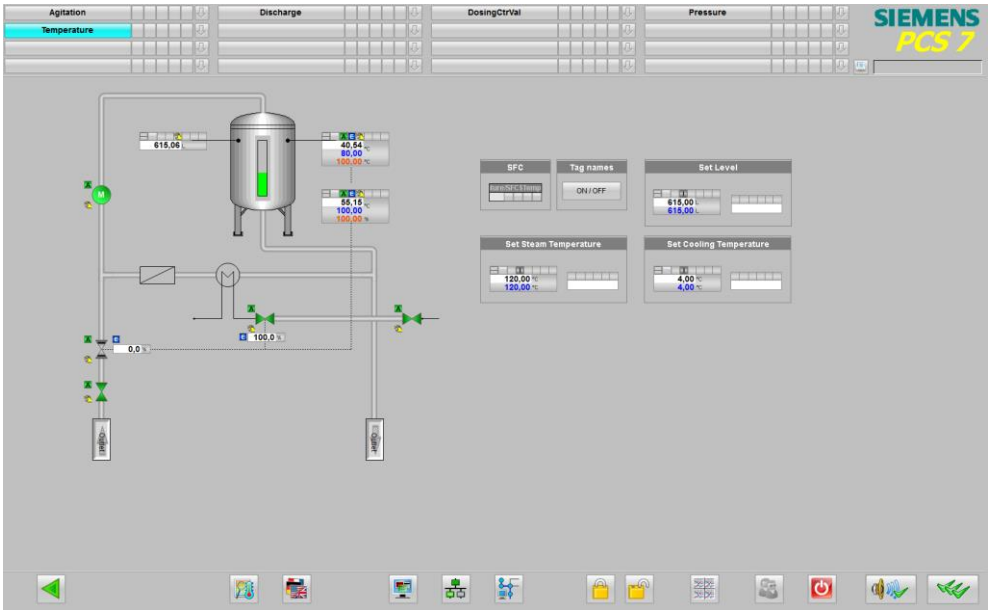
3.5 Temperature

In chemical processes that require a time-dependent temperature control of the product chamber, the auxiliary unit used must ensure rapid heat supply or dissipation. For this purpose, a pressurized water circulation system is used, in which a pump circulates the water in the jacket circuit.

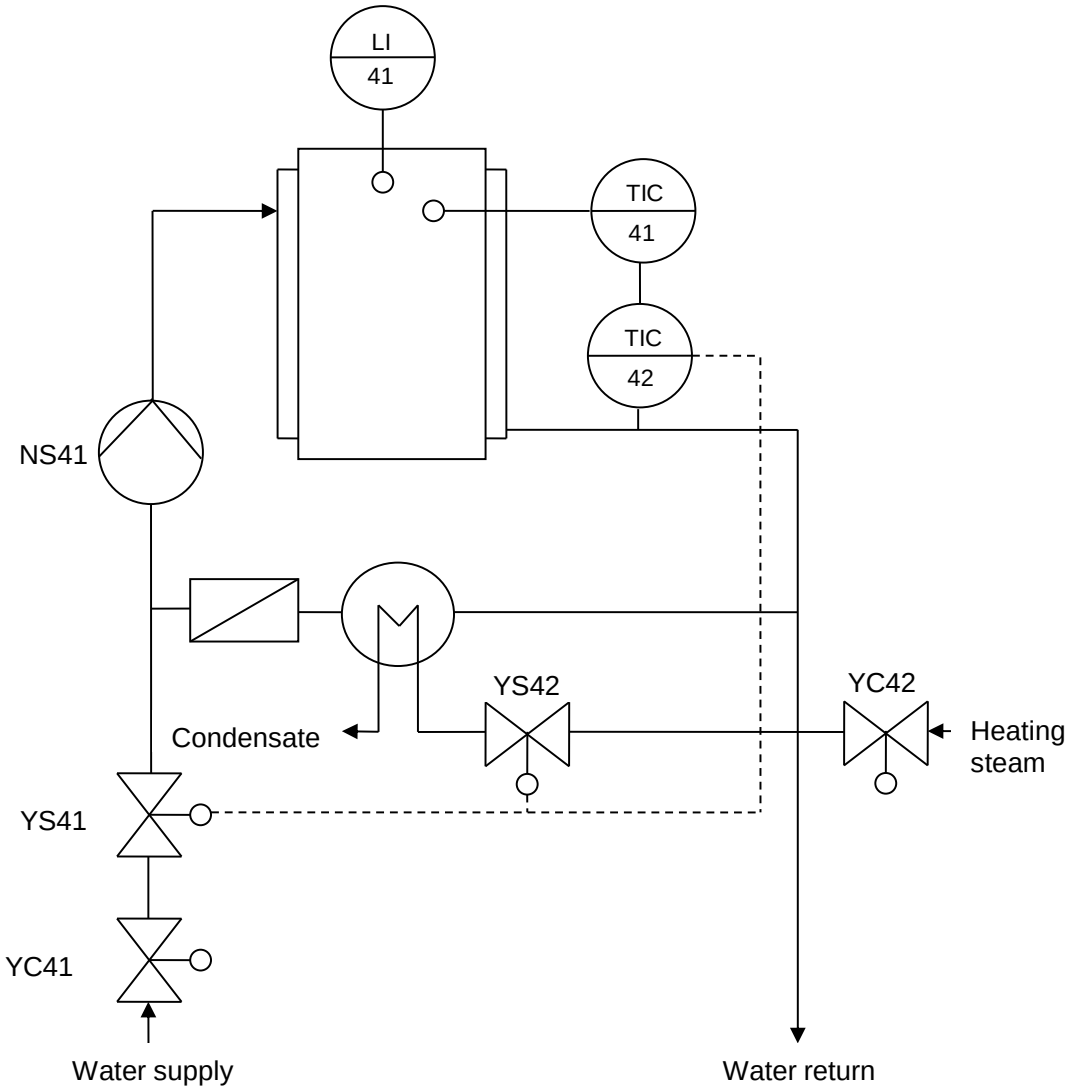
When heat is supplied, cooling water is indirectly heated with steam via a heat exchanger. The desired temperature is set by regulating the steam pressure with a steam inlet control valve. The resulting condensate is discharged via a condensate drain.

Cascade control with the internal temperature of the unit as the reference variable controls the inlet valves for cooling water and steam. The product temperature is therefore assigned to the master controller and the return flow temperature to the follow-up controller. The slave controller is designed as a split-range controller and supplies the control values to the control valves. The control valves are therefore not operated by the EPH. You are working in "External jobs" mode.

Depending on the filling level of the container, the cascade control is separated. This means that if the container level no longer ensures that the temperature sensors are immersed in the product, the setpoint for the follow-up controller is no longer the manipulated variable formed from the internal temperature in the master controller, but is switched over to direct setpoint input from the EPH.



3.5.1 Overview (R&I and components)



Designation	Template	Description
TIC41	Ctrl	Guiding temperature controller
TIC42	CtrlSplitRange	Slave temperature controller
NS41	Mot	Pump
LI41	AMon	Level display
YS41	Val	Flow valve
YS42	Val	Heating steam valve
YC41	ValAn	Flow valve
YC42	ValAn	Heating steam valve

3.5.2 Control strategy

Temperature_Control

In this operating mode, a preset temperature will be reached inside the tank. Either heating steam or cooling water is fed into the tank shell via the supply line. Both processes are indirect heat/cold transfer due to the separation with heat-permeable walls.

In the heat exchanger, the system continuously pumps the contents of the container through the heat exchanger via piping back to the container until a pre-defined temperature is reached.

Control parameters (SP_)

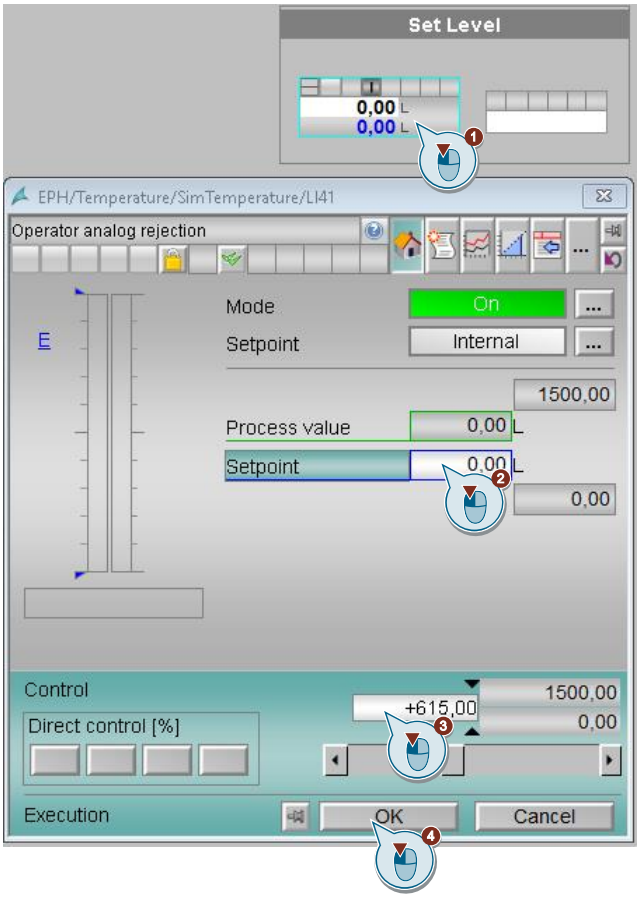
Name	Unit	Operable state Running	Control strategy										Comment
			1	2	3	4	5	6	7	8	9	10	
Temperature (SP_TEMP)	°C		X										product temperature set point
Tolerance (SP_TOLERANCE)	°C		X										Tolerance band of the set temperature
Hold_Time (SP_HOLD_TIME)	min		X										Time the product is to be kept at the set temperature

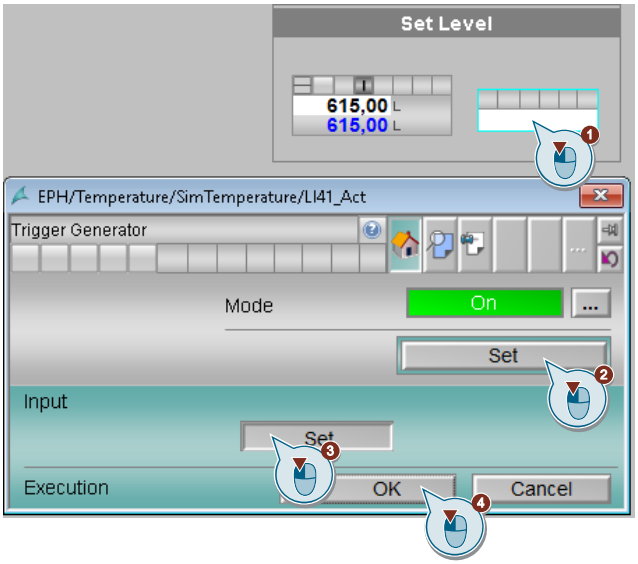
3.5.3 Operation

In the basic state and in the "Stop" state, the EPH can be switched to manual operation. This is not possible in the other states.

To select one of the modes and start the process, follow the instructions below:

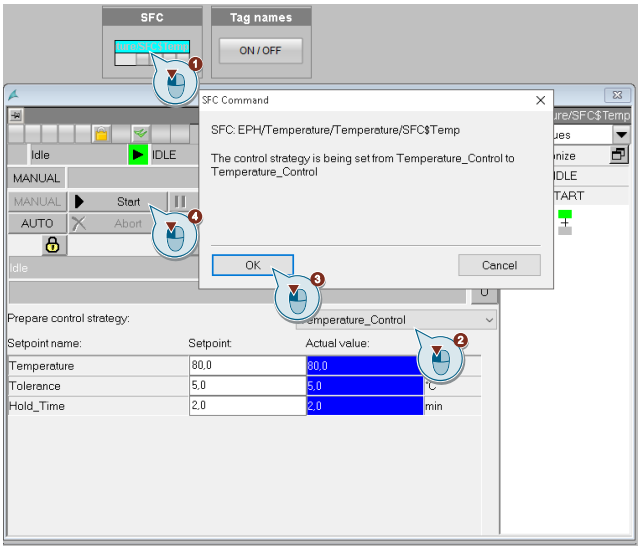
1. Simulate tank capacity "615 liters".





2. Change to steam temperature and simulate a temperature of "120 °C".

3. Change to the refrigerant temperature and simulate a temperature of "4 °C".
4. Open the SFC (1) and select the desired mode of operation (2). Confirm the "SFC Operation" dialog with "OK" (3). Start the operation with the "Start" button (4) and confirm the dialog with "OK".



Note

In the "Temperature_Control" mode, the target temperature ("Temperature") and tolerance ("Tolerance") in degrees Celsius and the time the product is to be kept at the target temperature ("Hold_Time") are specified and displayed in minutes.

4 Useful information

4.1 Basics

4.1.1 General Information

Automation technology

Process-engineering processes, e.g. in the chemical or pharmaceutical industries, are controlled and regulated with the aid of automation technology.

The degree of automation of the systems varies greatly and depends on the type of system and process.

An automation solution usually includes the following aspects:

- Measurement and control
- Rules, including higher-level control strategies if necessary
- Transfer, process and display information
- Adherence to defined steps and processes
- Observing complex contexts
- Guaranteeing constant product quality
- Strategies in the event of deviations, overruns of process variables or failure of components

Process control

The primary task of the operator is the operational process management based on process and plant information of process engineering production and its logistics and auxiliary processes.
With the help of process control, the targeted and reproducible setting of operating conditions is guaranteed and compliance with defined tolerance ranges is ensured. After faults have occurred, measures must be taken to restore the process to the desired state. In addition, the process is continuously optimized in terms of costs, quality and safety.

SIMATIC PCS 7 Advanced Process Graphics (APG) makes process visualization more efficient for the operator. The information relevant for orientation and navigation is placed in the system overview. The information required for operating and monitoring a plant section, e.g. reactor, is made available in a subordinate process image. The great advantage of this procedure is that the information is dosed and optimized for process operation.

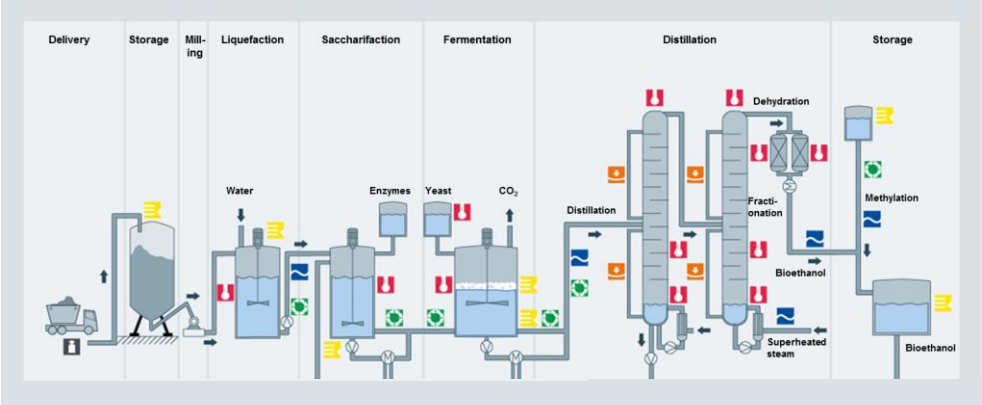
Note Detailed information and the procedure for configuring APG can be found in the article "Integration of Advanced Process Graphics in SIMATIC PCS 7" under https://support.industry.siemens.com/cs/ww/en/view/89332241.

4.1.2 Standardized plant units

Partial automation solution

The following figure shows the components of an automation solution for a process plant. The process is divided into several process steps, such as fermentation and distillation. One process step corresponds to a plant section, which in turn can consist of various technical functions, such as educt addition or agitation.

Figure 4-1: Process steps of a process engineering plant



Unit

The term subsystem stands for a "unit" in process engineering plants (e.g. agitated tank reactor, fermenter) including the apparatus, sensors, actuators and automation (hardware and software).

Structured subsystems exist for both continuous and discontinuous (batch) processes.

Package units are a variant of subsystems. Examples of package units are refrigeration systems, vacuum systems and packaging machines. Here, the manufacturer of the mechanical or process engineering apparatus supplies an automation system specially tailored for this apparatus, which is mounted locally on the apparatus on a separate hardware. The "Package Unit" is integrated as a whole into a higher-level process control system.

Equipment phases

A technical function is part of a subsystem and includes sensors, actuators, automation (hardware and software) and the SFC designed and configured for use in specific applications, e.g. in process engineering (dosing device, level or temperature control).

The automation solution of a technical function is structured as follows:

- Interconnected and parameterized measuring points
- Simulation to demonstrate the mode of operation

Each technical function is grouped in a hierarchy folder and can be integrated into existing projects.

Control module

Actuators and sensors are used on the individual control level as individual control units. In PCS 7, the individual control unit is implemented with software typicals (CMT = Control Module Types), e.g. for a valve, motor or controller.

The implementation in the CFC plan contains all relevant components, circuits and basic parameters. A single control unit type is generated from the CFC and stored in the PCS 7 master data library. Any number of instances can be generated from this individual control unit type, e.g. with the automation interface. The instances can differ greatly, for example, options for functions as well as options for the process connection can be selected.

Each name of an individual control unit follows a uniform naming convention. This means that the designation provides information about the function and task of the individual control unit.

Unit Template

A unit template consists of several technical functions. Technical functions are combined into an automation component solution in a unit template.

In addition, you can display additional information such as business or process key figures (KPI indicators) or the operating times of aggregates in a unit template.

A unit template is grouped in a hierarchy folder and can be easily integrated and adapted in existing projects.

In contrast to the "package units", the unit concept does not create local "island controls" with proprietary hardware, but rather prefabricated software solutions for frequently occurring units in a central process control system. Automation component solutions for process plants are standardized, prefabricated and editable for the user. This means that the templates only have to be adapted to the existing process technology and automation hardware. This significantly reduces the engineering effort for several similar automation tasks.

Configuration with templates

Template-based project planning can be carried out at sub-system level, at technical function level or at individual control level.

At the individual control level, a template for creating instances is created using individual control unit types in PCS 7. The instances of the individual ECU types can be compared and synchronized with the PCS 7 Automation Interface.

Technical functions or subsystems are duplicated as a unit and adapted to the corresponding process technology.

The technical function and the unit template contain all the functions required for automation in the form of:

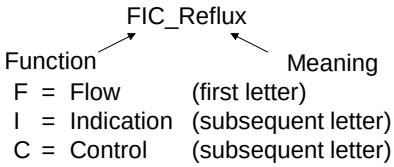
- CFC plans (instances of individual control unit types)
- SFC plans
- OS images

4.2 Design and structure

4.2.1 CFC plan naming convention

The designation is structured according to a uniform naming convention and corresponds to the function according to the European standard EN 62424 or ISO 3511. The following figure shows how a designation is composed:

Figure 4-2



The following table contains all letters used in the application example and their meaning:

Table 4-1

First letter	
Letter	**Meaning**
F	Flow
L	Level
N	Engine
P	Pressure
Q	Quantity
S	Speed (velocity, rotational speed, frequency)
T	Temperature
X	Freely selectable first letter
Y	Control valve
Subsequent letter	
C	Control
F	Fraction
I	Indication
S	Binary control function or switching function (not safety-relevant) ("Switching")

4.2.2 Technological perspective

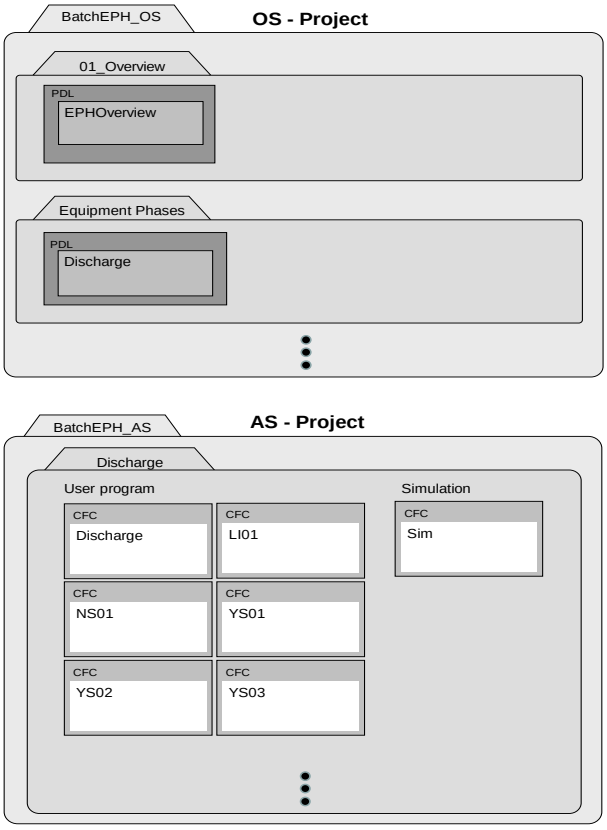
From a technological perspective, all batch equipment phases are realized in two hierarchy levels.

In the AS project "BatchEPH_AS" the first hierarchy level is empty and in the subordinate hierarchy level there is a hierarchy folder for each equipment phase with the necessary CFC and SFC.

The first hierarchy level of the OS project "BatchEPH_OS" is also empty. The subordinate hierarchy level contains a hierarchy folder for each equipment phase with a process screen and the hierarchy folder "01_Overview", in which the overview screen of all batch equipment phases "Overview.pdl" is located. In the

following figure, the folder structure is shown schematically, i.e. the names of the subfolders differ from the folder names of the PCS 7 project.

Figure 4-3



4.2.3 Individual control level

An individual controller is used to control individual devices such as motor, valve and controller. For this purpose, the components required for this task, e.g. for controlling a valve, are combined in a single control unit (CM = Control Module). If a single control unit is used several times in a project, e.g. in different versions, a single control unit type (CMT = Control Module Type) is created in PCS 7 and stored in the master data library. This CMT can be used flexibly as an instance in different forms in the project.

With this technology, automation projects with the program logic can also be tested without real hardware.

Note The application example "Control Module (CM) Technology - Efficient Engineering in PCS 7" gives you a general overview of how a CMT is created, extended and instantiated. The application example is available under the following link: https://support.industry.siemens.com/cs/ww/en/view/109475748

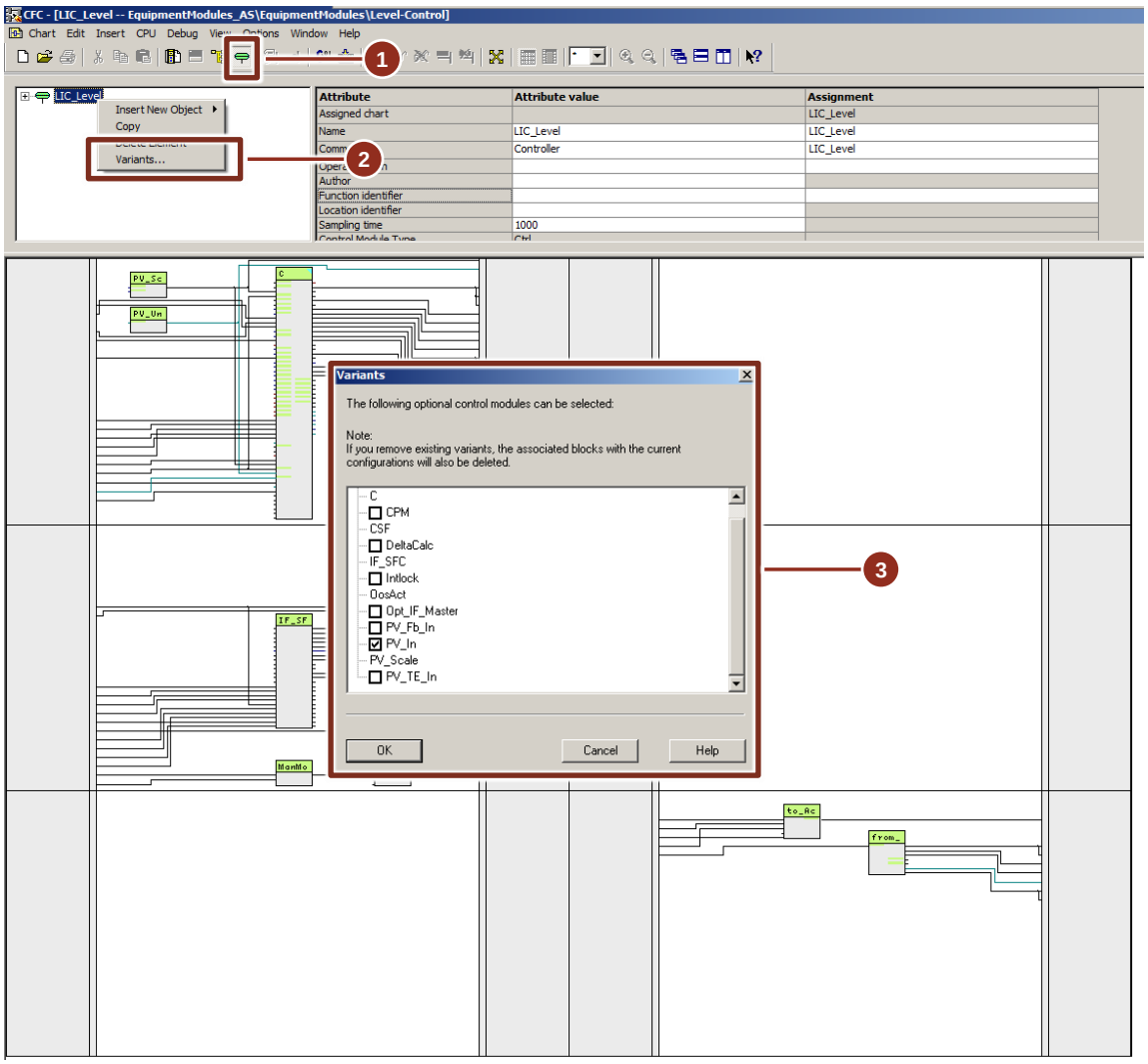
Selecting a variant

A variant and the options necessary for solving the automation task are determined in the instance.

1. For this purpose, the technological connections are displayed in the CFC.
2. The available variants are displayed in the context menu.

3. The functionality required for the automation task is determined by selecting the options.

Figure 4-4



4.3 Detailed description EPH

Each batch equipment phase consists of several CM instances and one SFC instance for executing the automation task. You will find a detailed description of the individual CM including its functions and variants in the application example "Technical functions for PCS 7 using the example of the chemical industry": https://support.industry.siemens.com/cs/ww/en/view/53843373.

4.3.1 "Agitation" - parameters and operation methods

Control parameter

Name	Unit	Operable state Running	Control strategy										Comment
			1	2	3	4	5	6	7	8	9	10	
Agitation_Time (SP_AGIT_TIME)	min		X	X									Agitation time
Level (SP_LEVEL)	l			X									Level (Setpoint)

If the agitation_time = 0, then the agitation is continuous. If the value is greater than 0, it is agitated until the entered value is reached.

Process values (PV_)

Name	Data type	Unit	Connection name	Comment
Agitation_Time	Analog	sec	PV_AGIT_TIME	Converted agitation time in seconds

Timer (TI_)

Name	Data type	Unit	Connection name	Comment
Agitation_Timer	Analog		TI_AGIT	Time for controlling the agitation time (switch-off delay)

Control values (QV_xy)

Name	Data type	Connection name	Comment
Enable_CM_Manual	Binary	QV_EN_CM_MAN	Release for operating mode change in manual for all CMs

Position texts

Number	Text
101	Start
102	Reset
103	EngineOn
104	AgitationTime
105	EngineOff
106	Agitate (agitate continuously)

Number	Text
302	ErrorMessage
303	Start_Timer
304	Pump_On
305	Pump_Off
306	Close_Valve
401	Stop_Timer
402	Enable_Manual
403	Disable_Manual

Connections

Name	Data type	Comment
FL_SEQ	Byte	Stored sequencer
FL_STEP	Word	Stored step

Standard SFC type messages

Number	Type	Text
SIG_1	Fault	Runtime exceeded
NSIG_1	Operator prompt - general	Operator prompt
NSIG_2	Status message - AS	Active
NSIG_3	Status message - AS	Completed
NSIG_4	Status message - AS	Held
NSIG_5	Status message - AS	Aborted
NSIG_6	Status message - AS	Ready to complete
NSIG_7	Status message - AS	Stopped
NSIG_8	AS control technology Message - error	Error
NSIG_9	Status message - AS	Manual
NSIG_10	Status message - AS	Not approved for SIMATIC BATCH
NSIG_11	Status message - AS	Runtime exceeded

Free messages

Number	Type	Text
SIG_2	Alarm on top	Locking failure
SIG_3		
SIG_4		
SIG_5		
SIG_6		
SIG_7		
SIG_8		
NSIG_12	Status message - AS	
NSIG_13	Status message - AS	

Number	Type	Text
NSIG_14	Status message - AS	
NSIG_15	Status message - AS	
NSIG_16	Status message - AS	

Summarizing states

The following table illustrates which sequence chains correspond to each other in the operating modes.

Status	Operating mode I Without_Level_Monitoring	Operating mode II With_Level_Monitoring
Starting	X	X_1
Active	X	X
Completing	X	X_1
Completed		
Holding	X	X_1
Held		
Holding error	X	X_1
Held error		
Resuming	X	X_1
Resuming error	$X_{Resuming}$	X_1
Stopping	X	X_1
Stopped		
Aborting	X	X_1
Aborted		

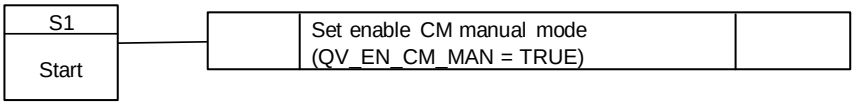
Legend

X : Sequencer exists

X_1 : Same as sequencer in operating mode I

Operating state: Idle (Ready)

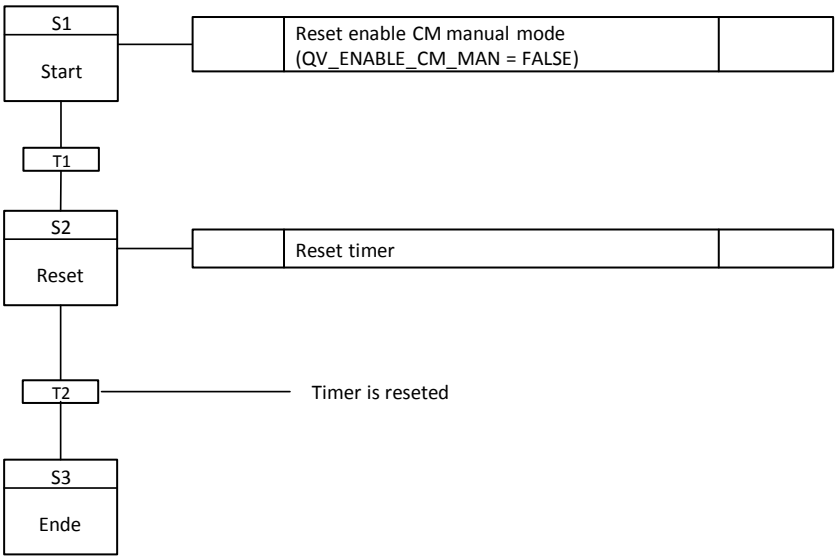
The EPH can only be started if there is no switch-on inhibit. The agitator engine NS01 is switched off.
Manual operation of the CMs in idle mode is possible.



Operating mode I - "Without Level Monitoring"

Operating state: Starting

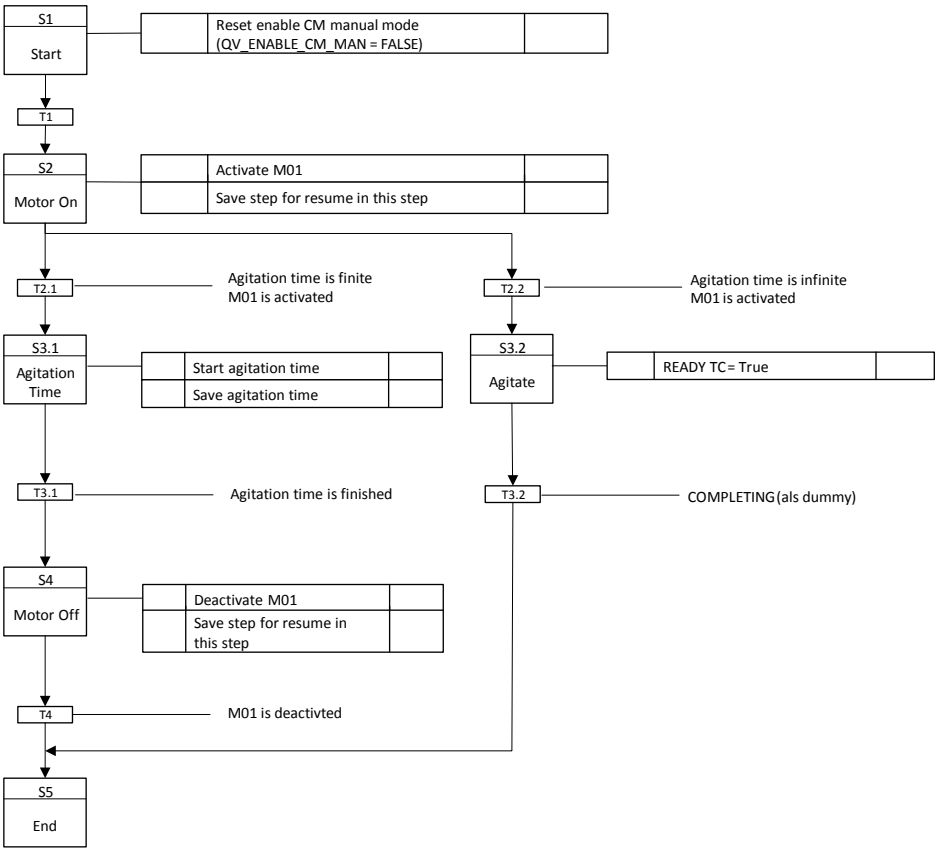
In the "Start" step, the release for manual operation of the CMs is reset. In the "Reset" step, the agitation time is reset.



Operating state: Run (active)

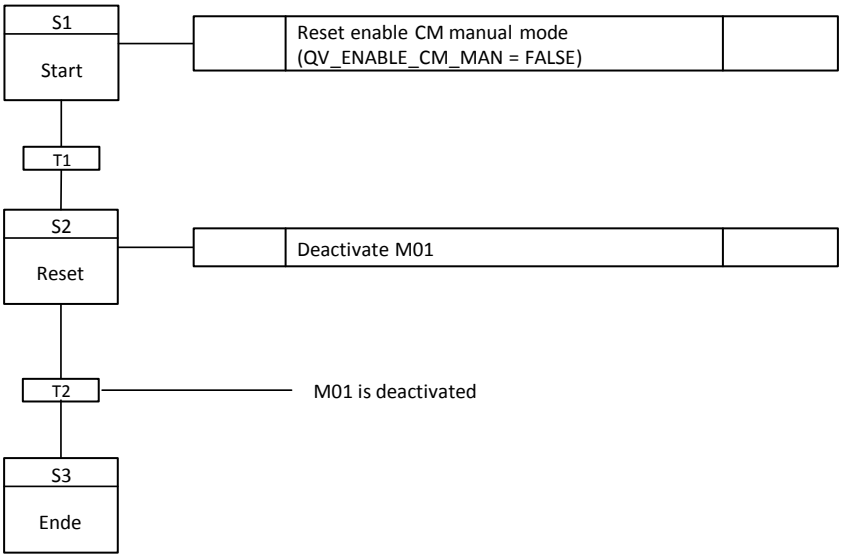
The "NS01" agitator motor is switched on when the machine is on. If the agitator motor "NS01" is running, then there are two possibilities:

1. Continuous agitation if agitation time (SP_AGIT_TIME) = 0.
   The operating mode can be terminated or restarted by a manual operation or a superimposed control (SIMATIC BATCH).
2. Agitation after time, if agitation time (SP_AGIT_TIME) > 0.
   When the agitation time has elapsed, the agitator motor "NS01" is switched off.



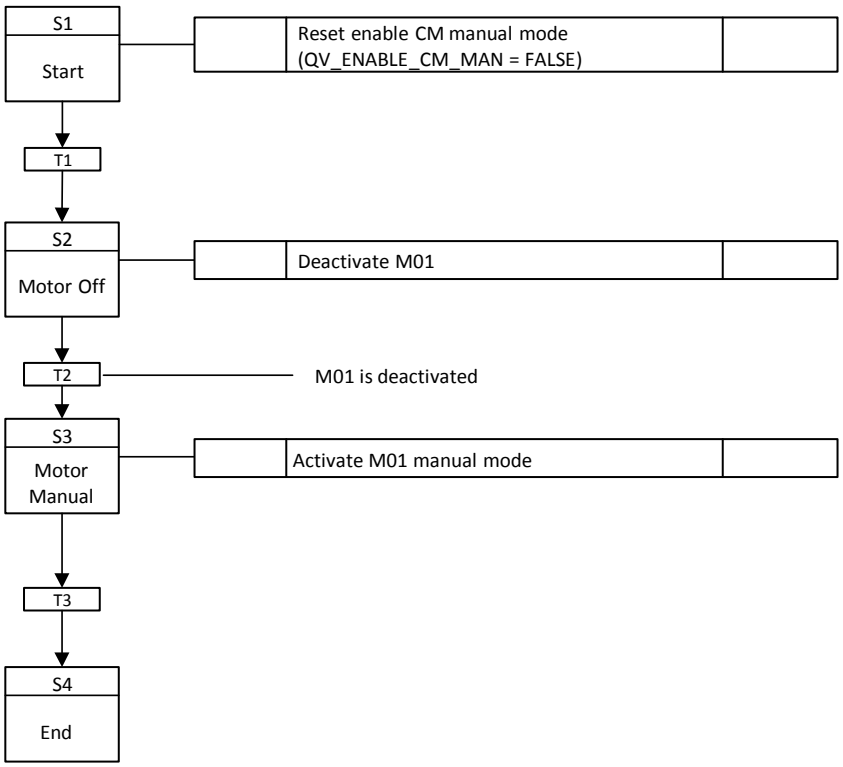
Operating state: Completing

In the "Start" step, the release for manual operation of the CMs is reset. If the agitator motor "NS01" is off, then the basic state (idle) is established.



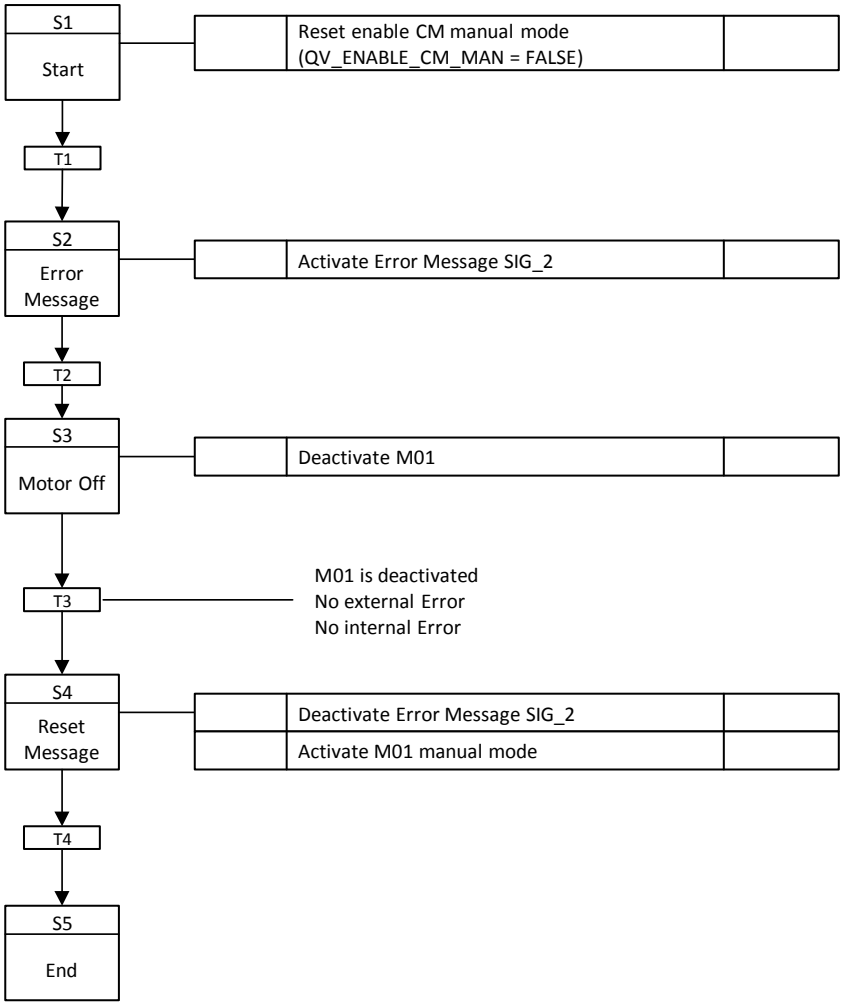
Operating state: Holding

In the "Start" step, the release for manual operation of the CMs is reset. In the "Holding" state, the "NS01" agitator engine is switched off and then switched to manual operation. The "Holding" state is used to set the "Held" state.



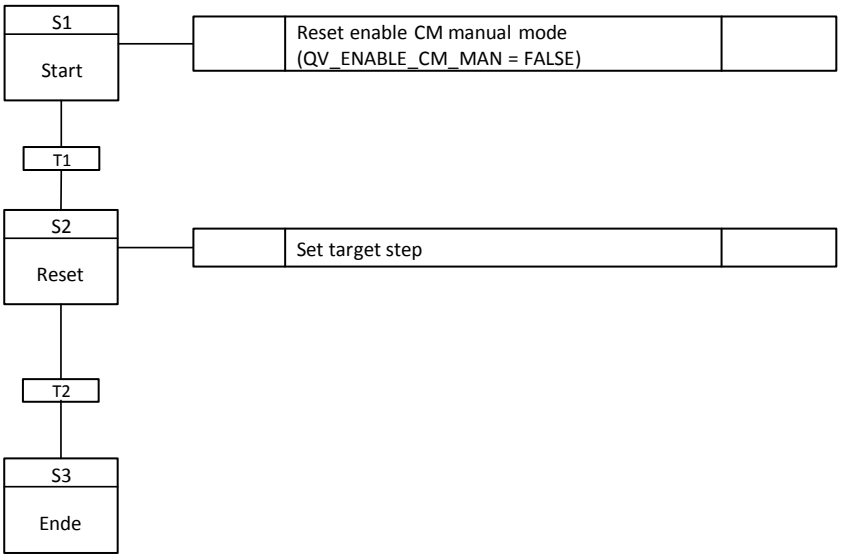
Operating state: Error (holding (error))

The " Holding (error) " state is reached by an extreme event (locking). In the "Start" step, the release for manual operation of the CMs is reset. The "NS01" agitator engine is switched off in the "Holding (error)" state. An error message is sent. Then the agitator engine "NS01" is put into manual operation.
The "Held (error)" state is not activated until the error has been corrected.



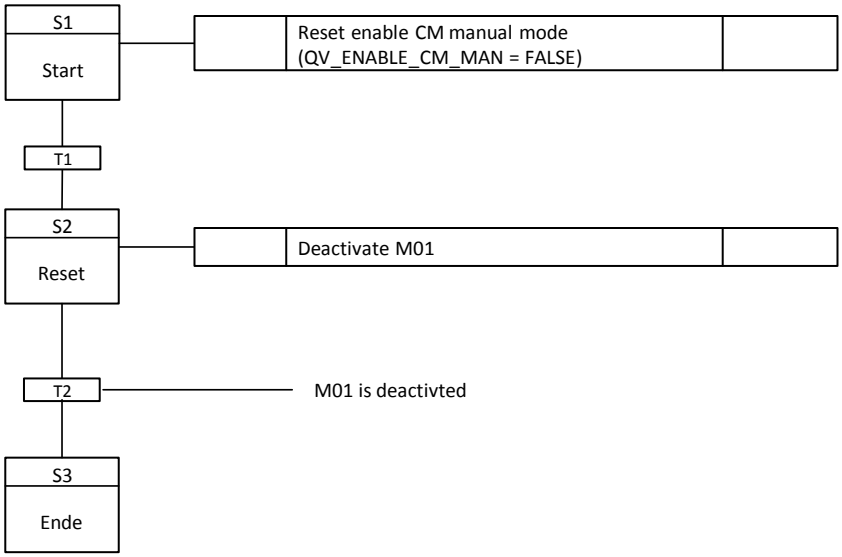
Operating state: Resuming

In the "Start" step, the release for manual operation of the CMs is reset. When a target step is saved, it continues from that point.
An error leads to a continuation lock. Resumption of the EM is possible only when continuation is not locked. The EPH can only be continued if there is no continuation lock.



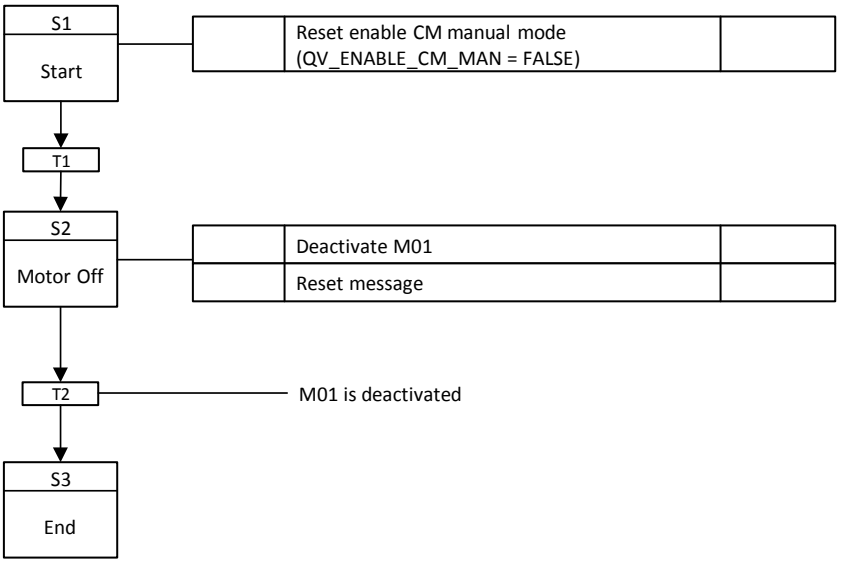
Operating state: Stopping

In the "Start" step, the release for manual operation of the CMs is reset. In the "Stopping" state, the "NS01" agitator engine is switched off. The basic state (idle) is set via the "Stopping" state.
The step chain is initialized (flags and times are reset).



Operating state: Aborting

In the "Start" step, the release for manual operation of the CMs is reset.
In the "canceling" state, the agitator engine "NS01" is switched off.
The "Cancelling" state is used to set the idle state.



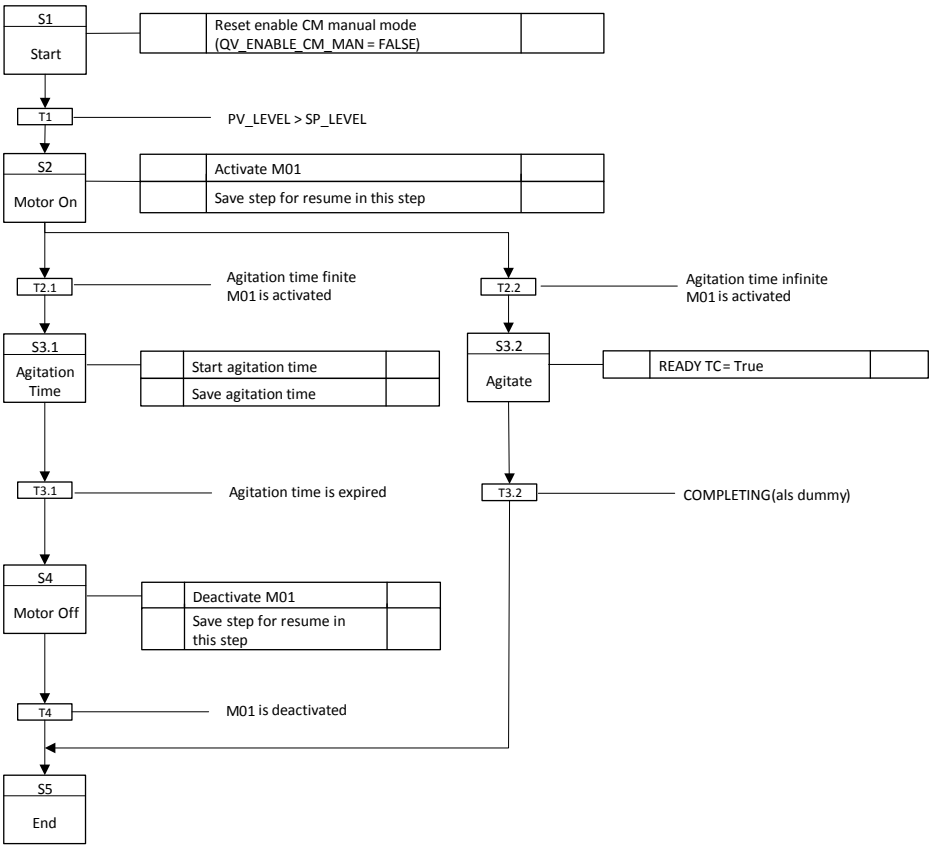
Operating mode II – "With level monitoring"

Operating state: Run (active)

The "NS01" agitator engine is switched on in the operating mode after the fill level has been checked.

If the agitator motor "NS01" is running, then there are two possibilities:

1. Continuous agitation if agitation time (SP_AGIT_TIME) = 0.
   The operation mode is terminated by a manual operation or by a superimposed control (SIMATIC Batch).
2. Agitation after time, if agitation time (SP_AGIT_TIME) > 0.
   Once the agitation time has elapsed, the "M01" agitator engine is switched off.



4.3.2 "Discharge" - parameters and operation methods

Control parameter

Name	Unit	Operable state Running	Control strategy										Comment
			1	2	3	4	5	6	7	8	9	10	
Circulation_Time (SP_CIRC_TIME)	min				x								Circulation time in minutes
Discharge_Amount	l		x										Quantity to be delivered

Process values (PV_xy)

Name	Data type	Unit	Connection name	Comment
Circulation_Time_Sec	Analog	sec	PV_TANK_CIRC_TIME_SEC	Recalculated circulation time in seconds
Settle_Time_Sec	Analog	sec	PV_SETL_TIME	Calculated follow-up time in seconds
Tank_Number_OK	Binary		PV_TANK_NO_OK	Requirement from EPH "Dosing"
Tank_Empty	Binary		PV_TANK_EMPTY	Container is empty

Parameter (IN_xy)

Name	Data type	Unit	Connection name	Comment
Settling_Time	Analog	sec	IN_SETTLE_TIME	Follow-up time during emptying

Control values (QV_xy)

Name	Data type	Connection name	Comment
Enable_CM_Manual	Binary	QV_EN_CM_MAN	Release for operating mode change in hand for all CMs
Enable_CS	Integer	QV_EN_CS	Enable change of operating mode
Start_Circ_Time	Binary	QV_START_CIRC_TIME	Start command external time counter
Reset_Circ_Time	Binary	QV_RESET_CIRC_TIME	Reset external timers
Start_Settle_Time	Binary	QV_START_SETTL_TIME	Start command external time counter
Reset_Settle_Time	Binary	QV_RESET_SETTL_TIME	Reset external timers
Settle Time	Real	QV_SETTLE_TIME	Follow-up time in seconds

Position texts

Number	Text
1	Idle
100	Start
101	Reset
102	Check_Vessel
103	Open Route
104	Error
201	Enable_Control_Strategy
202	Start_Timer
301	Pump_On
401	Pump_Off
402	Close_Valve
403	Stop_Timer
404	Enable_Manual
405	Disable_Manual
501	CMs_Off (switch off individual controls)
502	Aborted
503	Completed

connections

Name	Data type	Comment
IN_CSEnableIDLE	DWord	Specifies which operating modes can be jumped to from IDLE.
IN_CSEnableCS1	DWord	Indicates into which operating modes you are allowed to jump from operating mode 1
IN_CSEnableCS2	DWord	Specifies into which operating modes you are allowed to jump from operating mode 2.
IN_CSEnableCS3	DWord	Specifies into which operating modes the user is allowed to jump from operating mode 3.

Standard SFC type messages

Number	Type	Text
SIG_1	Fault	Step execution time exceeded
NSIG_1	Operating requirements - general	Operator prompt - (Operating requirements)
NSIG_2	Status message - AS	Active
NSIG_3	Status message - AS	Completed
NSIG_4	Status message - AS	Held
NSIG_5	Status message - AS	Aborted
NSIG_6	Status message - AS	Ready to complete
NSIG_7	Status message - AS	Stopped
NSIG_8	AS control technology Message - error	Error
NSIG_9	Status message - AS	Manual
NSIG_10	Status message - AS	Not released for SIMATIC BATCH
NSIG_11	Status message - AS	Execution time exceeded

Free messages

Number	Type	Text
SIG_2	Alarm on top	Interlock failure
SIG_3	Alarm on top	Tank Empty
SIG_4		
SIG_5		
SIG_6		
SIG_7		
SIG_8		
NSIG_12	Status message - AS	
NSIG_13	Status message - AS	
NSIG_14	Status message - AS	
NSIG_15	Status message - AS	
NSIG_16	Status message - AS	

Summarizing states

The following table illustrates which sequence chains correspond to each other in the operating modes.

Status	Operating mode I Discharge	Operating mode II Drain	Operating mode III Circulation
Starting	X	X_1	X_1
Active	X	X_1	X_1
Completing	X	X_1	X_1
Completed			
Holding	X	X_1	X_1
Held	X	X_1	X_1
Holding error	X	X_1	X_1
Held error	X_{Held}	X_1	X_1
Resuming	X	X_1	X_1
Resuming error	$X_{Resuming}$	X_1	X_1
Stopping	$X_{Completed}$	X_1	X_1
Stopped			
Aborting	X	X_1	X_1
Aborted			

Legend

X : Sequencer exists

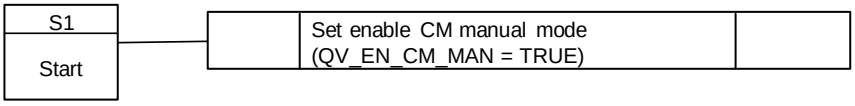
X_1 : Same as sequencer in operating mode I

X_{Held} : Same as "held" state in the same operating mode

Operating state: Idle (Ready)

The EPH can only be started if there is no switch-on inhibit.

Manual operation of the CMs in idle mode is possible.

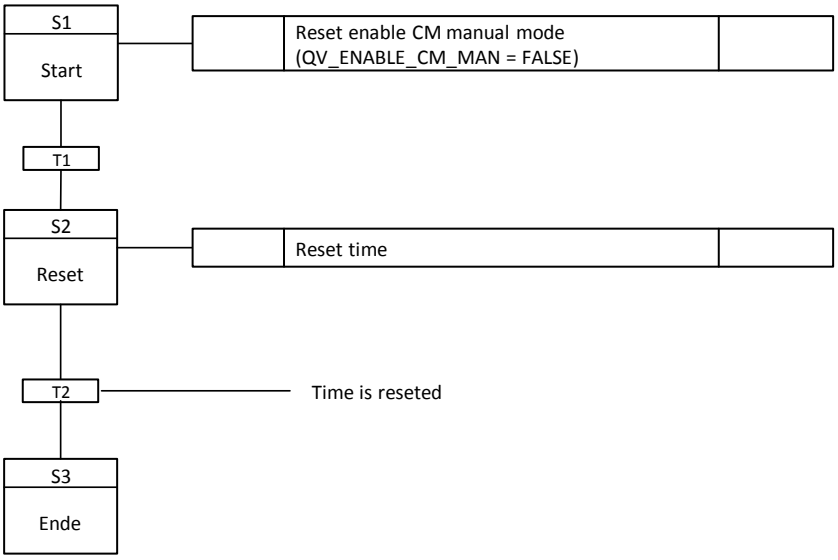


Operating mode I – "Discharge"

Operating state: Starting

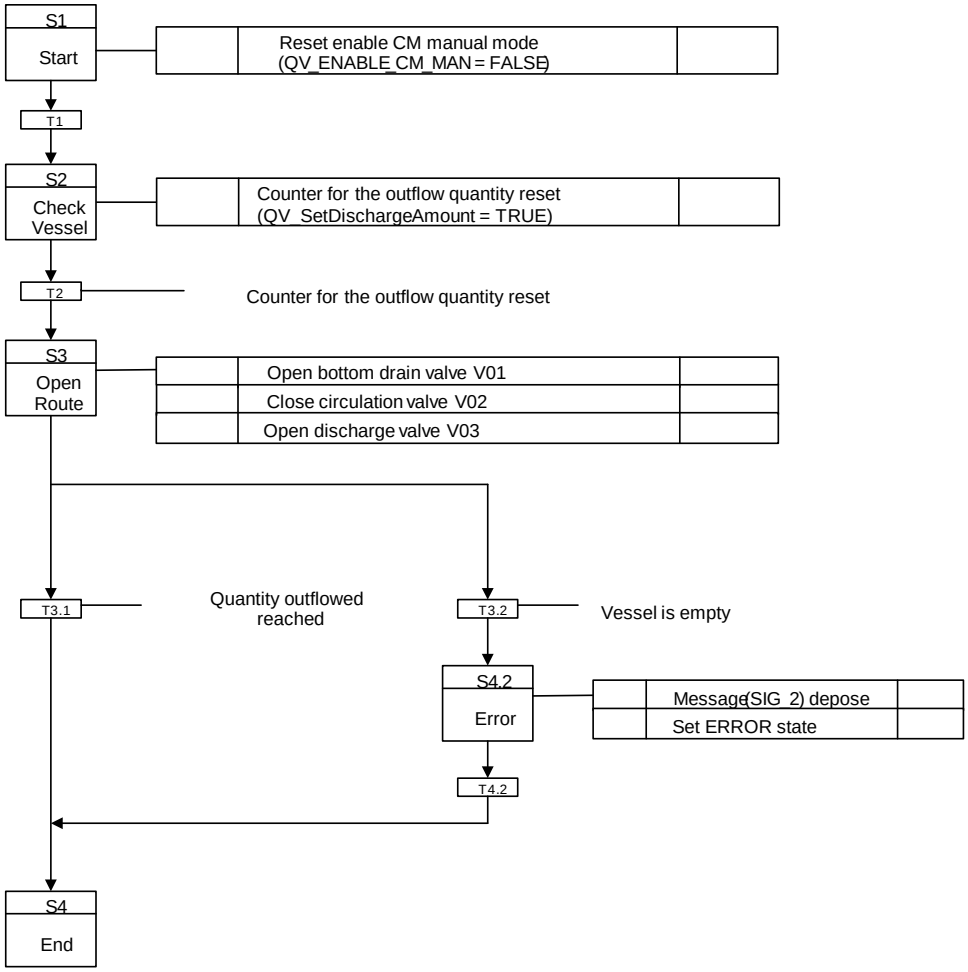
In the "Start" step, the release for manual operation of the CMs and the release for active change of operating modes is reset (ENASTART = FALSE).

In the "Starting" state, the EPH is initialized, i.e. all times are reset.



Operating state: Run (active)

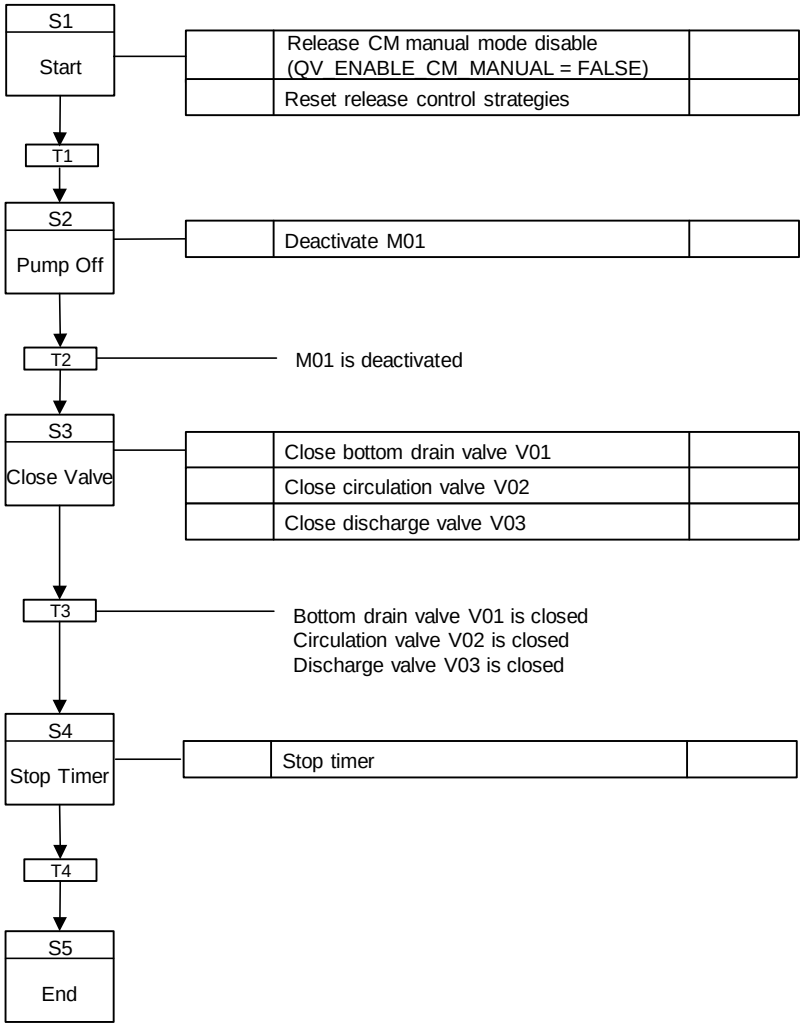
In the "Active" state, the counter for the outflowed quantity is reset (PV_TANK_NO_OK = TRUE).
When the counter is reset, the pump-over valve "YS12" is closed, the bottom drain valve "YS11" and the drain valve "YS13" are opened. When "YS12" is closed and "YS11" and "YS13" are open, the delivery starts. It runs until the expired quantity is reached (PV_TANK_NO_OK = FALSE).
If the tank is empty before the request is reset (PV_TANK_EMPTY = TRUE), the message "SIG_2" is output and the EPH goes into the "Error" state.



Operating state: Completing

In the "Start" step, the release for manual operation of the CMs and the release for active change of operating modes is reset (ENASTART = FALSE).

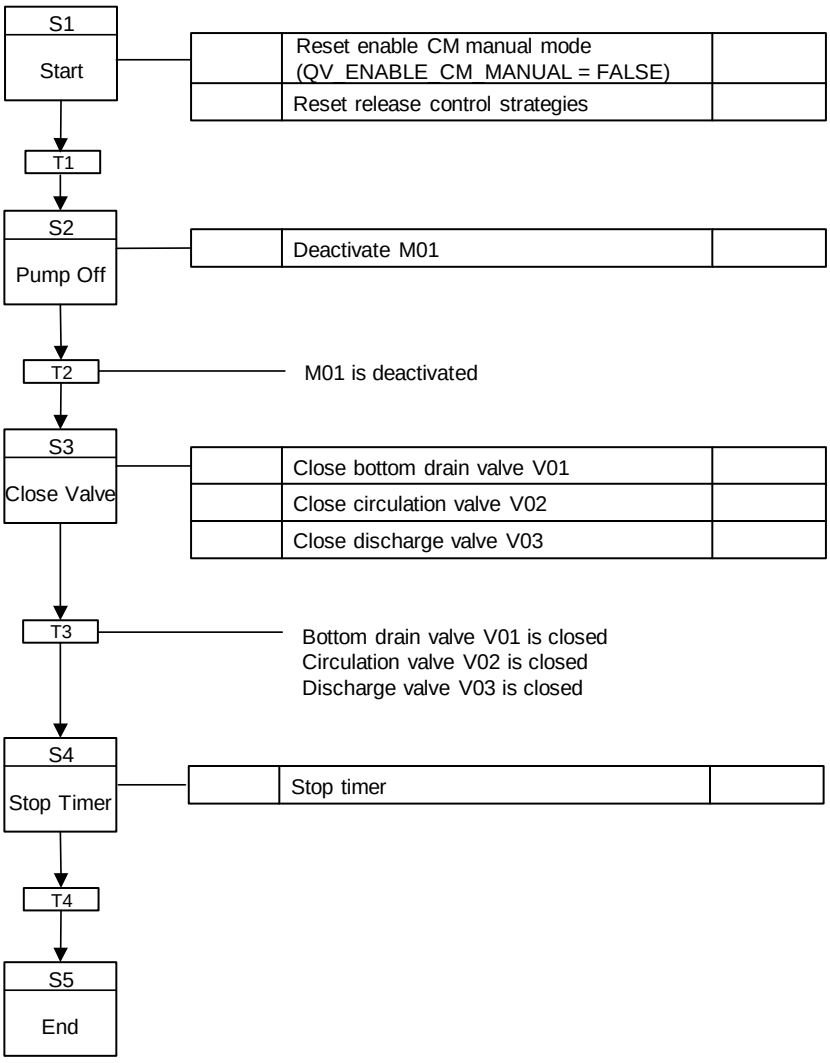
The "NS11" pump is switched off and all valves are then closed. Then the basic state (idle) is set via the "completed" state.



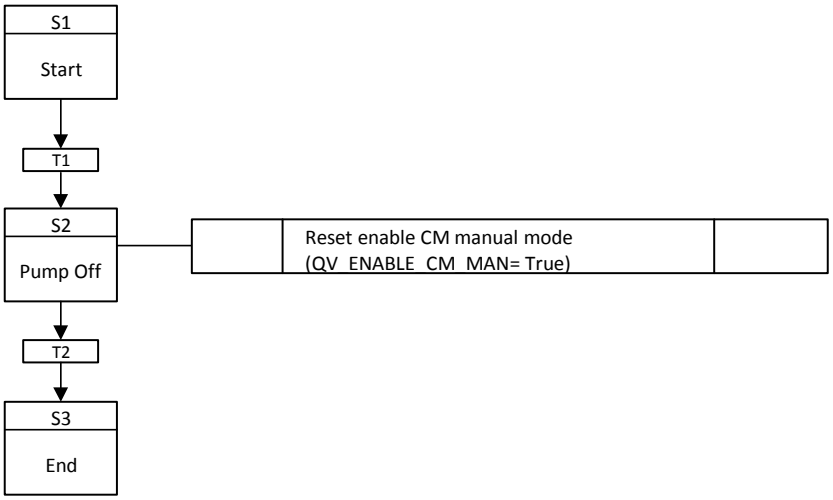
Operating state: Holding

In the "Start" step, the release for manual operation of the CMs and the release for active change of operating modes is reset (ENASTART = FALSE).
In the "Holding" state, the "NS11" pump is switched off. When the pump is off, all valves are closed and then the times are stopped.

The "Holding" state is used to set the "Held" state.



Operating state: Held



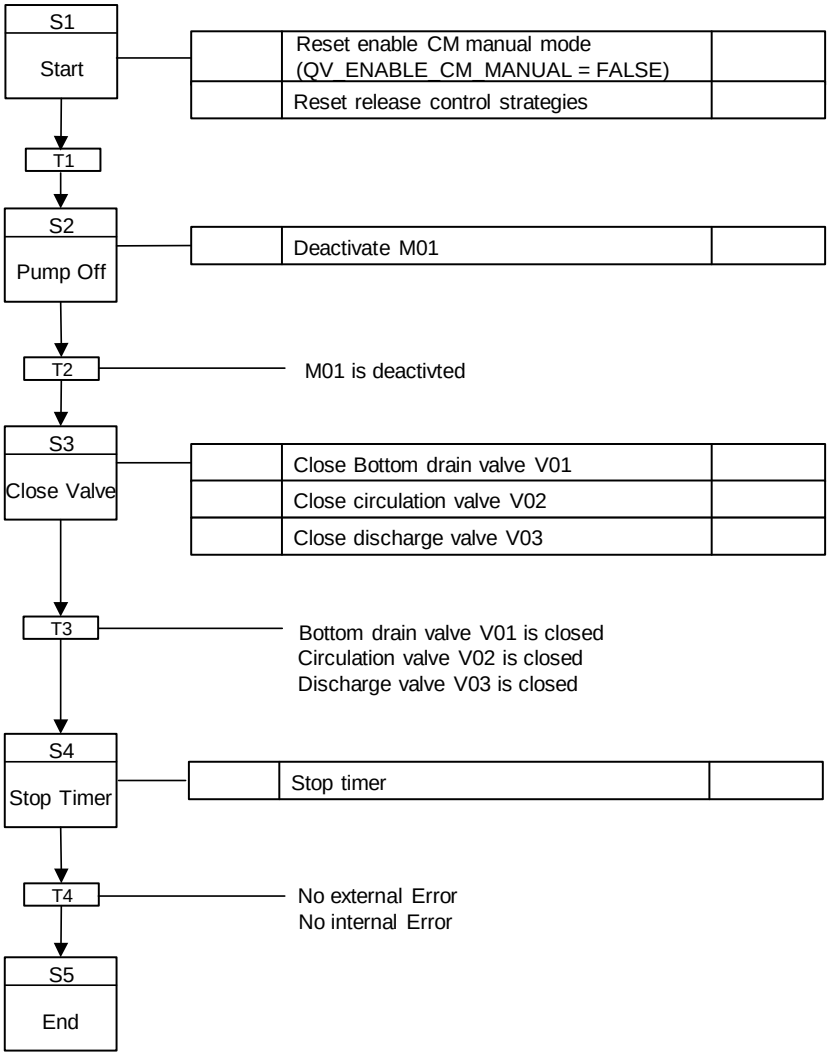
Operating state: Error (Holding error)

The "Holding (error)" state is achieved by an external event (interlock) or by an internal "Error" command.

In the "Start" step, the release for manual operation of the CMs and the release for active change of operating modes is reset (ENASTART = FALSE).

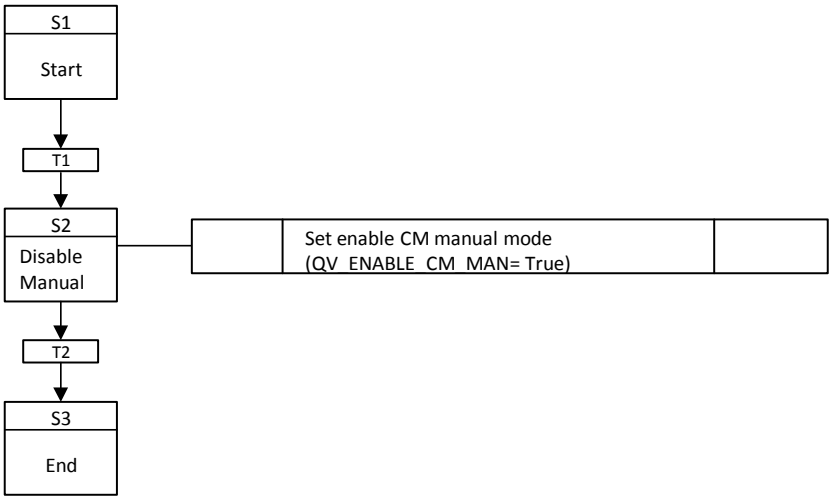
In the holding (error) state, the pump NS11 is turned off. When the pump is off, all valves are closed and then the times are stopped.

If the error is no longer pending, the held (error) state is set after the holding (error) state.



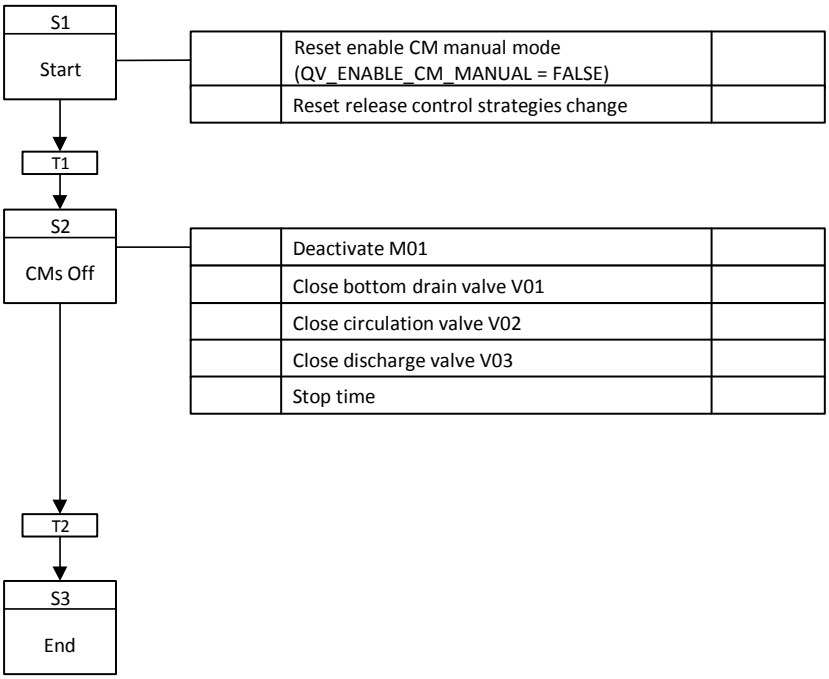
Operating state: Resuming

In the "Disable Manual" step, the release for manual operation of the CMs is reset.
The "Continuing" state is used to set the "Active" state again.
Active sequencer starts again from the "Start" step.



Operating state: Aborting

In the "Start" step, the release for manual operation of the CMs and the release for active change of operating modes is reset (ENASTART = FALSE).
In the "canceling" state, the pump "NS11" is switched off, the valves closed and the times stopped. The "Cancelling" state is used to set the idle state.



Operating mode II – "Drain"

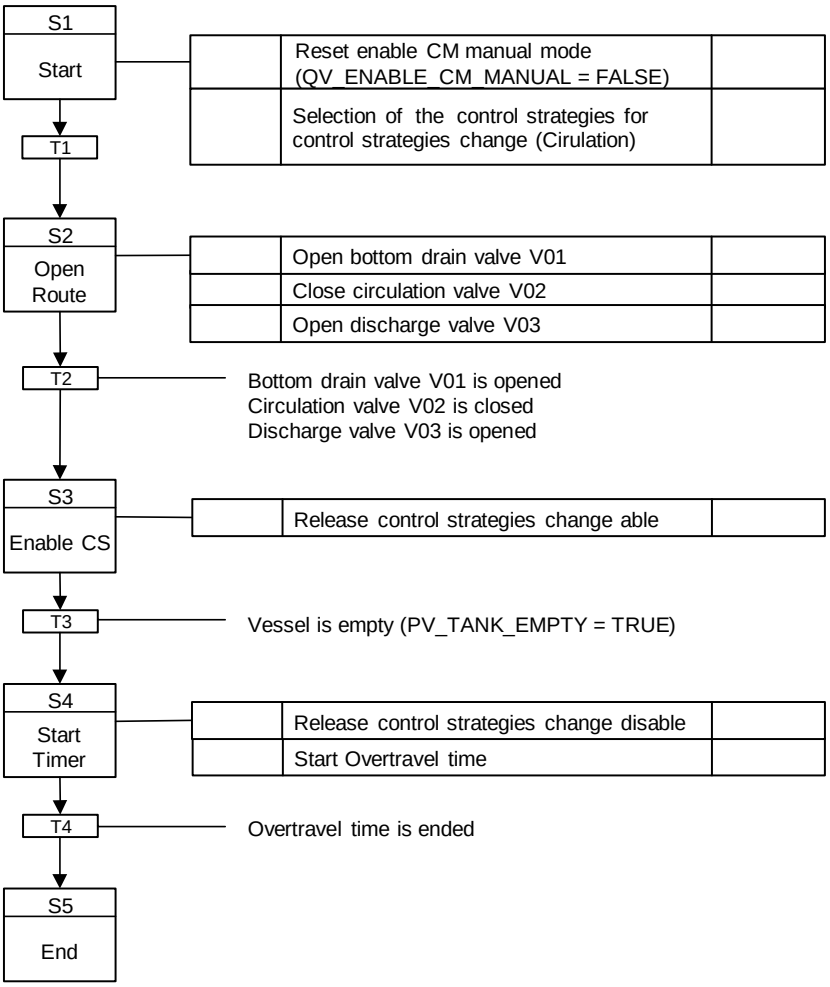
Operating state: Run (active)

In the "Active" state, the "YS12" pump-over valve is closed, the "YS11" bottom outlet valve and the "YS13" drain valve are opened.
If "YS12" is closed and "YS11" and "YS13" are open, then the pump "NS11" is switched on.

If the tank is empty (PV_TANK_EMPTY = TRUE), the Settling_Time is started to empty the tank completely.

If the operation mode is not changed, the operation mode is terminated after the tank has been completely emptied.

It is possible to change to the "pump over" mode of operation.

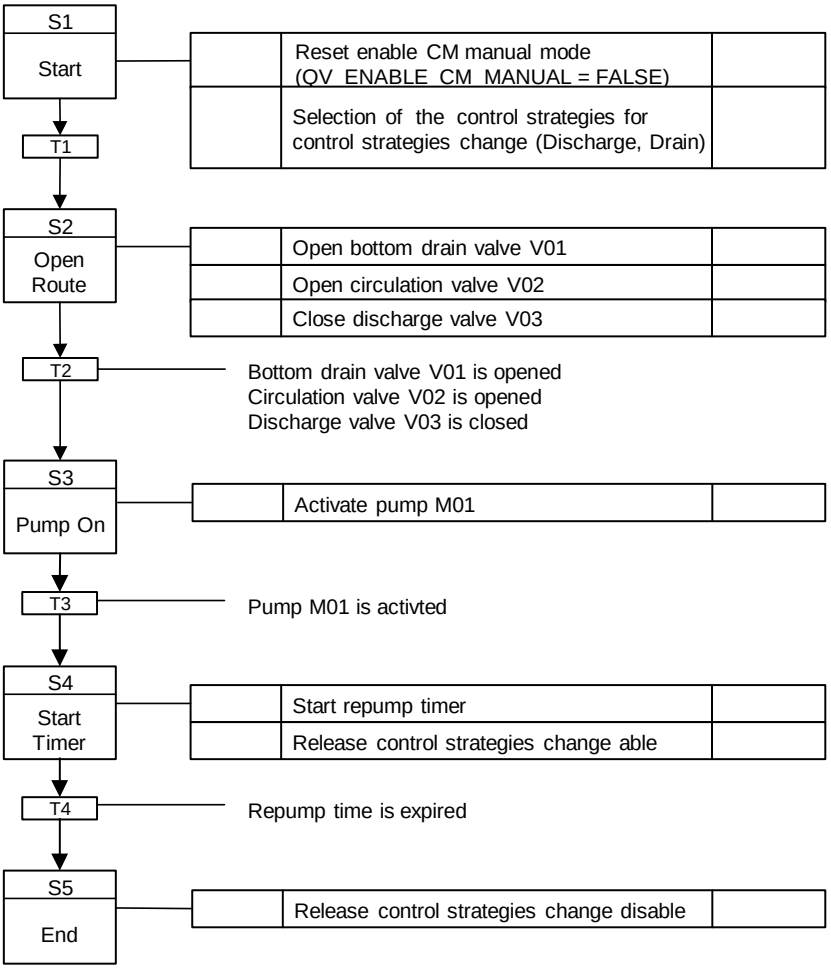


Operating mode III – Circulation

Operating state: Run (active)

In the "Active" state, the "YS12" pump over valve and the "YS11" bottom outlet valve are opened and the "YS13" outlet valve is closed. If "YS11" and "YS12" are open and "YS13" is closed, then the pump "NS11" is started. If the pump is on, the circulation time is started. On expiry of the circulation time, the bottom drain valve YS11 is closed and the control strategy completed.

You can change to the "Discharge" or "Drain" operating modes.



4.3.3 "Dosing Control Valve" - Parameters and operating mode

Control parameters (SP_)

Name	Unit	Operable state Running	Control strategy										Comment
			1	2	3	4	5	6	7	8	9	10	
CoarseFlow (SP_FLOW)	l/min		X	X		X							Flow rate coarse dosing
FineFlow (SP_MIN_FLOW)	l/min		X	X		X							Flow rate fine dosing
Tolerance (SP_TOLERANCE)	l			X									Filling tolerance
Level (SP_LEVEL)	l			X		X							Level (Setpoint)
Amount (SP_AMOUNT)	l		X										dosing volume
Tank_Number (SP_TANK_NO)			X	X	X	X							Container number

Process values (PV_xy)

Name	Data type	Unit	Connection name	Comment
Actual_Amount	Analog	l	SP_AMOUNT_AI	Actual amount dosed into the tank
Actual_Flow	Analog	l/min	SP_FLOW_AI	Actual flow rate
Actual_Level	Analog	l	SP_LEVEL_AI	Actual tank level
Actual_Remaining	Analog	l	PV_AM_REM	Amount still to be dosed
Level_High_Limit	Binary		PV_LVL_HL	Upper limit reached
Level_Low_Limit	Binary		PV_LVL_LL	Lower limit reached

Parameter (IN_xy)

Name	Data type	Unit	Connection name	Comment
Min_Coarse_Flow	Analog	l/min	IN_MIN_COARSE_FILL	Minimum flow rate for coarse filling
Switch_Fine_Filling	Analog	l	IN_FINE_FILL_SW	From this quantity on, the system switches to fine filling.
Min_Fine_Filling	Analog	l/min	IN_MIN_FINE_FILL	Target flow rate for fine filling
Max_Tank_Level	Analog	l	IN_MAX_TANK_LEVL	Maximum level when filling
Flow_Fine_Dosing	Analog	l/min	IN_FINE_DOSE	Target flow rate for fine dosing
Settling_Time	Analog	sec	IN_SETL_TIME	Settling time after which the tank level is measured
Switch_Fine_Dosing	Analog	l	IN_FINE_DOSE_SW	From this quantity on, the system switches to fine dosing.
Switch_Max_Level	Binary		IN_MAX_SW	Switching point maximum container level reached while standing still
Switch_Fine_Level	Binary		IN_FINE_SW	Switching point for fine filling while standing still

Timer

Name	Connection name	Comment
Settling_Timer	TI_SETL	Timer for controlling the settling time (off-delayed)
Flow_Min_Time	TI_FMIN	Override of the flow monitoring

Markers (FL_xy)

Name	Data type	Connection name	Comment
Fill_Max_Error	Binary	FL_FILL_ERROR	Markers: Maximum filling level was exceeded during filling

Control values (QV_xy)

Name	Data type	Connection name	Comment
Enable_CM_Manual	Binary	QV_EN_CM_MAN	Enable to switch to manual mode for all CMs
Actual_Tank_Number	String	QV_TANK_NO	Current tank number

Position texts

Number	Text
101	Start
102	Reset
103	Open_Valve

Number	Text
104	Pump_On
105	Dosing
106	Error
107	Fine_Dosing
201	Filling
202	Fine_Filling
203	Settling Time
301	Ctrl_Manual
403	Ctrl_Off
404	Pump_Off
405	Close_Valve
406	Waiting
501	CMs Off
502	Enable_Manual
503	Disable_Manual
504	SetTargetStep

connections

Name	Data type	Connection name	Comment
SequenceFlag	Byte	FL_SEQ	Stored sequencer
StepFlag	Word	FL_STEP	Stored step

Standard SFC type messages

Number	Type	Text
SIG_1	Fault	Step execution time exceeded
NSIG_1	Operating requirements - general	Operator Prompt
NSIG_2	Status message - AS	Active
NSIG_3	Status message - AS	Completed
NSIG_4	Status message - AS	Held
NSIG_5	Status message - AS	Aborted
NSIG_6	Status message - AS	Ready to complete
NSIG_7	Status message - AS	Stopped
NSIG_8	AS control technology Message - error	Error
NSIG_9	Status message - AS	Manual
NSIG_10	Status message - AS	Not released for SIMATIC BATCH
NSIG_11	Status message - AS	Execution time exceeded

Free messages

Number	Type	Text
SIG_2	Alarm on top	Interlock failure
SIG_3		
SIG_4		
SIG_5		
SIG_6		
SIG_7		
SIG_8		
NSIG_12	Status message - AS	
NSIG_13	Status message - AS	
NSIG_14	Status message - AS	
NSIG_15	Status message - AS	
NSIG_16	Status message - AS	

Summarizing states

The following table illustrates which sequence chains correspond to each other in the operating modes.

Status	Operating mode I Dosing	Operating mode II Filling	Operating mode III Rinsing	Operating mode III Level_Control
Starting	X	X_1	X_1	X_1
Active	X	X	X	X
Completing	X	X_1	X_1	X_1
Completed				
Holding	X	X_1	X_1	X_1
Held		X_1	X_1	X_1
Holding error	$X_{Holding}$	X_1	X_1	X_1
Held error	X_{Held}	X_1	X_1	X_1
Resuming	X	X_1	X_1	X_1
Resuming error	$X_{Resuming}$	X	X_1	X_1
Stopping	$X_{Completed}$	X_1	X_1	X_1
Stopped				
Aborting	X	X_1	X_1	X_1
Aborted				

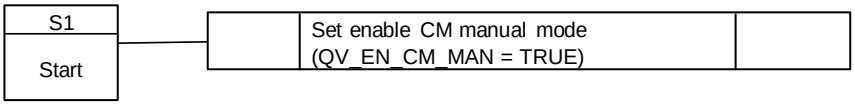
Legend

X : Sequencer exists

X_1 : Same as sequencer in operating mode I

Operating state: Idle (Ready)

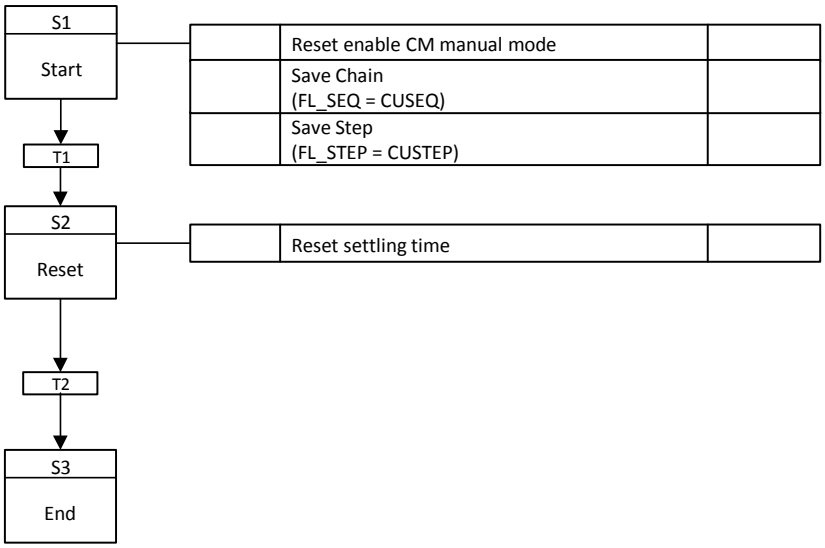
Enable switching to manual mode for all CMs
Manual operation of the CMs in idle mode is possible.



Operating mode I – "Dosing"

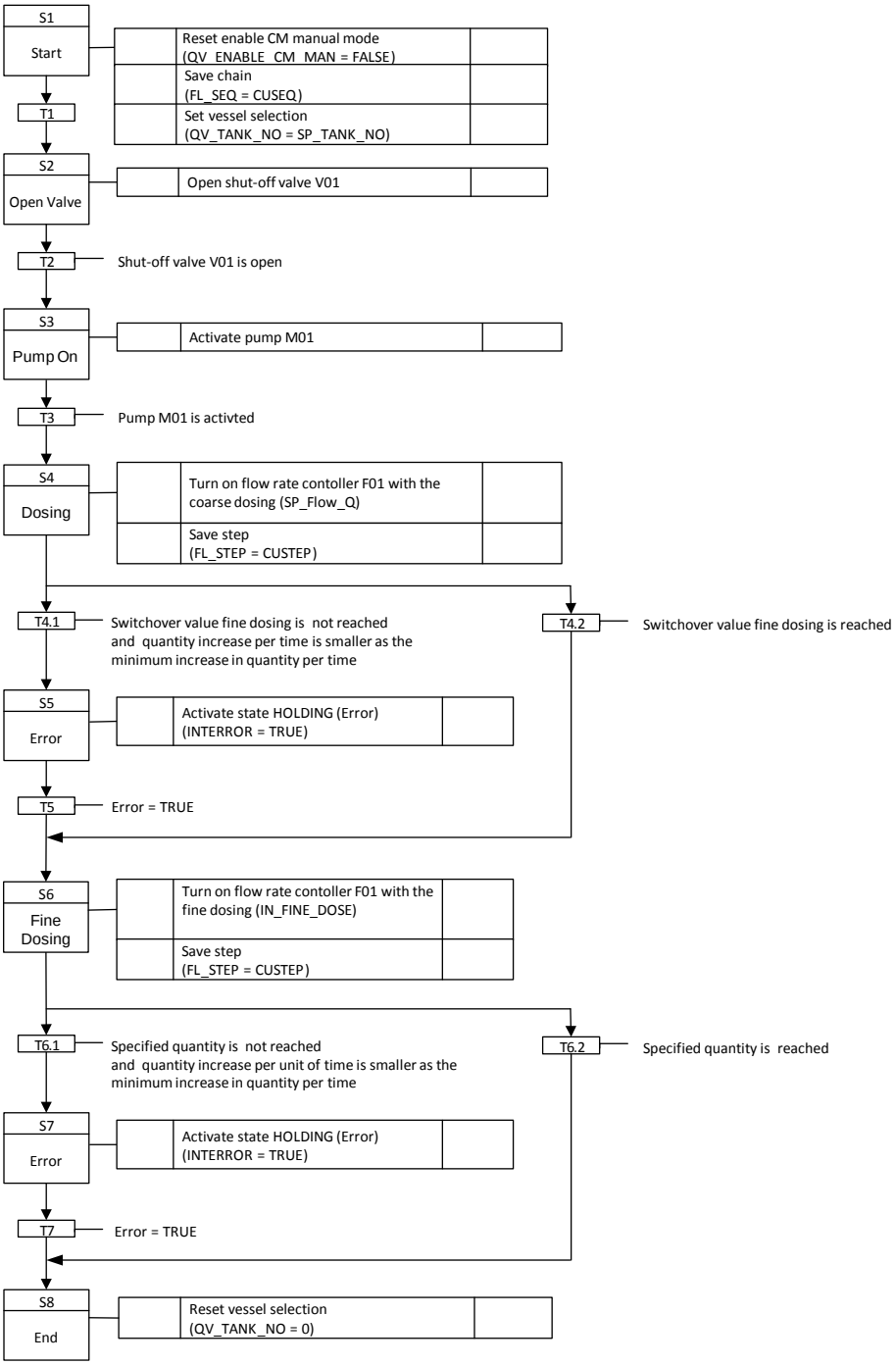
Operating state: Starting

In the "Start" step, the release for manual operation of the CMs is reset. In the "Starting" state, the EPH is initialized and the settling time is reset.



Operating state: Run (active)

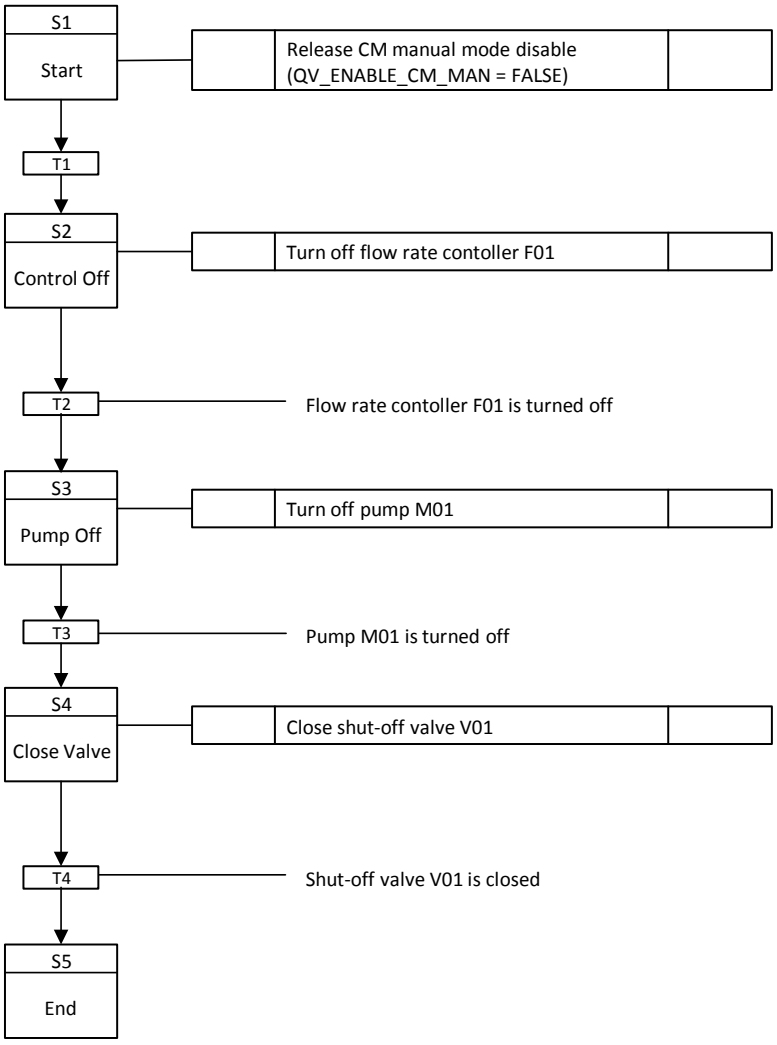
In the "Active" state, first open the shut-off valve "YS21" and then switch on the pump "NS21" so that the dosing path is set.
The product is first dosed with a coarse dosing unit. To do this, start the flow controller "F21" with the flow rate "Coarse dosing (SP_FLOW)". When the batched quantity (SP_AMOUNT_AI) reaches the switchover value "fine dosing (IN_FINE_DOSE_SW)", the flow controller controls the flow rate "fine dosing (IN_FINE_DOSE)" and fine dosing is active. If during the dosing phases (coarse dosing, fine dosing) the value falls below the setpoint "minimum flow increase per time unit (SP_MIN_FLOW)", the state "Holding (error)" is set. When the preset amount (SP_AMOUNT) is reached, fine dosing and operating mode are ended automatically.



Operating state: Completing

In the "Start" step, the release for manual operation of the CMs is reset.

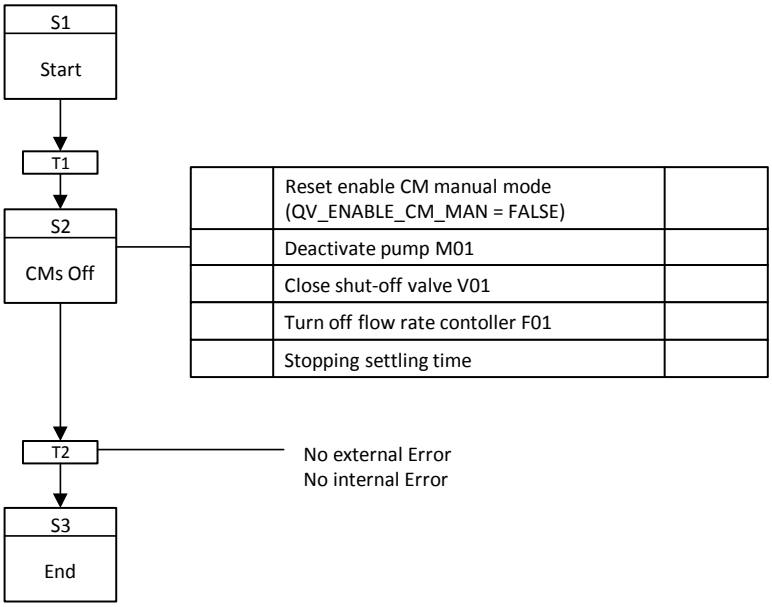
In the "Completing" state, the flow controller "F01" and then the pump "M01" are switched off. The shut-off valve "V01" is closed as soon as the pump is off. When the shut-off valve is closed, the basic state (idle) is set via the "Completed" state.



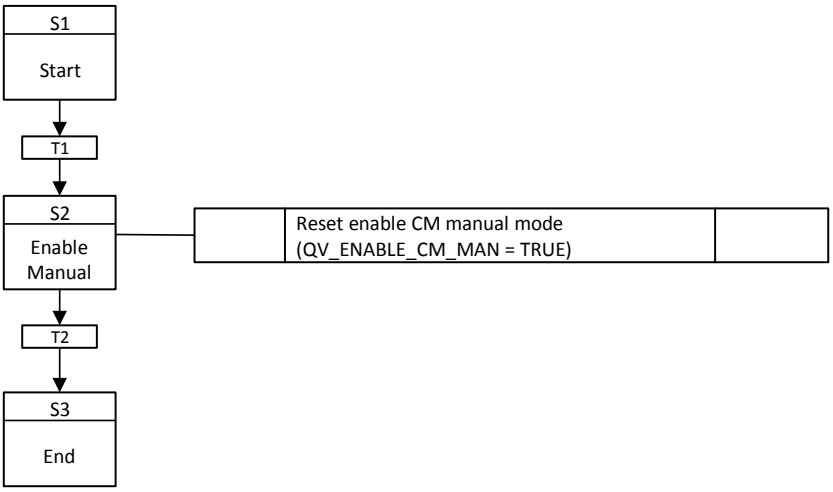
Operating state: Holding

In the "Start" step, the release for manual operation of the CMs is reset.

In the "Holding" state, the pump "M01" and the flow controller "F01" are switched off, the shut-off valve "V01" is closed and the settling time is stopped. If no more errors are present, the "Holding" state is used to set the "Holding" state.



Operating state: Held

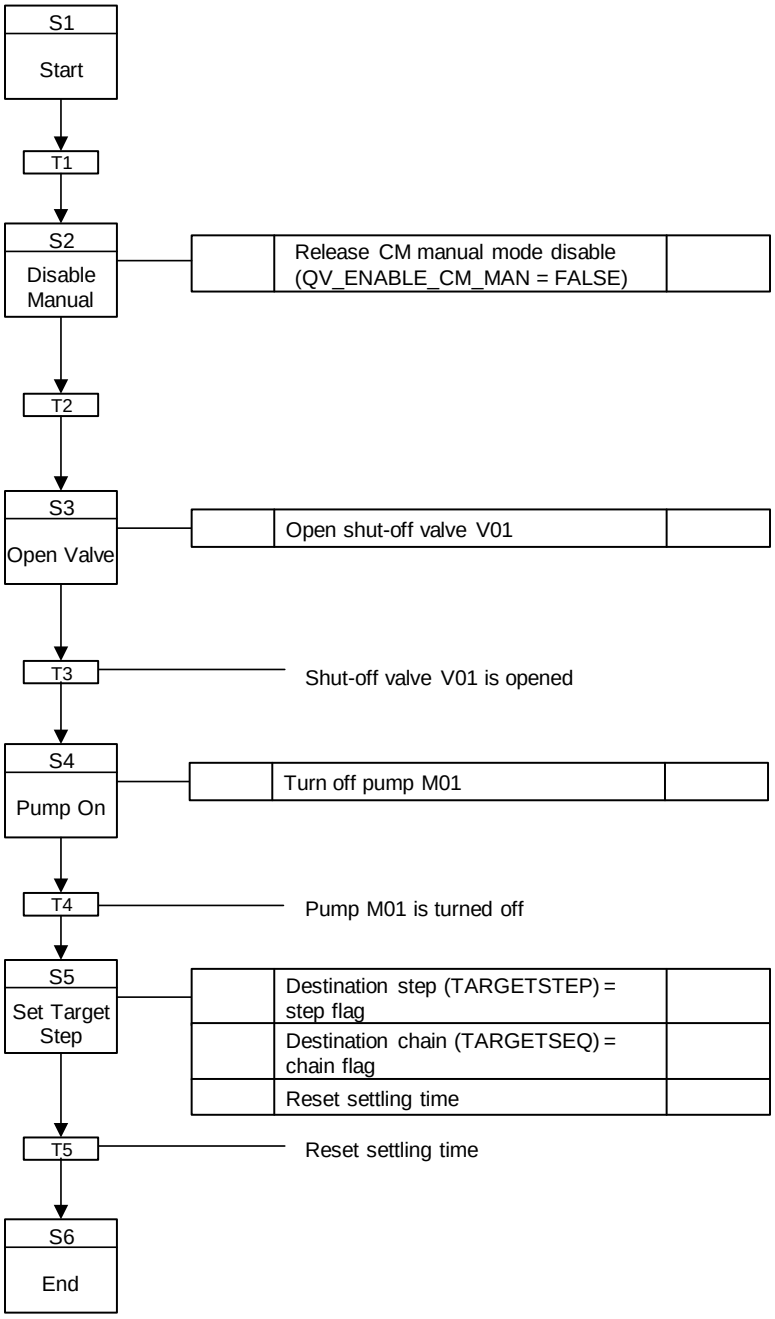


Operating state: Resuming

In the "Disable Manual" step, the release for manual operation of the CM is reset.

In the "Continuing" state, first the shut-off valve "V01" is opened and then the pump "M01" is switched on. When the pump is switched on, the set step of the active step chain is set and the settling time is reset.

The "Continuing" state is used to set the "Active" state again.

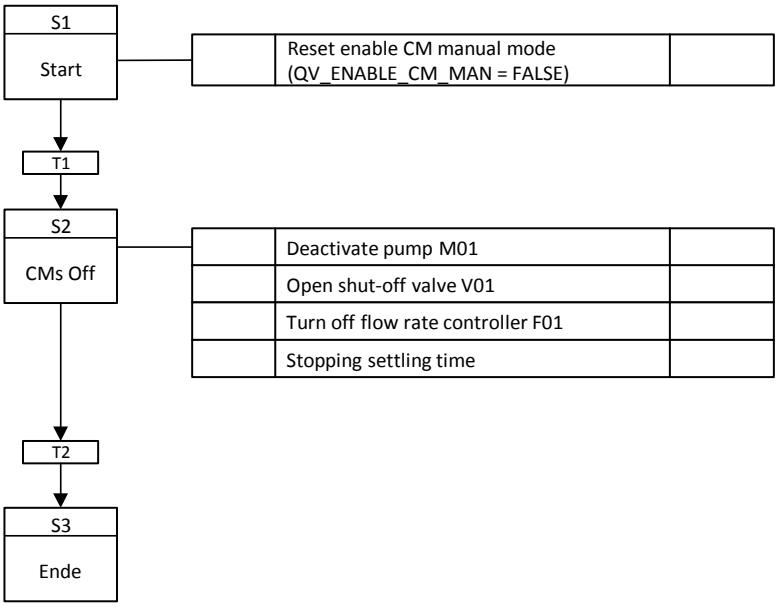


Operating state: Aborting

In the "Start" step, the release for manual operation of the CMs is reset.

In the "Holding" state, the pump "M01" and the flow controller "F01" are switched off, the shut-off valve "V01" is closed and the settling time is stopped.

The "Cancelling" state is used to set the idle state.



Operating mode II – "Filling"

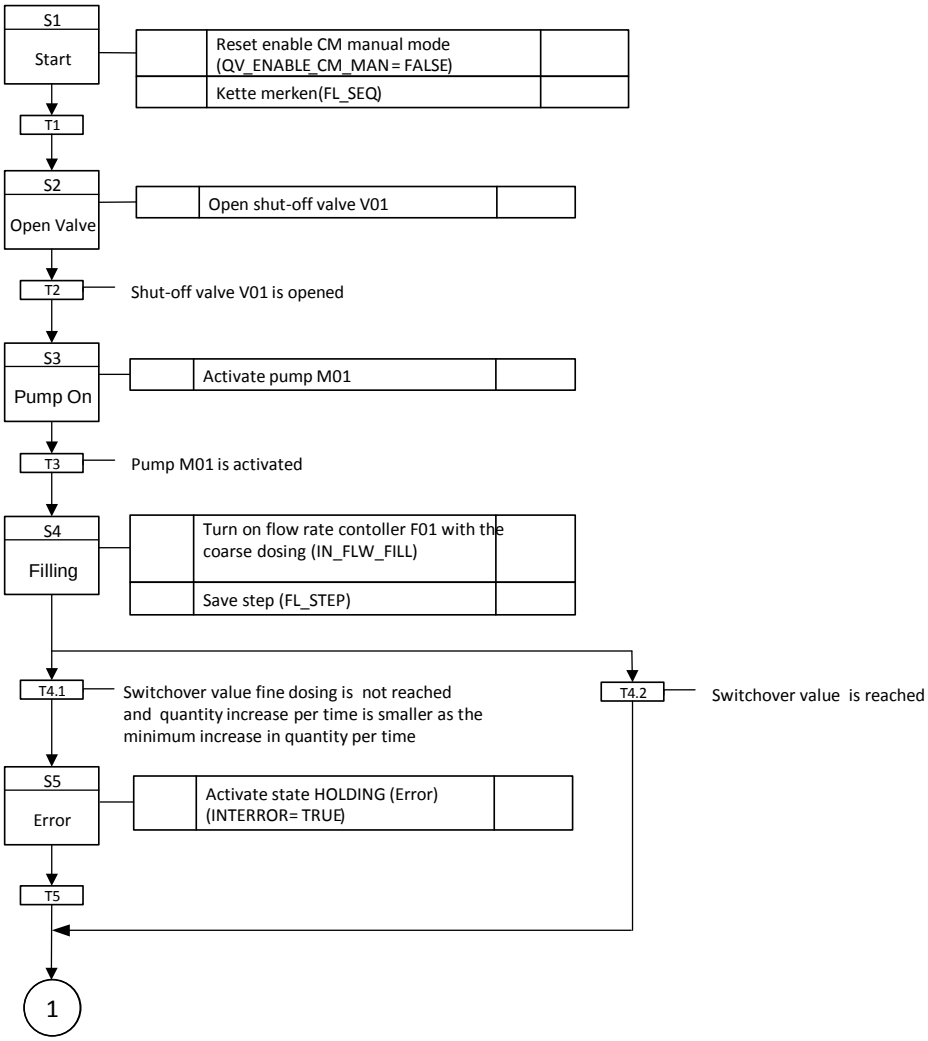
Operating state: Run (active)

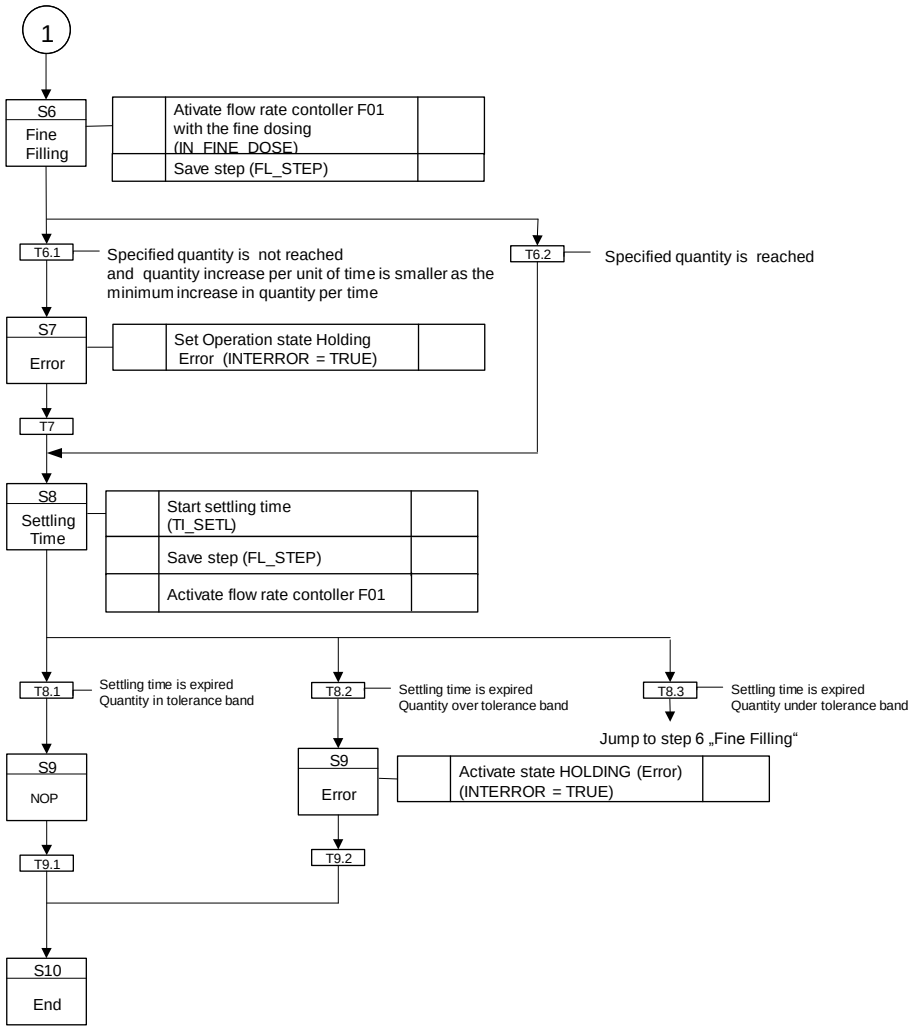
In the "Active" state, first the shut-off valve "V01" is opened and then the pump "M01" is switched on so that the dosing path is set.

The tank is first filled with a coarse filling. To do this, start the flow controller "F01" with the flow parameter "Coarse filling (IN_FLW_FILL)". When the tank level (PV_LEVEL_AI) has reached the parameter "Changeover fine filling (IN_FINE_FILL_SW)", the flow controller changes to the flow parameter "Fine filling (IN_FLW_FINE_FILL)" and the fine filling is running.

If the "maximum tank level (IN_MAX_TANK_LEVL)" is then reached, filling is stopped and the flow controller is switched off. After a "settling time (TI_SETL)", an actual/setpoint comparison is performed. If the actual tank level is within a "tolerance band (SP_TOL)", the operation mode is automatically terminated. If the actual tank level is below the tolerance band, the "Filling" step is carried out again. If the actual container level is above the tolerance band, the " Holding (error) " state is set.

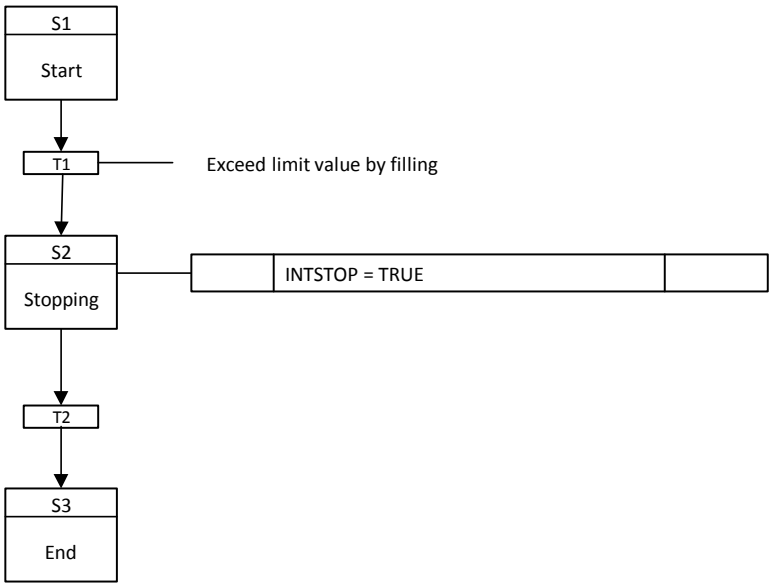
If during the filling phases (coarse filling, fine filling) the set point "minimum flow increase per time unit (SP_MIN_FLOW)" is not reached, the " Holding (error) " state is set.





Operating state: Resuming (Error)

If the limit value was exceeded during filling, the EPH is terminated via the "Stop" command.



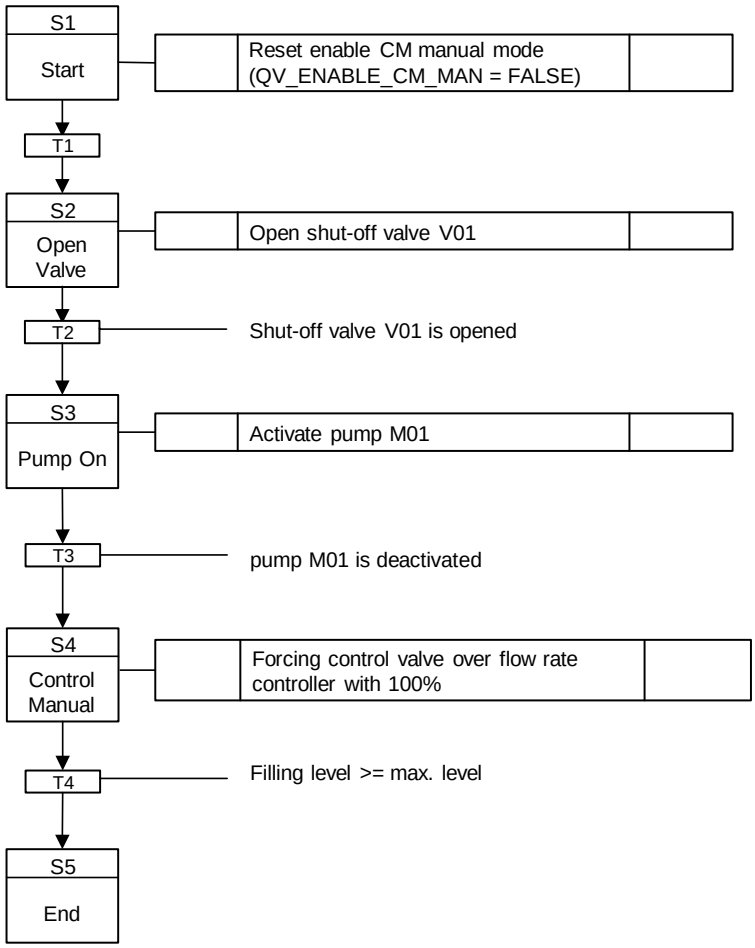
Operating mode III – "Rinsing"

Operating state: Run (active)

In the "Active" state, first the shut-off valve "V01" is opened and then the pump "M01" is switched on so that the flushing path is set.

During the flushing process, the "F01" flow controller is operated in the setting mode, i.e. the EPH sends a control signal to the controller. This passes it on to the control valve. The control value is 100% so that the control valve is opened completely.

If the "Container level (SP_LEVEL_AI)" reaches the "Maximum tank level (IN_MAX_TANK_LEVL)", the operation is automatically stopped.



Operating mode IV – "Level_Control"

Operating state: Run (active)

In the "Active" state, a distinction is made between three cases:

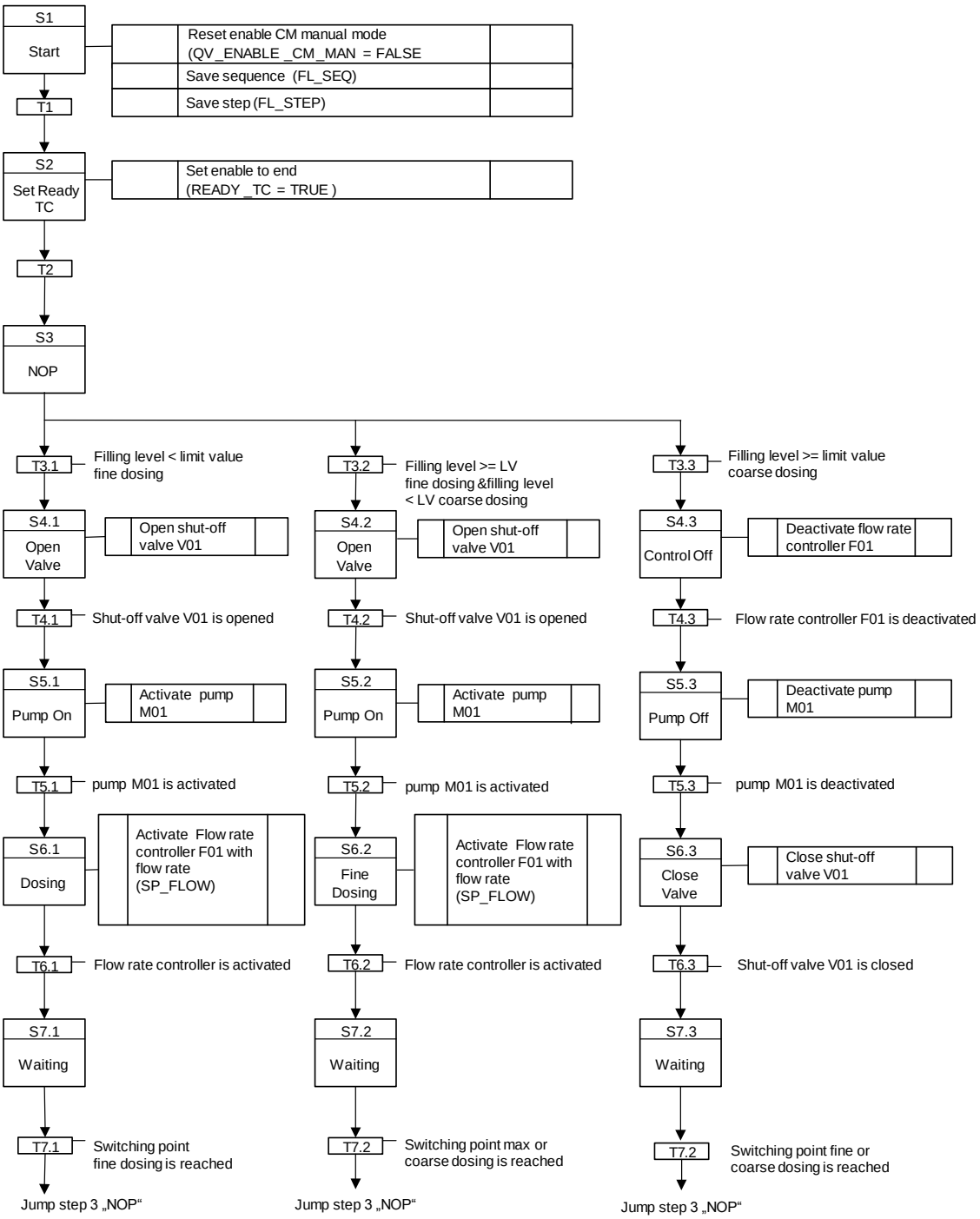
1. If the product quantity in the tank is below the changeover value "fine dosing (IN_FINE_FILL_SW)", then the shut-off valve "V01" is opened and then the pump "M01" is switched on. Then the flow controller is switched on with the "Coarse dosing (SP_FLOW)" set point.

2. If the product quantity in the tank lies between the "Fine dosing limit value (IN_FINE_FILL_SW)" and the "Set point (SP_LEVEL)", then the shut-off valve "V01" is opened and then the pump "M01" is switched on. Then the flow

controller is switched on using the "Fine dosing (IN_FINE_DOSE)" parameter.

3. If the product quantity in the tank is above the set value (SP_LEVEL), the flow controller and then the pump "M01" are switched off. As soon as the pump is off, the shut-off valve is closed.

Note The operating mode can be terminated at any time by manual operation.



4.3.4 "Pressure" - parameters and operation modes

Control parameters (SP_)

Name	Unit	Operable state Running	Control strategy										Comment
			1	2	3	4	5	6	7	8	9	10	
Inerting_Pressure (SP_INERT_PRES)	bar		X										contact pressure set point
Release_Pressure (SP_RELEASE_PRES)	mbar		X			X	X						Pressure to which release is to be applied
Flushing_Time (SP_FLUSHING_TIME)	min			X		X							flushing time
Monitoring_Time (SP_MONITOR_TIME)	min		X	X			X						Monitoring time (monitoring pressure changes over time)
Expansion_Pipe (SP_EXPAN_PIPE)			X	X		X							Selection of the exhaust air duct
Number_of_Inertisations (SP_NO_INERT)			X										Number of container pressurizations with inert gas
Hold_Pressure (SP_HOLD_PRES)	mbar				X			X					Tank pressure set point

Note

The "Expansion_Pipe" setpoint is an enumeration. Three states are possible:

1. Expansion pipe 1 preselected
2. Expansion pipe 2 preselected
3. Expansion pipe 3 preselected

Process values (PV_xy)

Name	Data type	Unit	Connection name	Comment
Flushing_Time_Sec	Analog	sec	PV_FLUSHING_TIME	Rinsing time (converted into seconds)
Monitoring_Time_Sec	Analog	sec	PV_MONITORING_TIME	Monitoring time (converted into seconds)
Actual_Pressure	Analog	bar	PV_PRESSURE_AI	Actual pressure in the tank
Differential_Pressure	Analog	mbar	PV_DIFFERENTIAL_PRES	Differential pressure
Outlet_Pipe_Open	Binary		PV_PRODUCT_PIPE_OPEN	Product line display connected and opened
Oxygen	Analog	%	PV_Oxygen	Oxygen actual value

Parameter (IN_xy)

Name	Data type	Unit	Connection name	Comment
Expansion_Valve_V03_Exists	Binary		IN_EXPAN_V03_EXISTS	Exhaust air valve V03 available
Expansion_Valve_V04_Exists	Binary		IN_EXPAN_V04_EXISTS	Exhaust air valve V04 available
Pressure_Limit_Vacuum	Analog	bar	IN_PRES_LIM_VAC	Value from which the vacuum valve may be opened
Oxygen_Meas_Exists	Binary		IN_O_MEAS_EXISTS	Display oxygen measurement present or not
SP_Oxygen	Analog	%	IN_SP_OXYGEN	Setpoint oxygen content (in the tank)

Timers (TI_x)

Name	Connection name	Comment
Flushing_Timer	TI_FLUSHING	Timer for controlling the flushing time (switch-off delay)
Monitoring_Timer	TI_MONITORING	Timer for controlling the monitoring time (switch-off delay)

Control values (QV_xy)

Name	Data type	Connection name	Comment
Mode_Split_Range	Binary	QV_MODE_SPLIT_RANGE	0 = split range 1 = not split range
Inert_Counter	Binary	QV_INERT_COUNTER	Increase the number of rinsing cycles by 1
Reset_Counter	Binary	QV_RESET	Reset counter for flushing procedures

Position texts

Number	Text
1	Idle
11	NOP
12	Error
13	Reset
14	End
101	Start
102	Open_N2
104	Close_N2
105	Open_V02
106	Close_V02
107	Open_V03
108	Close_V03
109	Open_V04
110	Close_V04
111	Counting
201	Open_V01_V02
202	Open_V01_V03
203	Open_V01_V04
204	Flushing_Time
205	Monitoring_Time
206	Close_Valves
402	Message

connections

Connection name	Data type	Comment
FL_SEQ	Byte	Stored sequencer
FL_STEP	Word	Stored step

Standard SFC type messages

Number	Type	Text
SIG_1	Fault	Step execution time exceeded (step time exceeded)
NSIG_1	Operating requirements - general	Operator Prompt (Operating request)
NSIG_2	Status message - AS	Active
NSIG_3	Status message - AS	Completed
NSIG_4	Status message - AS	Held
NSIG_5	Status message - AS	Aborted
NSIG_6	Status message - AS	Ready to complete
NSIG_7	Status message - AS	Stopped
NSIG_8	AS control technology Message - error	Error
NSIG_9	Status message - AS	Manual
NSIG_10	Status message - AS	Not released for SIMATIC BATCH (Not released for SIMATIC BATCH)
NSIG_11	Status message - AS	Execution time exceeded (Runtime exceeded)

Free messages

Number	Type	Text
SIG_2	Alarm on top	Monitoring Time expired (monitoring time expired)
SIG_3	Alarm on top	Differential Pressure not reached (differential pressure not reached)
SIG_4		
SIG_5		
SIG_6		
SIG_7		
SIG_8		
NSIG_12	Status message - AS	
NSIG_13	Status message - AS	
NSIG_14	Status message - AS	
NSIG_15	Status message - AS	
NSIG_16	Status message - AS	

Summarizing states

Status	FW I Inerting	FW II Flushing	FW III Inerting with open outlet	FW IV Ventilating	FW V Evacuating	FW VI Pressure Control
Starting	X	X_1	X_1	X_1	X_1	X_1
Active	X	X	X	X	X	X
Completing	X	X_1	X_1	X_1	X_1	X_1
Completed						
Holding	X	X_1	X_1	X_1	X_1	X_1
Held						
Holding error	X	X_1	X_1	X_1	X_1	X_1
Held error						
Resuming	X	X_1	X_1	X_1	X_1	X_1
Resuming error	$X_{Resuming}$	X_1	X_1	X_1	X_1	X_1
Stopping	$X_{Holding}$	X_1	X_1	X_1	X_1	X_1
Stopped						
Aborting	X	X_1	X_1	X_1	X_1	X_1
Aborted						

Legend

X : Sequencer exists

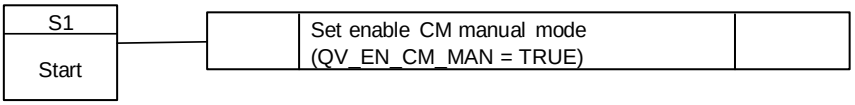
X_1 : Same as sequencer in operating mode I

Operating state: Idle (Ready)

In the basic state, the CMs are checked to ensure that they are in a fault-free state.

An error leads to a power-on lockout. The basic function can only be started if there is no switch-on inhibit. The valves V01 to V04 are closed.

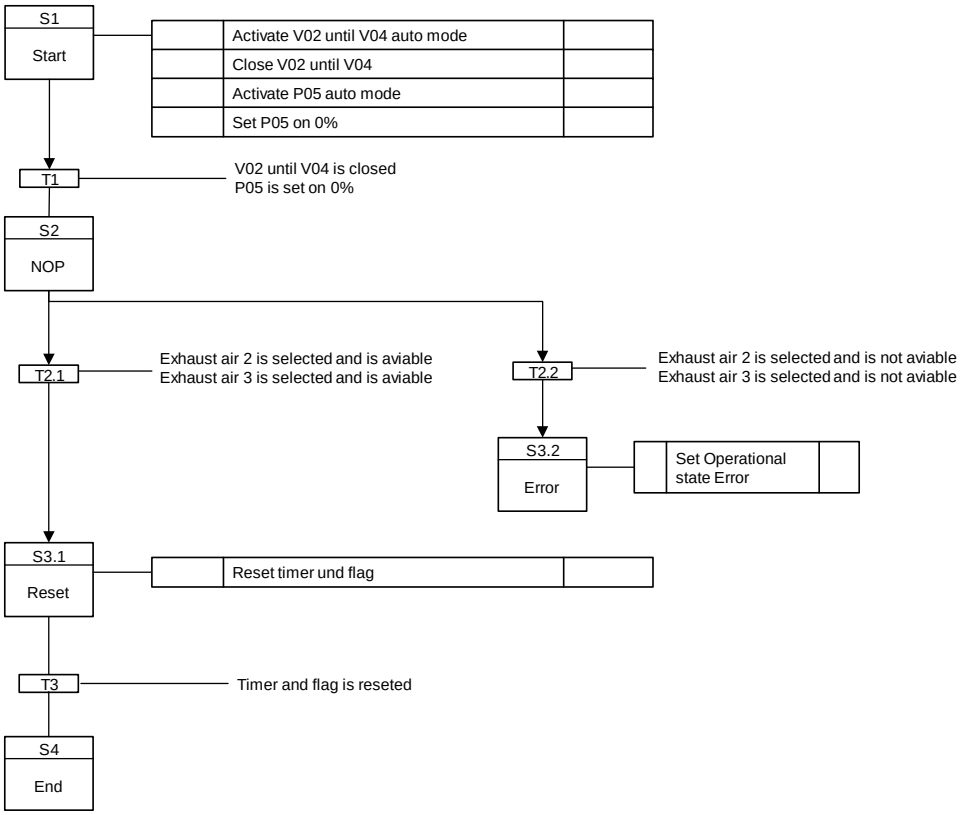
Manual operation of the CMs in "idle" mode is possible.



Operating mode I – "Inerting"

Operating state: Starting

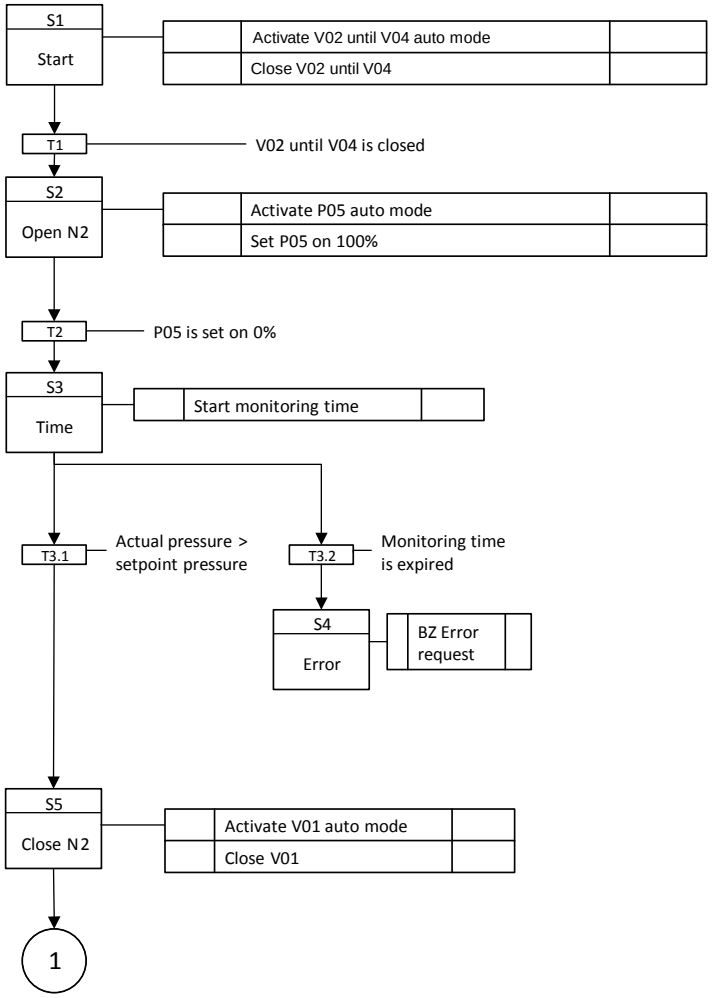
In the "Starting" state, the basic function is initialized, i.e. prepared for the "Active" state. All times and flags are reset for this purpose.

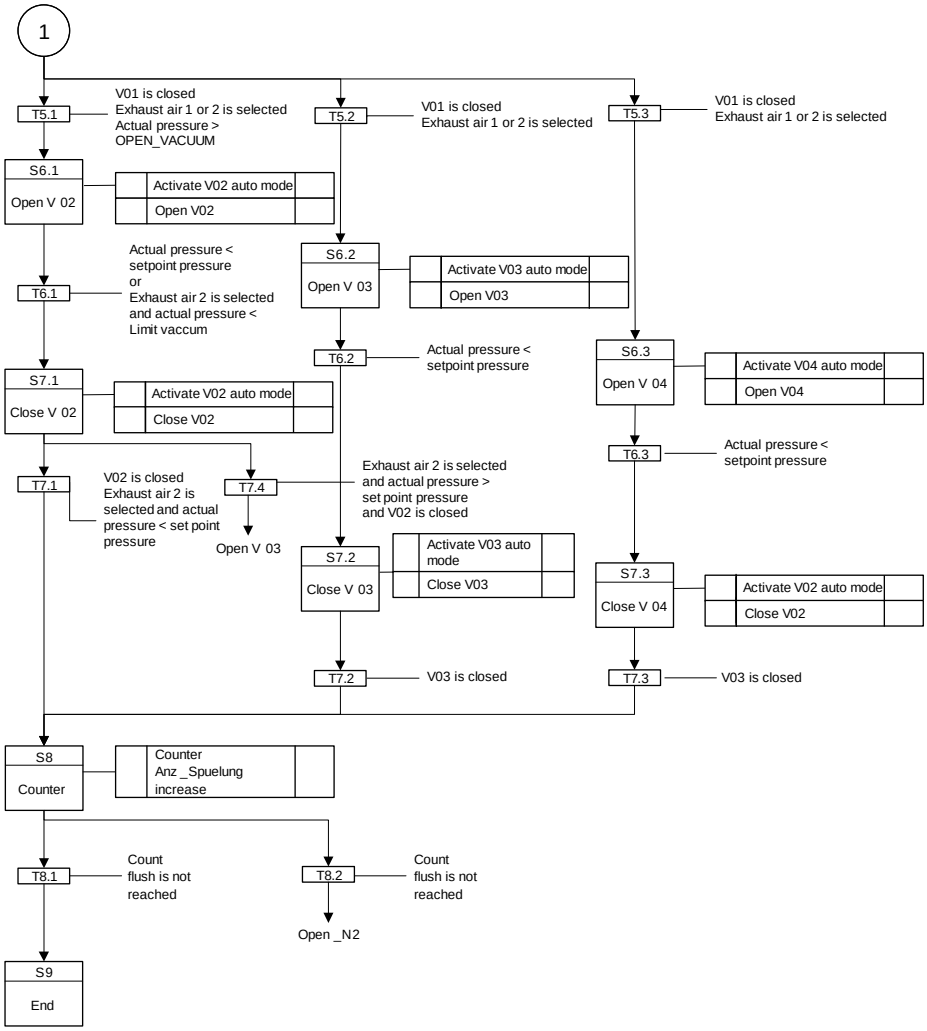


Operating state: Run (active)

By opening the valve in the supply air line, the unit is pressed on with inert gas up to a shut-off pressure when the exhaust air valves are closed.

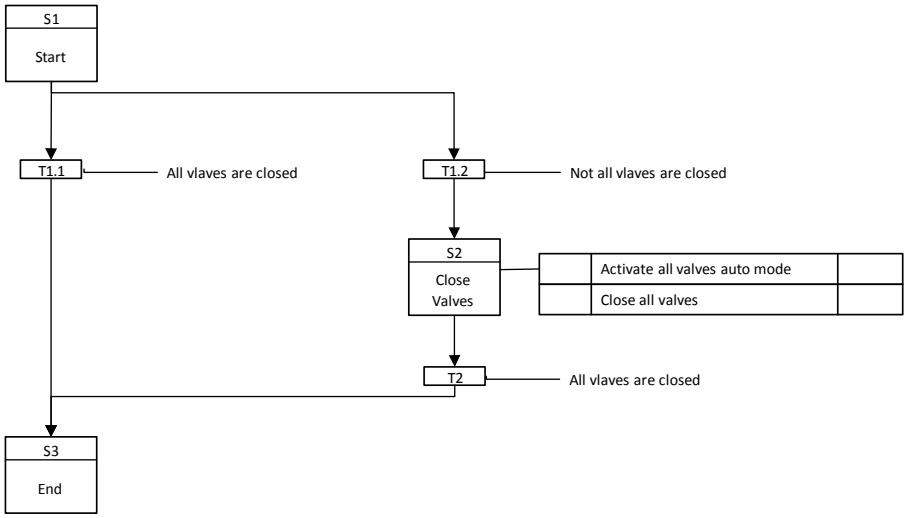
When the shut-off pressure is reached, a preselected exhaust valve is opened after the supply air valve has been successfully closed and the pressure in the unit is reduced to a predetermined pressure. The "pressing-on" and "lowering" processes are monitored in each case.
The entire process can be repeated n times.





Operating state: Completing

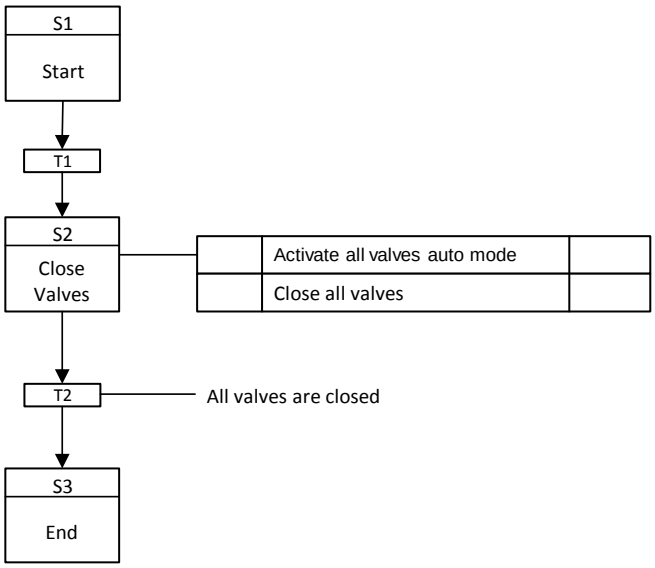
In the transition state completing, the machine is set to idle mode.



Operating state: Holding

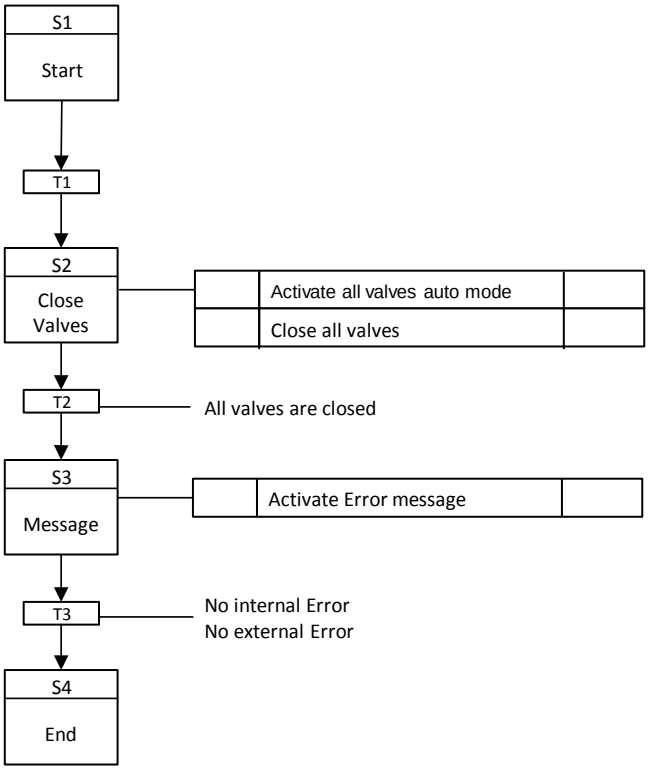
In the "Holding" state, valves "V01" to "V04" are closed.

The "Holding" state is used to set the "Held" state.



Operating state: Error (Holding error)

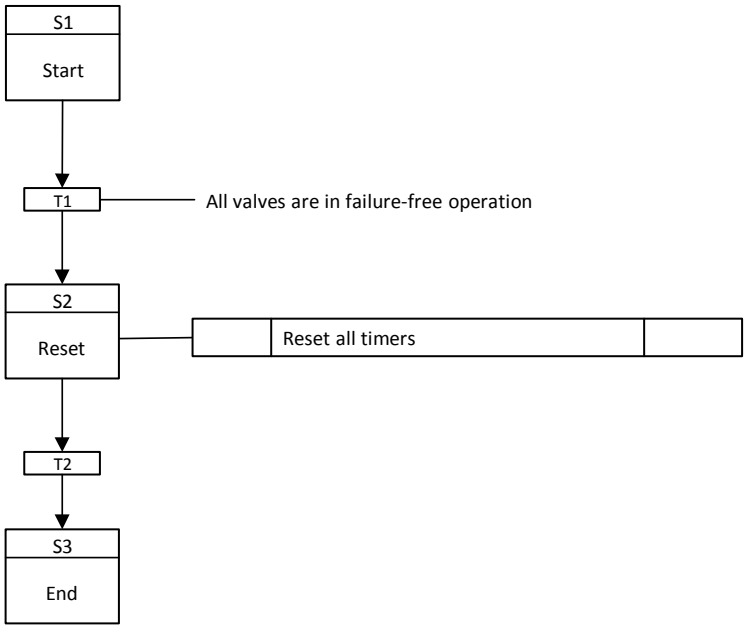
The holding error state is achieved by an external event (interlock) or by an error in the step chain (e.g. monitoring time elapsed).
Valves "V01" to "V04" are closed in the "holding error" state.
An error message is sent.
The “holding error" state can only be reached if there is no external or internal error.



Operating state: Resuming

In the "Continuing" state, the CMs are checked for fault-free condition. All timers and markers are reset. An error leads to a continuation lock. You can only continue if there is no continuation lock.

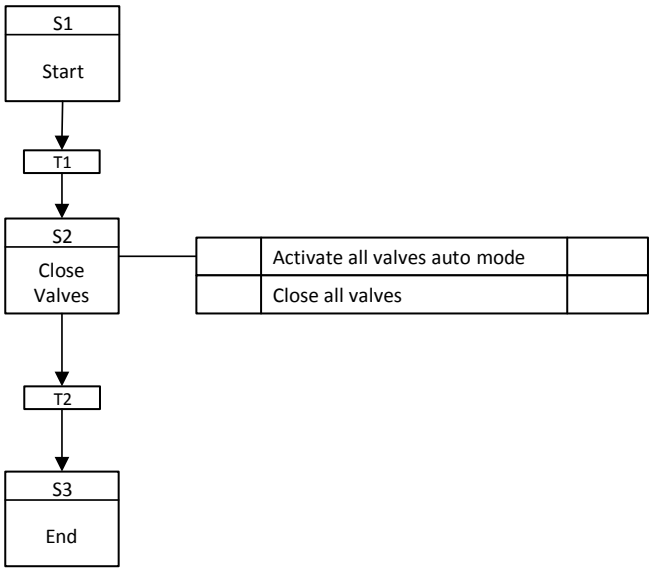
The "continuing" state is used to set the "active" state again and to restart the corresponding mode of operation (RUNHOLD = FALSE).



Operating state: Aborting

In the "canceling" state, all valves are closed.

The "Canceling" and "Aborted" states are used to set the basic state (idle).



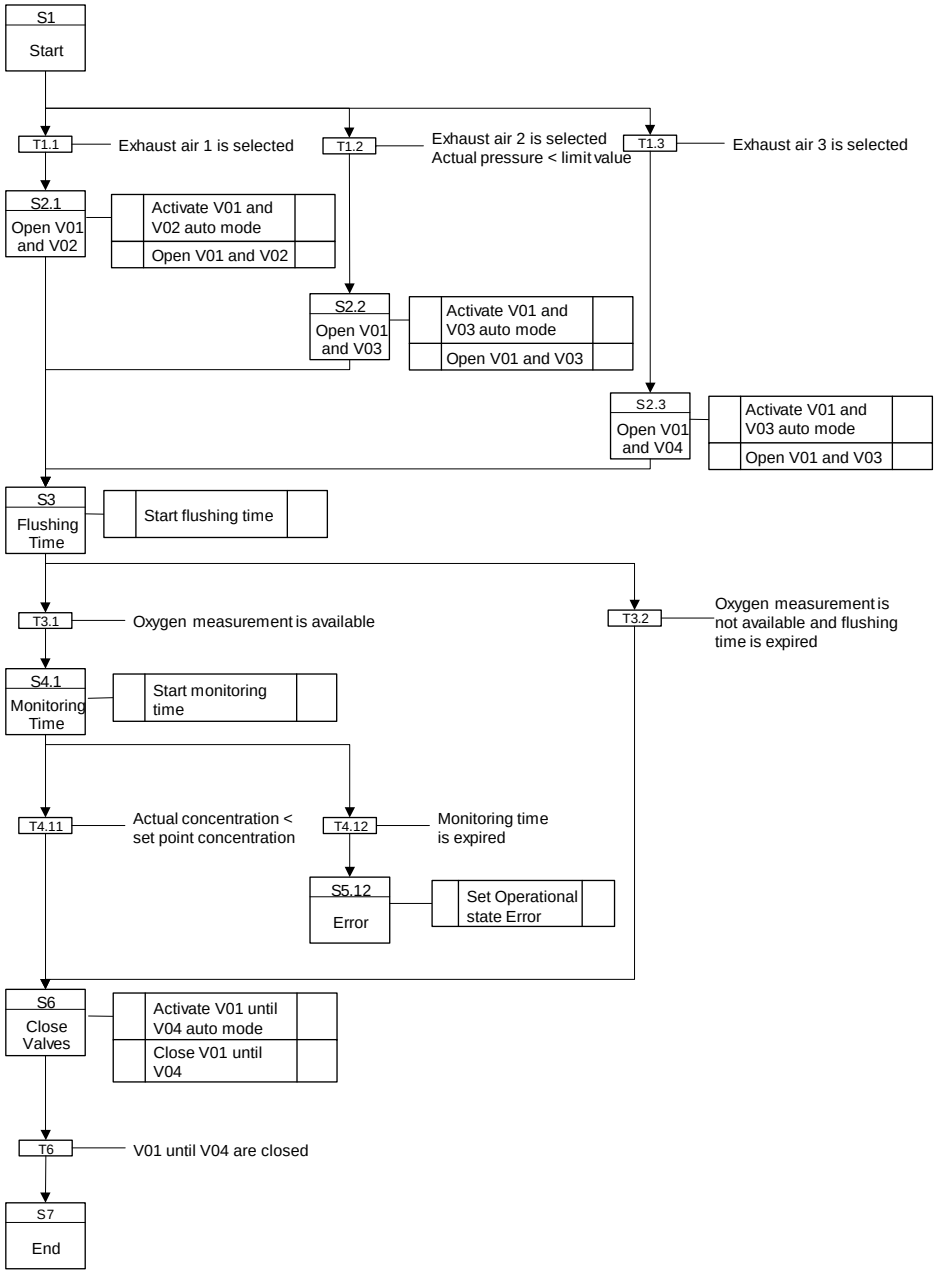
Operating mode II – "Flushing"

Operating state: Run (active)

The unit is flushed with inert gas by opening the valve in the supply air pipe and opening a preselected exhaust air valve.

When the preset flushing time has expired, the inlet valve and the outlet valve are closed.

If an oxygen measurement is connected to the apparatus, then the shutdown criterion for the flushing is when the oxygen content falls below a specified level. This switch-off point is time-monitored.

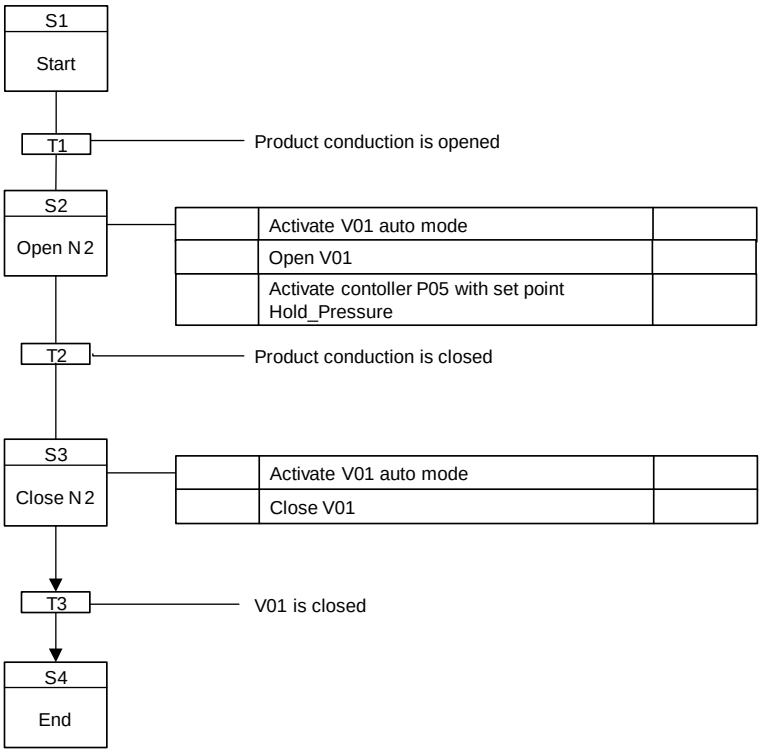


Operating mode III – "Inerting with open outlet"

Operating state: Run (active)

An inert gas is fed into the apparatus via a supply air line to push the product out of the apparatus via an open product outlet or to inert the empty apparatus and the product outlet.

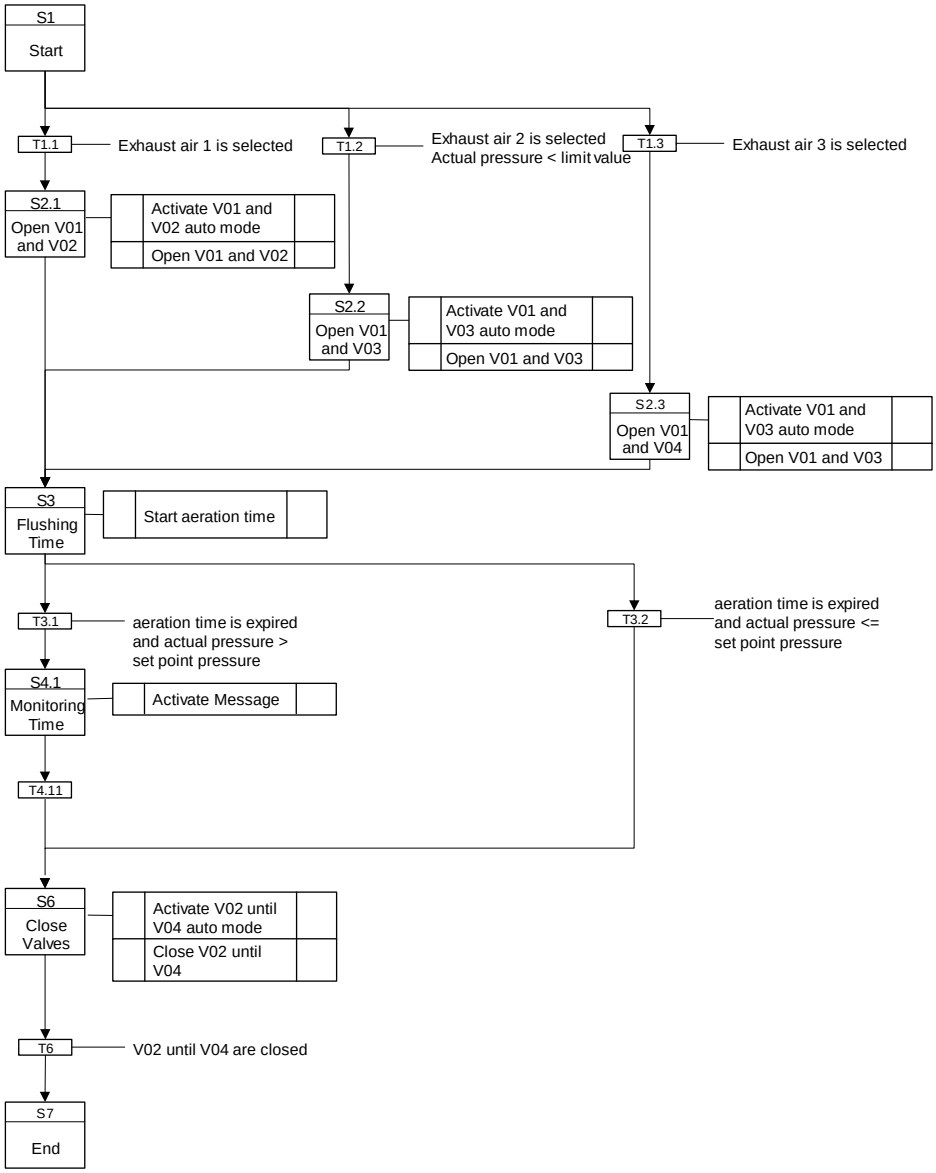
Closing the product discharge ends this mode of operation.



Operating mode IV – "Ventilating"

Operating state: Run (active)

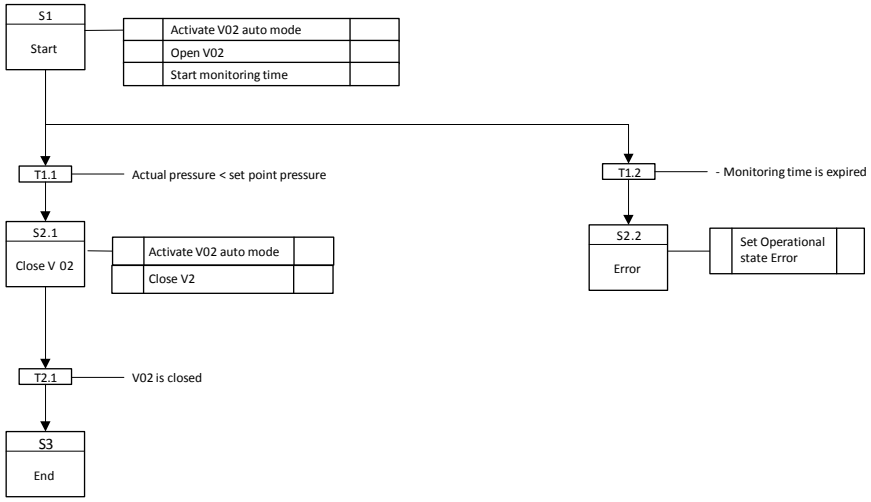
The unit is vented by opening a preselected exhaust duct. After the set venting time (flushing time) has elapsed, the exhaust air valve is closed. If a specified differential pressure is not reached within the venting time, a message is displayed.



Operating mode V – "Evacuating"

Operating state: Run (active)

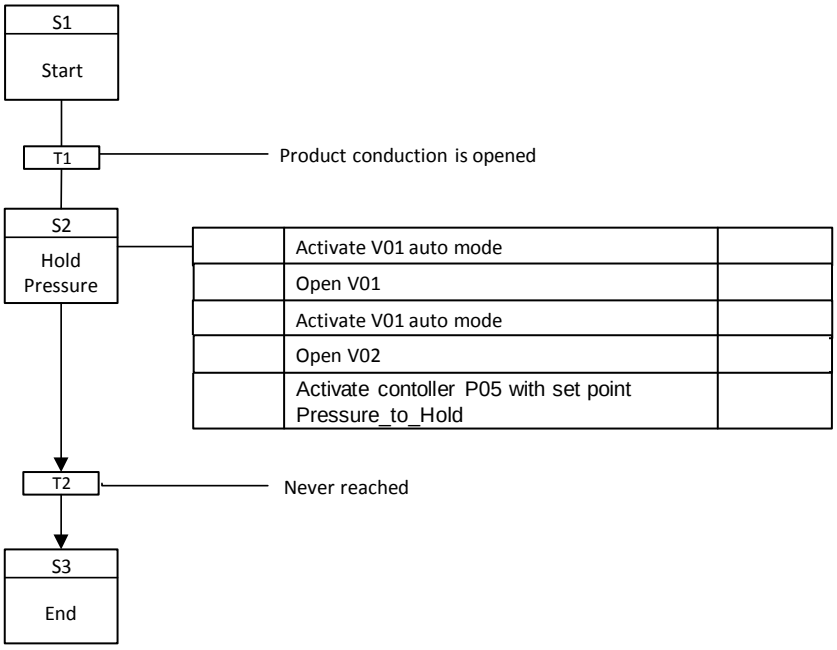
The unit is evacuated by opening the vacuum line when the supply air line is closed. An set pressure serves as switch-off point. Reaching this switch-off point is time-monitored.



Operating mode VI – "Pressure Control"

Operating state: Run (active)

Pressure control is switched on with path "Exhaust air 1". The preset pressure set point is maintained.



4.3.5 "Temperature" - parameters and operation modes

Control parameters (SP_)

Name	Unit	Operable state Running	Control strategy										Comment
			1	2	3	4	5	6	7	8	9	10	
Temperature (SP_TEMP)	°C		X										product temperature set point
Tolerance (SP_TOLERANCE)	°C		X										Tolerance band of the set temperature
Hold_Time (SP_HOLD_TIME)	min		X										Time for which the product is to be kept at the set temperature.

Process values (PV_xy)

Name	Data type	Unit	Connection name	Comment
Level_Tank	Analog	l	PV_LEVEL_TANK	Actual tank level
Neg_Tolerance	Analog	l	PV_NEG_TOL	Negative tolerance
Hold_Time_sec	Analog	sec	PV_HOLD_TIME_SEC	Stopping time
InToleranceZone	BOOL	QV_InTolZone	Enable for switching to manual mode (CM)	Target value is within tolerance range

Parameter (IN_xy)

Name	Data type	Unit	Connection name	Comment
Min_Level_Tank	Analog	l	IN_MIN_LEVEL_TANK	Minimal tank level
Settle_Time_TR	Analog	sec	IN_TR_SETL	Time during which the product must be at set temp (T01)
Settle_Time_TJ	Analog	sec	IN_TJ_SETL	Time during which the product must have stabilized to target temp (T02)

Timers (TI_x)

Name	Connection name	Comment
TI_Settle_Time_TR	TI_TR_SETL	Timer for controlling the settling time for indoor temperature control
TI_Settle_Time_TJ	TI_TJ_SETL	Timer for controlling the settling time for jacket temperature control
TI_Hold_Timer	TI_HOLD_TIMER	Timer for controlling the hold time

Control values (QV_xy)

Name	Data type	Connection name	Comment
Enable_CM_Manual	BOOL	QV_EN_CM_MAN	Enable for switching to manual mode (CM)
Control_Mode	BOOL	QV_CTRL_MODE	0 = Internal temperature 1 = Jacket temperature

Position texts

Number	Text
1	Idle
100	Start
102	Reset
103	Open_Valve
104	Pump_On
105	Ctrl_Inside_Temp_On
106	SettleTime_Inside_Temp
107	Ctrl_Jacket_Temp_On
108	SettleTime_Jacket_Temp
109	HoldTime_Temperature
110	Error
201	Control_Modules_Off
202	Stop_Timer
203	Enable_Manual
204	Disable_Manual
301	Temp_Ctrl_Off
302	Pump_Off
303	Close_Valve
304	Reset_Message
307	Aborted
308	Stopped
309	Completed

Standard SFC type messages

Number	Type	Text
SIG_1	Fault	Step execution time exceeded (step time exceeded)
NSIG_1	Operating request - General	Operator Prompt (Operating request)
NSIG_2	Status message - AS	Active
NSIG_3	Status message - AS	Completed
NSIG_4	Status message - AS	Held
NSIG_5	Status message - AS	Aborted

Number	Type	Text
NSIG_6	Status message - AS	Ready to complete Ready to complete
NSIG_7	Status message - AS	Stopped
NSIG_8	AS control technology Message - error	Error
NSIG_9	Status message - AS	Manual
NSIG_10	Status message - AS	Not released for SIMATIC BATCH (Not released for SIMATIC BATCH)
NSIG_11	Status message - AS	Execution time exceeded (Runtime exceeded)

Free messages

Number	Type	Text
SIG_2	Alarm on top	Interlock failure (Fault interlocking)
SIG_3	Alarm on top	Temperature out of tolerance (Temperature out of tolerance)
SIG_4		
SIG_5		
SIG_6		
SIG_7		
SIG_8		
NSIG_12	Status message - AS	
NSIG_13	Status message - AS	
NSIG_14	Status message - AS	
NSIG_15	Status message - AS	
NSIG_16	Status message - AS	

Summarizing states

Status	Operating mode I Temperature_Control
Starting	X
Active	X
Completing	X
Completed	
Holding	X
Held	X
Holding error	$X_{Holding}$
Held error	
Resuming	X
Resuming error	$X_{Resuming}$
Stopping	X
Stopped	
Aborting	X
Aborted	

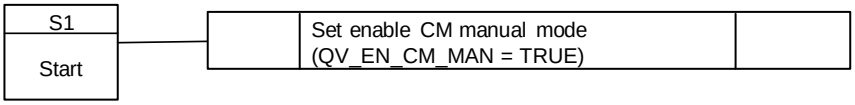
Legend

X : Sequencer exists

X_1 : Same as sequencer in operating mode I

Operating state: Idle (Ready)

Enable switching to manual mode for all CMs
Manual operation of the CMs in idle mode is possible.

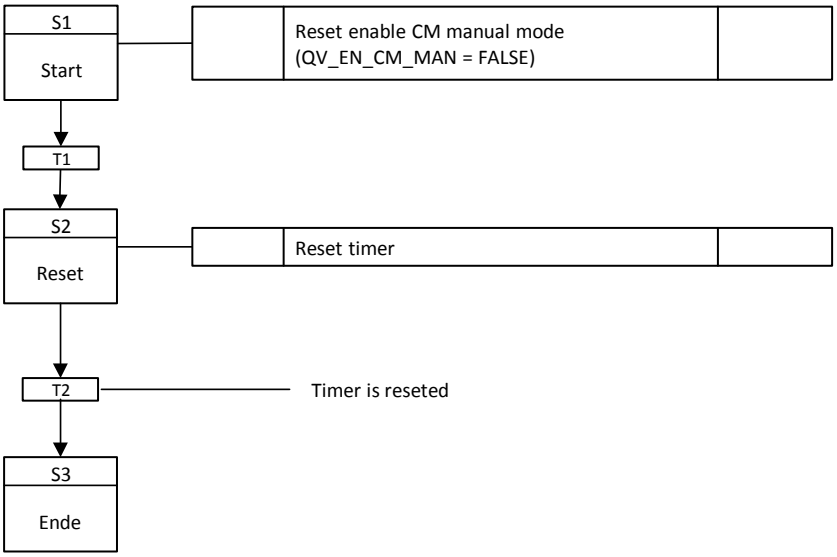


Operating mode I – "Temperature Control"

Operating state: Starting

In the "Start" step, the release for manual operation of the CMs is reset.

In the "Starting" state, the EPH is initialized by resetting all times.



Operating state: Run (active)

In the "Active" state, the control circuit is opened first, i.e. the flow valve "V01" and the heating steam valve "V02" are opened. When these are open, the pump "M01" is switched on. If the pump "M01" is switched on, temperature control can be started.

A distinction is made between two cases:

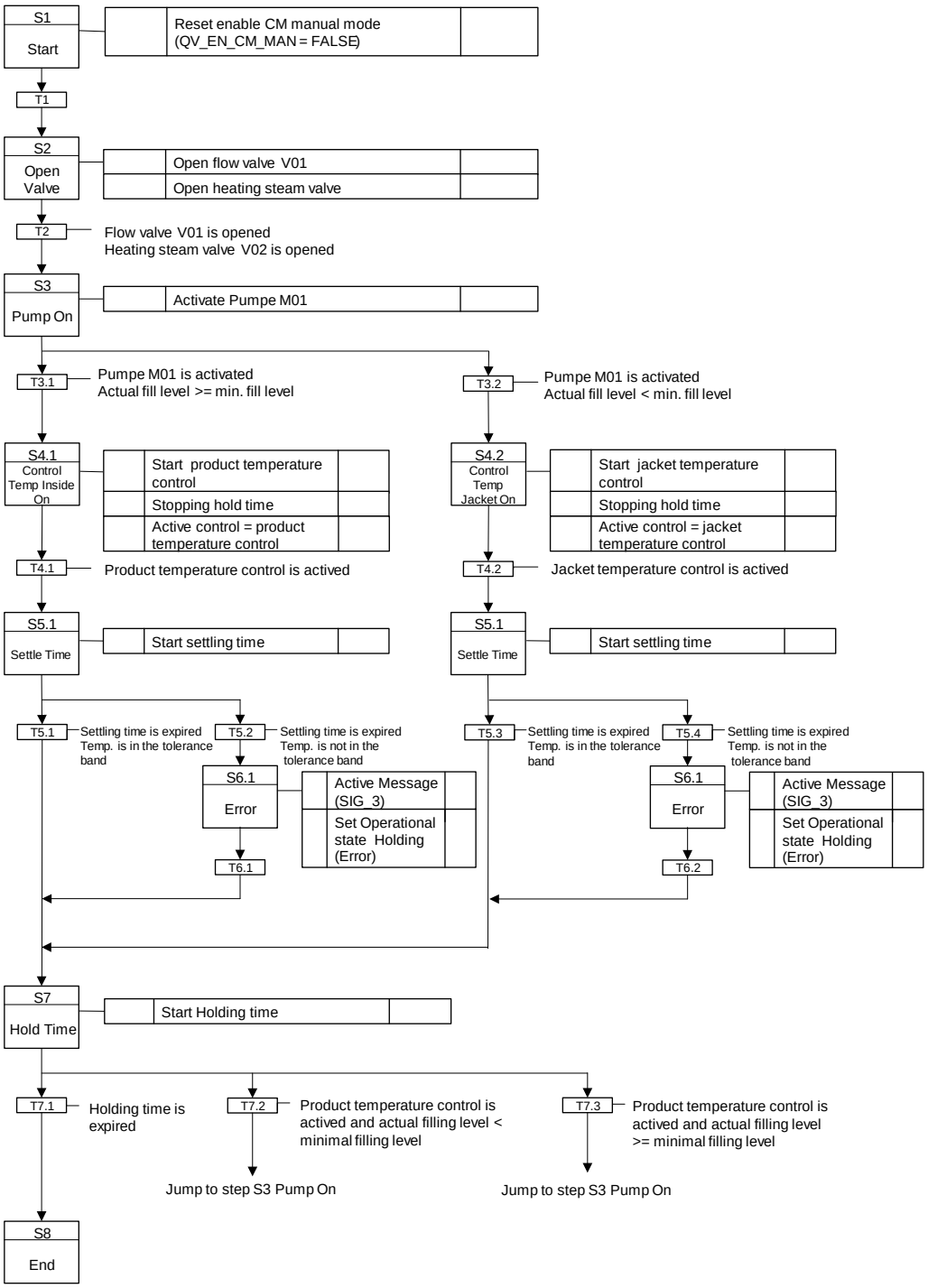
Case 1: Inner temperature control

If the tank level (PV_LEVEL_TANK) is above the minimum tank level (IN_MIN_LEVEL_TANK), the temperature control operates as cascade control, i.e. the master temperature controller receives the setpoint "Temperature (SP_ TEMP)" from the EM and passes its setpoint as setpoint to the subsequent temperature controller. If the indoor temperature is within the specified tolerance (SP_TOLERANCE) after the settling time for indoor temperature control (TI_TR_SETL), the operation mode is automatically terminated after a hold time (TI_HOLD_TIMER). If the internal temperature is not within the specified tolerance after the settling time, a message is sent and the EM switches to the " Holding (error)" state.

If the container level falls below the minimum container level, the holding time is stopped and continued with "Case 2". Please note that in "Case 2" the hold time is still used and is not restarted.

Case 2: Jacket temperature control

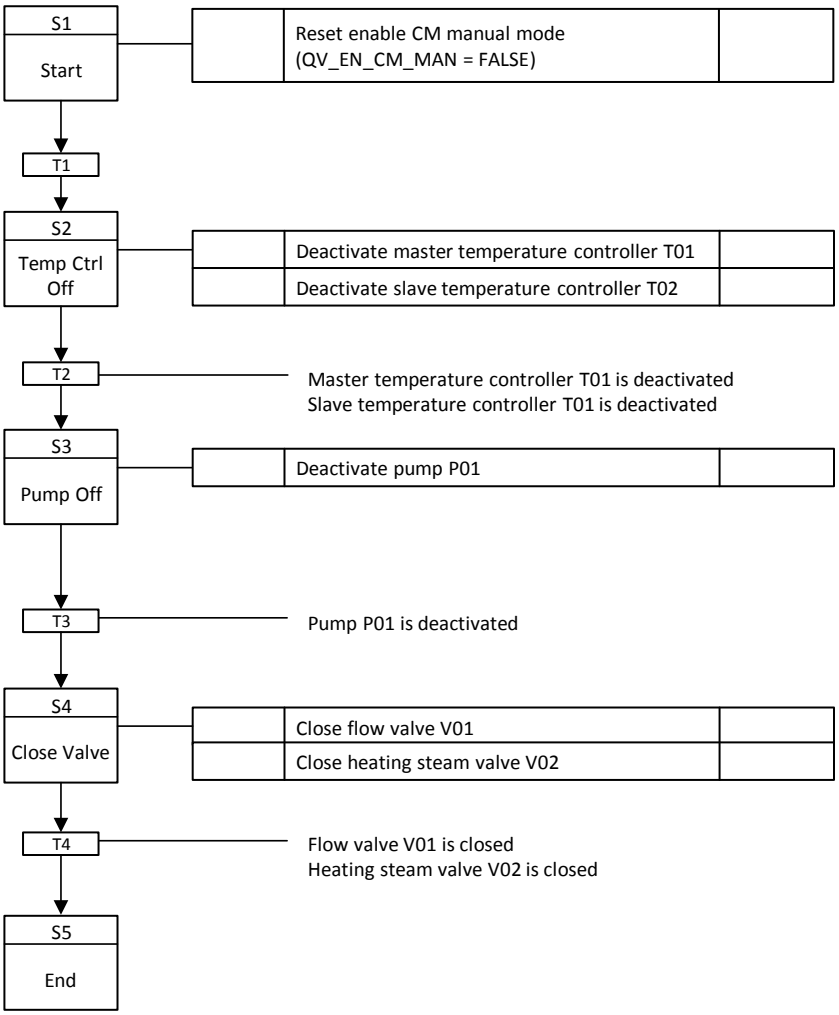
If the tank level (PV_LEVEL_TANK) is below the minimum tank level (IN_MIN_LEVEL_TANK), then the cascade control is separated and only the jacket temperature is controlled via the follow-up temperature controller, i.e. the setpoint "Temperature (SP_TEMP)" is now directly connected from the EM to the follow-up temperature controller. If the jacket temperature is within the specified tolerance (SP_TOLERANCE) after the settling time for jacket temperature control (TI_TJ_SETL), the operation mode is automatically terminated after a hold time (TI_HOLD_TIMER). If the internal temperature is not within the specified tolerance after the settling time, a message is sent and the EM switches to the " Holding (error)" state. If the tank level exceeds the minimum tank level, the hold time is stopped and continued with "Case 1". Please note that in "Case 1" the hold time is still used and is not restarted.



Operating state: Completing

In the "Start" step, the release for manual operation of the CMs is reset.

In the "Completing" state, the master controller "T01" and the slave controller "T02" are switched off first. If the controllers are off, then the pump "M01 is switched off". Then the heating steam valve and the flow valve are closed. If these are closed, the basic state (idle) is set via the " completed " state.

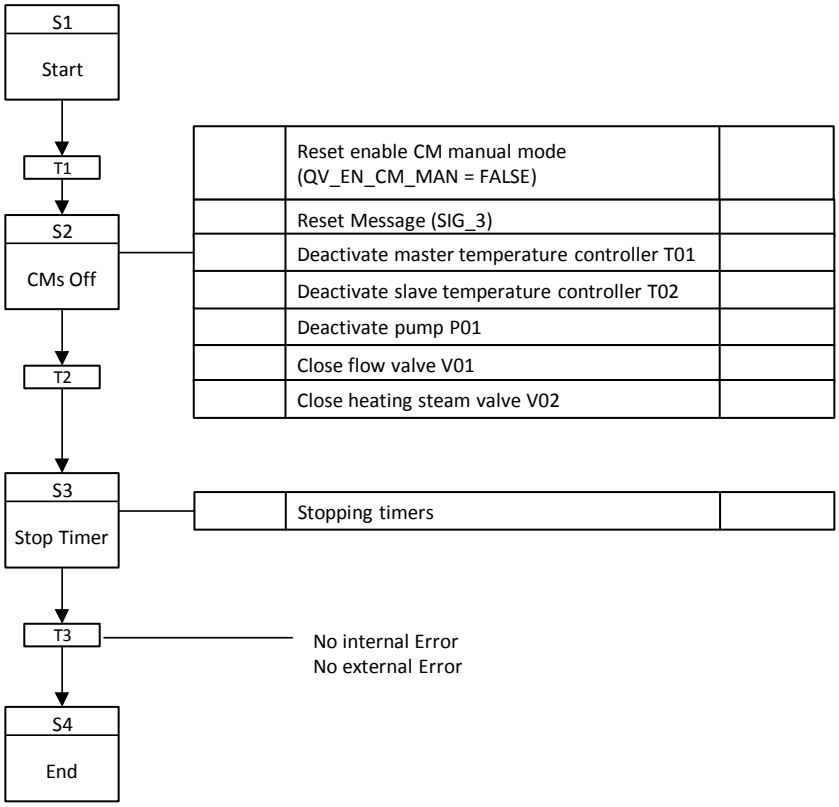


Operating state: Holding

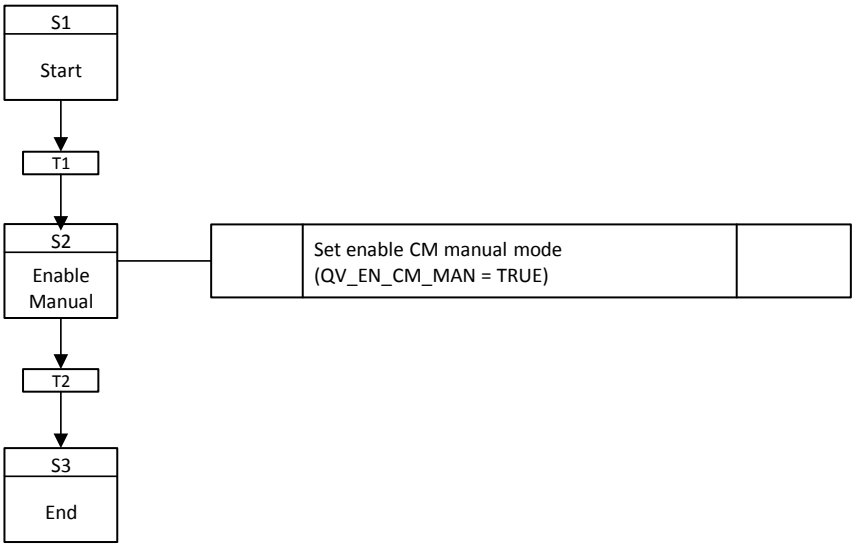
In step "Start" the release for a manual operation of the CMs and a pending message (SIG_3) of the EPH is reset.

In the "Holding" state, the master controller "T01", the slave controller "T02" and the pump "M01" are switched off, the heating steam valve and the flow valve are closed and all times are stopped.

The "Holding" state is used to set the "Held" state.

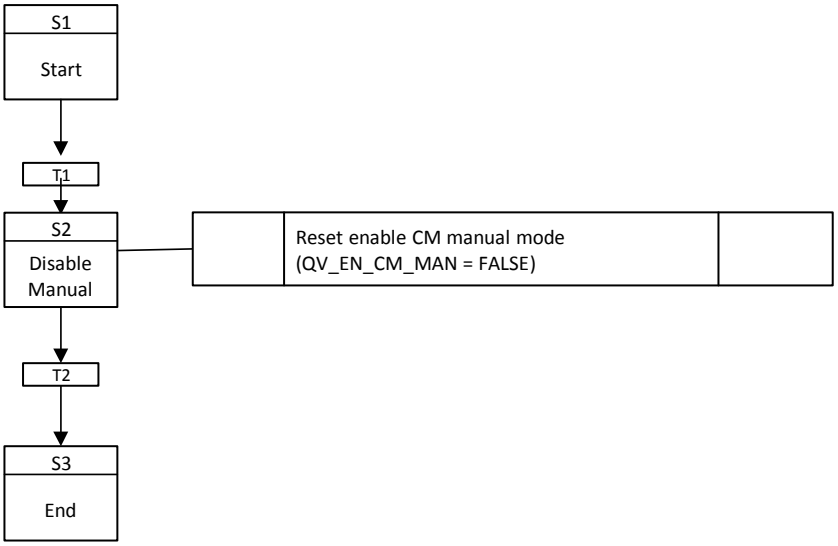


Operating state: Held



Operating state: Resuming

In the "Disable Manual" step, the release for manual operation of the CMs is reset.
In the "Continuing" state, all times are reset.
The "Continuing" state is used to set the "Active" state again. The
active sequencer starts again from the start step.

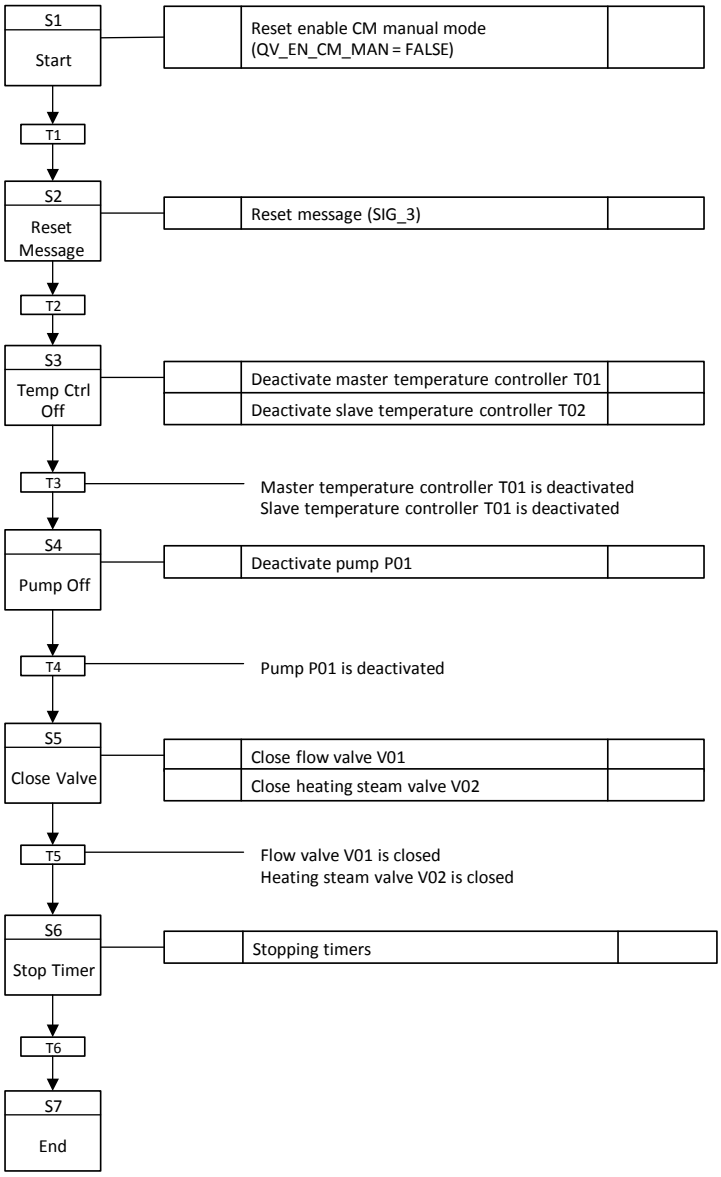


Operating state: Stopping

In the "Start" step, the release for manual operation of the CMs is reset.

In the "Stopping" state, the master controller "T01" and the slave controller "T02" are switched off first. Once the controllers are off, pump M01 is turned off. Then the heating steam valve and the flow valve are closed. If they are closed, all timers are stopped.

The basic state (idle) is set via the "Stopping" state.

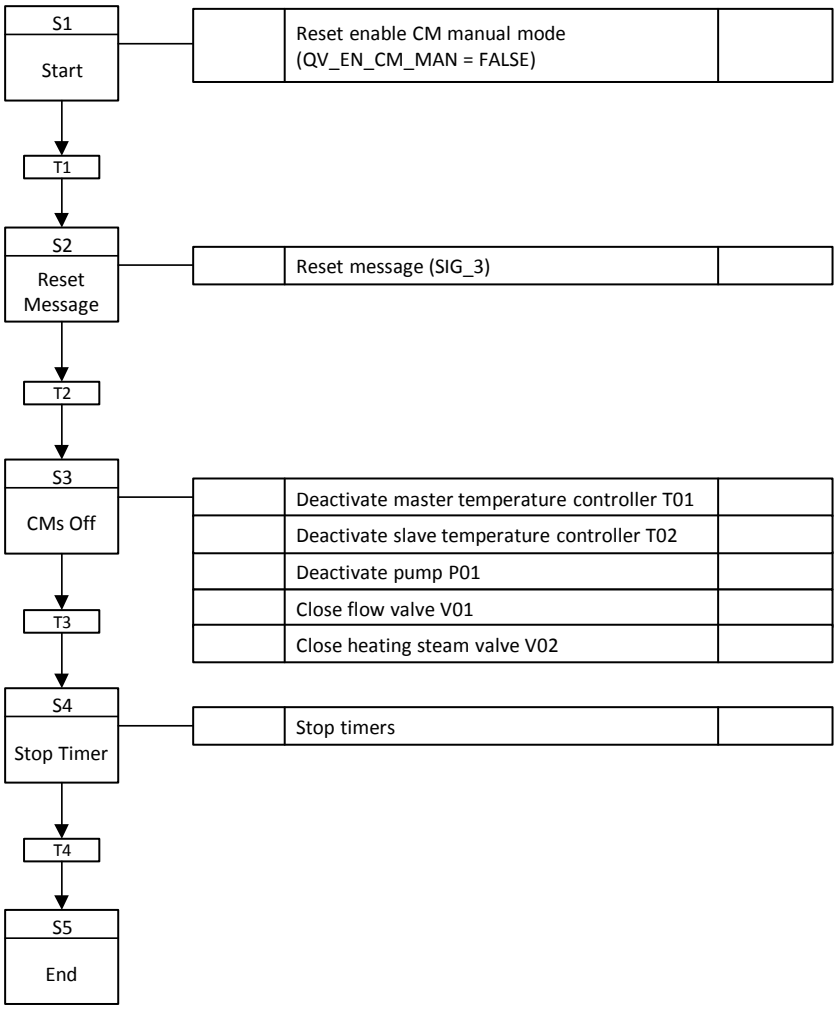


Operating state: Aborting

In the "Start" step, the release for manual operation of the CMs is reset.

In the "Stopping" state, the master controller "T01", the slave controller "T02" and the pump "M01" are switched off, the heating steam valve and the flow valve are closed and all times are stopped.

The "Cancelling" state is used to set the idle state.



5 Appendix

5.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:
https://support.industry.siemens.com/

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts. Please send queries to Technical Support via Web form:
https://www.siemens.com/industry/supportrequest

SITRAIN – Training for Industry

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:
https://www.siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:
https://support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone:
https://support.industry.siemens.com/cs/ww/en/sc/2067

5.2 Links and literature

Table 5-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/109740620
\3\	SIMATIC PCS 7 process control system PCS 7 Readme V9.0 https://support.industry.siemens.com/cs/ww/en/view/109744312
\4\	Integration of Advanced Process Graphics in SIMATIC PCS 7 https://support.industry.siemens.com/cs/ww/en/view/89332241
\5\	Control Module (CM) Technology - Efficient Engineering with SIMATIC PCS 7 https://support.industry.siemens.com/cs/ww/en/view/109475748
\6\	Technische Funktionen für SIMATIC PCS 7 am Beispiel der Chemischen Industrie https://support.industry.siemens.com/cs/ww/en/view/53843373
\7\	Templates for specification of technical functions with SFC Types in SIMATIC PCS 7 https://support.industry.siemens.com/cs/ww/en/view/33412955

5.3 Change documentation

Table 5-2

Version	Date	Modifications
V1.0	09/2018	First version