

applications & TOOLS

SIMATIC Route Control
Control of material transports with Route Control
using the example of a project extension

Application Note

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Note

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Preface

Objective of the application

This application shall provide an overview of what steps have to be taken when an existing PCS 7 project is to be extended by SIMATIC Route Control.

Main contents of this application

The following main points are discussed in this application:

- Extending the configuration in SIMATIC Manager
- Engineering with SIMATIC Route Control

Reference to the Automation and Drives Service & Support

This article is from the Internet application portal of the Automation and Drives Service & Support. Clicking the link below directly displays the download page of this document.

<http://support.automation.siemens.com/WW/view/en/32201967>

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1. Introduction

1.1 What is SIMATIC Route Control?

SIMATIC Route Control is an option package of the SIMATIC PCS 7 process control system and it is integrated in the PCS 7 engineering and runtime system. Route Control forms a system for the automated or manual control of material transports (routes) in process plants. The system software Route Control (RC) has been available since PCS 7 V6.

Simple transport processes up to comprehensive route combinations are possible in runtime. For it the plant operator needs only to specify the source and destination locations when the route request is made. Route Control permits the user to determine, check, control and monitor transport routes and the route elements which are contained in them.

By using RC the engineering, processing and diagnostics of material transports can be simplified and standardized.

1.2 Using SIMATIC Route Control

The RC is suitable both for small plants with simple/static lines and for plants with medium and higher performance ranges with extensive routes / pipelines.

The RC is particularly suitable for plants with many distributed transport routes and tank farms of the food and beverages industries (F&B), chemical/pharmaceutical industries or petro chemistry.

Benefits from using Route Control

- RC ensures safe material transports even in the case of extensive route networks.
- Changes in the configuration can be realized easily with the help of RC (reconfiguration and extensions).
- RC can be used efficiently for simultaneous transfers as, for instance, the engineering becomes much easier.
- RC can also be used both for batch-based and non-batch-based processes → integration in SIMATIC BATCH.

1.3 Use cases of SIMATIC Route Control

RC can be used in the most diverse use cases.

Table 1-1: Fields and use cases

Industry	Application/products	Special requirements
Pharmaceutical industry	Blood plasma bank and transfers	Contaminated pipelines must be disinfected and cleaned after a certain time.
Chemical industry	Paint pigment mixing plant	Paint pigment mixing with high pressure while being transferred in the line
Oil & gas	Loading port: Loading and unloading of ships Mineral oils	Change „on the fly“ (source – destination) Blending: Two components are mixed in the pipeline.
Food & beverages	Brewery Cooking oils, soft drinks, yoghurt, cocoa paste and butter, cereals, malt, starch	High flexibility in the transfers; finding alternative routes Soft drinks: Mixing during transfer Cereals transfer = transfer of liquids Starch: High pressure in the tank → short reaction time of the software + valves

1.4 When does using RC make sense?

Route Control offers the option to adapt to different plant sizes (up to 30 / up to 100 / up to 300 simultaneous material transports) regardless of whether there are simple transport routes or complex material transport networks.

Using RC is particularly suitable for plants:

- which require frequent reconfiguration and extensions,
- which require a high flexibility of the transport routes,
- which require a high number of material transports which are to run simultaneously or
- which are to be used for projects in combination with SIMATIC BATCH.

2 Structuring of a plant with Route Control

Concept of plant structuring

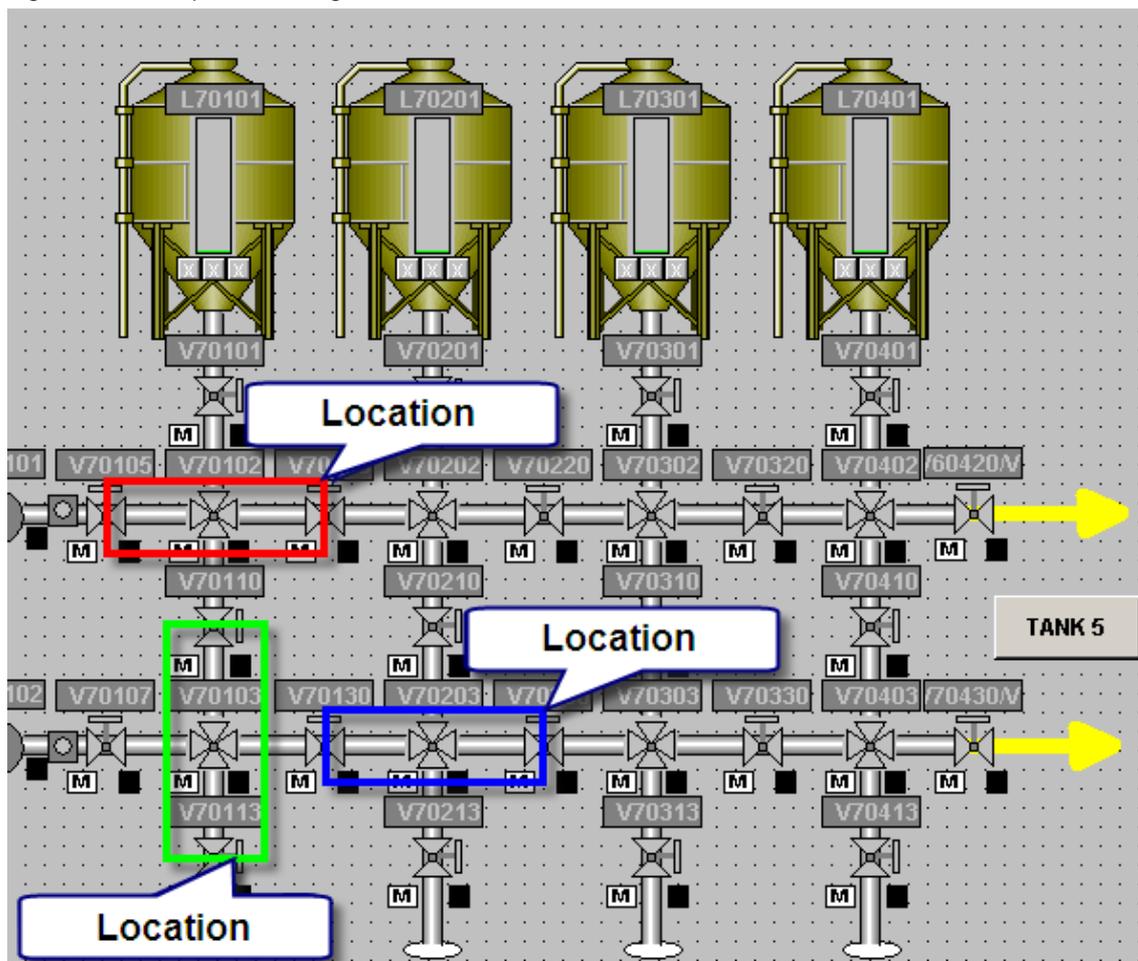
To structure a plant you have to define so-called locations.

2.1 Locations in RC

Locations are fictitious elements of the route control and serve to structure the plant into partial routes. The locations are configured as equipment properties in the Plant View of the PCS7 project and then they are transferred to the Route Control Engineering with the Route Control Wizard.

In the deactivated state a location forms a confined section in a plant. This confined section can neither be entered by new transport material nor be left by existing transport material.

Figure 2-1: Example of a configuration of locations



A location comprises all elements which, in the deactivated state, come into contact with the transport material.

2.2 Interconnections in Route Control Engineering

The following engineering rules apply to interconnections:

- Depending on the location assignment of valves their “closed” state (“initial position” mode) has to be inquired:
 - all elements of the source node
 - elements of the destination node only if it is a potential route destination
- Common connection elements are controlled (opened)
These are valves which are used both in the source and destination nodes.
The selection of the function depends on the technological function of the valve (e.g. “Set path” or “Open source”, ...).
- Motors/pumps of the source node must be activated.
- The interlocking of modes is realized in two modes by the active control of the common elements in the opposite direction.

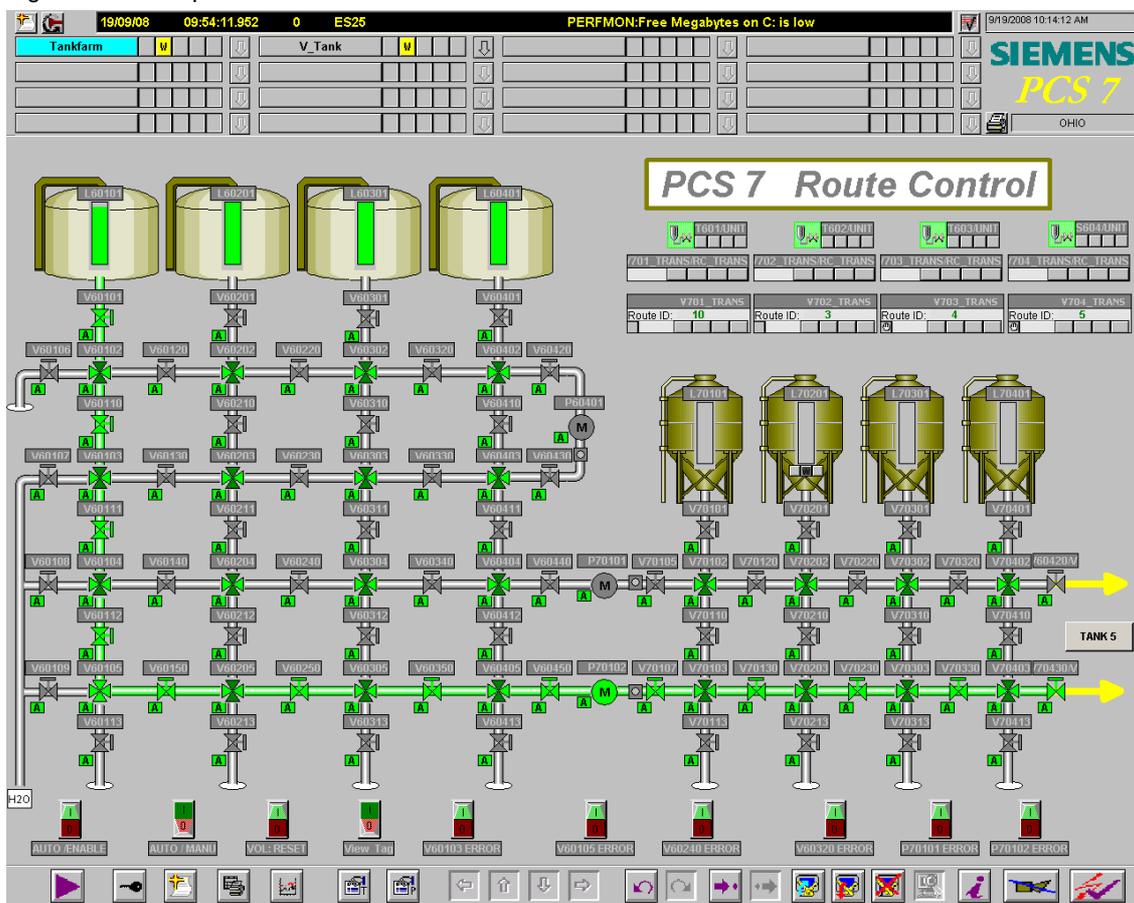
3 Use case: Extension of an existing plant "Tankfarm"

3.1 Task

The following document describes the use case of a plant extension. The focus is placed particularly on the Route Control engineering steps.

The extension is made on the plant called „Tankfarm“. Liquids can be transferred from one of the source tanks via the material transport network (comprising valves, pumps and pipelines) to the destination tanks here.

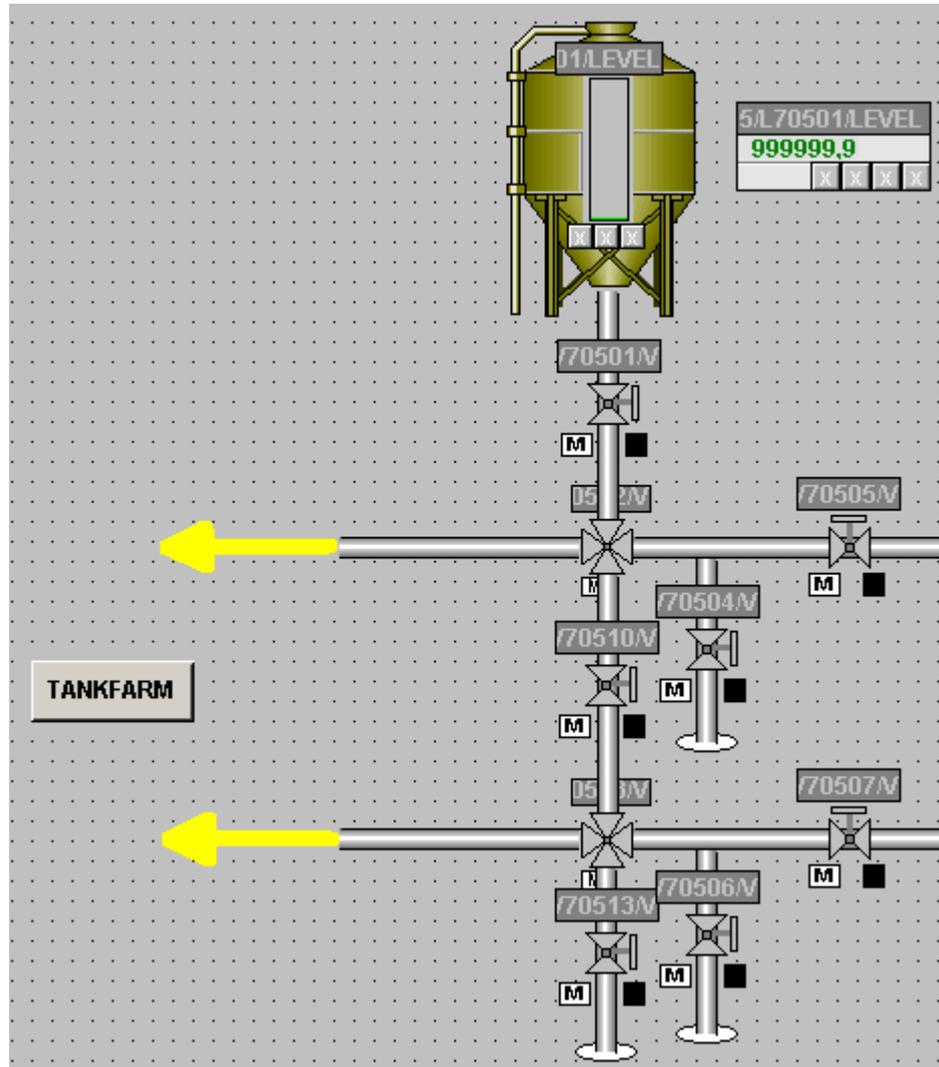
Figure 3-1: Plant picture of Tankfarm



On the OS the material way is during the Runtime pointed out. The operator control of the material transport is done via SIMATIC Route Control.

The plant is to be extended by another destination tank and by the respective control, sensor and link elements required for the transport network.

Figure 3-2: Plant extension with destination tank and transport network



The necessary steps are configured both in SIMATIC Manager and in SIMATIC Route Control Engineering.

3.2 Engineering

The engineering of the extension takes few steps in SIMATIC Manager and SIMATIC Route Control Engineering.

As the work environment is already known through the process control system, working and navigating in Route Control will be very easy for the experienced user of SIMATIC PCS 7.

Prefabricated templates will help to realize the charts for valves and material transport quite easily which allows you to do the configuration fast and flexibly.

Procedures for plant extension

The central engineering is done in SIMATIC Manager:

- Plant Hierarchy
 - Appending the plant
 - Appending the locations
- CFC
 - Appending charts with interface blocks
 - Appending transport blocks

The other tools of SIMATIC Route Control are started from the SIMATIC Manager menu:

- RC Wizard
 - Applying the configured RC blocks to the CFCs and the locations to RC Engineering
 - Assigning the IDs for the RC blocks
- RC Engineering
 - Appending partial routes and assigning elements
 - Loading and updating the changes on the RC Server

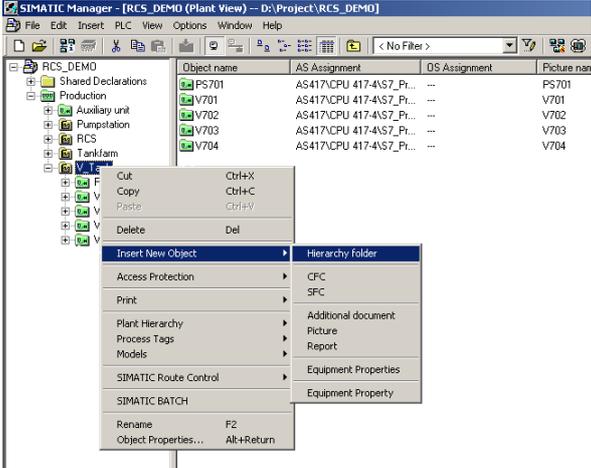
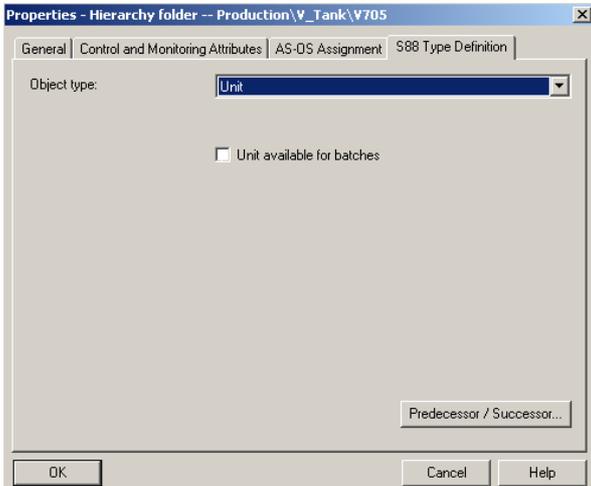
3.2.1 Extending the unit

Extending the Plant Hierarchy

According to the desired plant extension the existing Plant Hierarchy (PH) has to be extended by a hierarchy folder.

The unit folder V705 is added to the plant folder V_Tank.

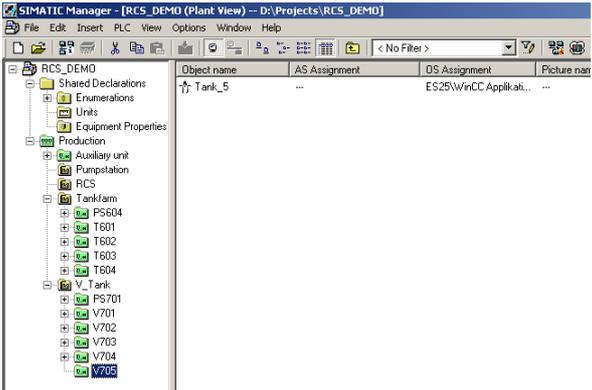
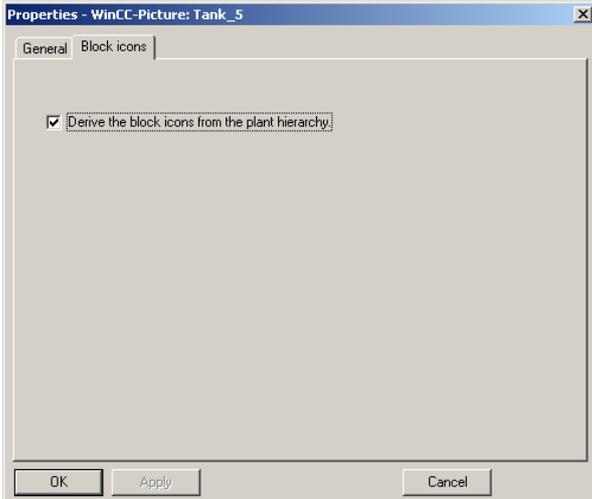
Table 3-1: PH extension

	Activity	Screenshot
<p>1.</p>	<p>Insert a new folder via the context menu of the plant folder: „Insert New Object > Hierarchy folder” The folder will be renamed “V705” in this example.</p>	
<p>2.</p>	<p>In Properties of the new PH folder the object type „Unit” is selected on the drop-down list on the tab “S88 Type Definition”. Click “OK” to apply the setting.</p>	

Plant picture extension

In order to avoid that the plant picture becomes confusing later, a picture of the unit will be created in addition for the OS.

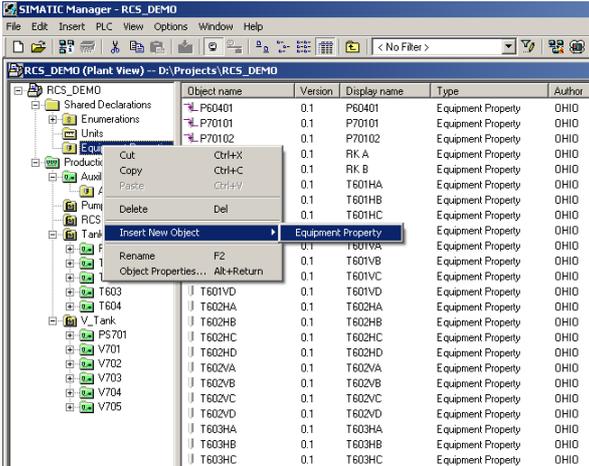
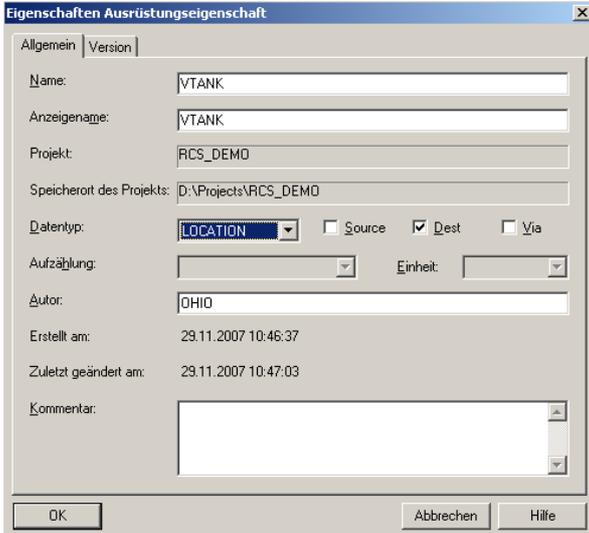
Table 3-2: PH extension

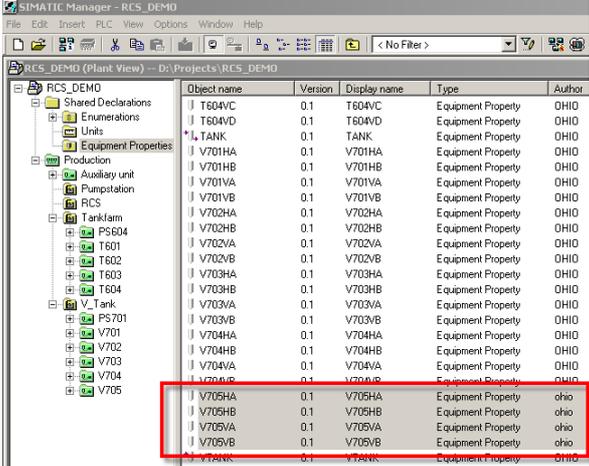
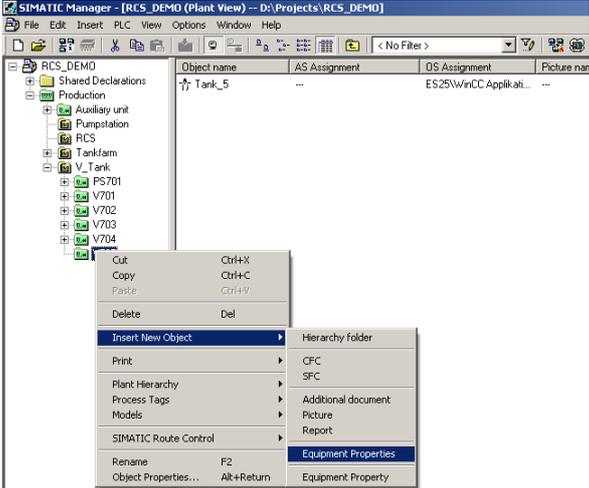
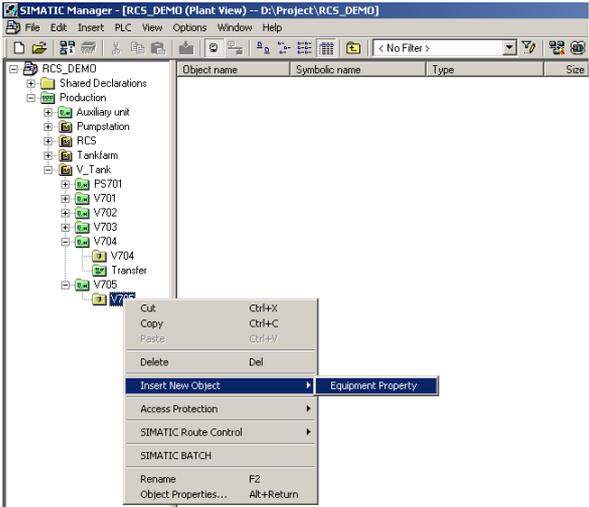
	Activity	Screenshot
<p>1.</p>	<p>Insert a new picture via the context menu of the unit folder „V705“: „Insert New Object > Picture“</p>	 <p>The screenshot shows the SIMATIC Manager interface. The left pane displays a project tree for 'RCS_DEMO'. Under the 'V_Tank' folder, the 'V705' unit is selected. The right pane shows the 'Object name' table with 'Tank_5' listed.</p>
<p>2.</p>	<p>In order to have available the block icons from the PH in the OS project later, select “Derive the block icons from the plant hierarchy” on the "Block icons" tab. Click “OK” to activate the selection.</p>	 <p>The screenshot shows the 'Properties - WinCC-Picture: Tank_5' dialog box. The 'Block icons' tab is active, and the checkbox 'Derive the block icons from the plant hierarchy' is checked. The 'OK' button is highlighted.</p>

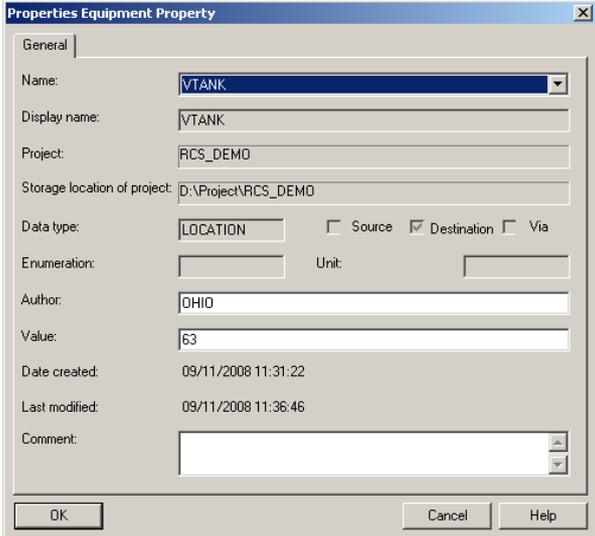
Inserting the locations

Locations are configured as equipment properties and are used to create partial routes. By connecting two locations a partial route is built. The locations are created in SIMATIC Manager as equipment properties in the PH of the S7 project.

Table 3-3: Configuring equipment properties in the PH

	Activity	Screenshot
<p>1.</p>	<p>New location types must be created on a global level according to the planned partial route network. For this purpose go to the context menu of the PH folder "Equipment Properties" under "Shared Declarations" and select the menu option: „Insert New Object > Equipment Property“</p>	 <p>The screenshot shows the SIMATIC Manager interface with a tree view on the left and a table on the right. The tree view shows a project structure with folders like 'Shared Declarations', 'Units', 'Product', 'Auxil', 'Pump', 'RCS', and 'Tank'. A context menu is open over the 'Equipment Property' folder under 'Shared Declarations'. The menu options include 'Cut', 'Copy', 'Paste', 'Delete', 'Insert New Object', 'Rename', and 'Object Properties...'. The 'Insert New Object' option is selected, and a sub-menu is visible with 'Equipment Property' highlighted.</p>
<p>2.</p>	<p>This newly created location type has to be processed. Assign the name in Properties, here „VTANK“ and in addition select the option "Data type > LOCATION" from the drop-down list.</p> <p>For the destination tank tick the „Dest“ box.</p> <p>Note that the „Source“, „Dest“ and „Via“ boxes should only be selected if this corresponds to the usage of the location type! Confirm the settings with "OK".</p>	 <p>The screenshot shows the 'Eigenschaften Ausrüstungseigenschaft' dialog box. It has two tabs: 'Allgemein' and 'Version'. The 'Allgemein' tab is active. The fields are: Name: VTANK, Anzeigename: VTANK, Projekt: RCS_DEMO, Speicherort des Projekts: D:\Projects\RCS_DEMO, Datentyp: LOCATION (selected in a dropdown), Aufzählung: (empty), Einheit: (empty), Autor: OHIO, Erstellt am: 29.11.2007 10:46:37, Zuletzt geändert am: 29.11.2007 10:47:03, and a text area for 'Kommentar'. There are checkboxes for 'Source', 'Dest' (checked), and 'Via'. Buttons for 'OK', 'Abbrechen', and 'Hilfe' are at the bottom.</p>

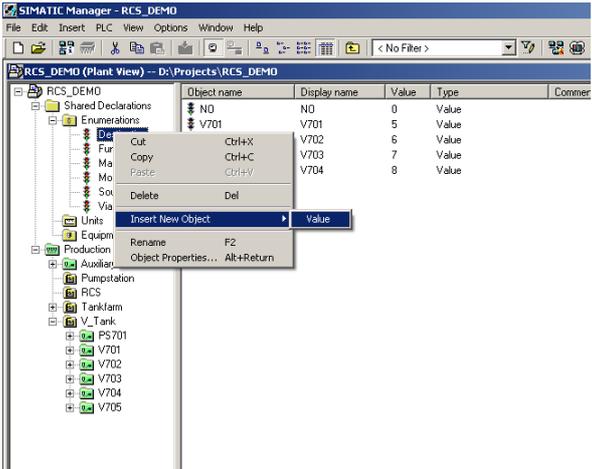
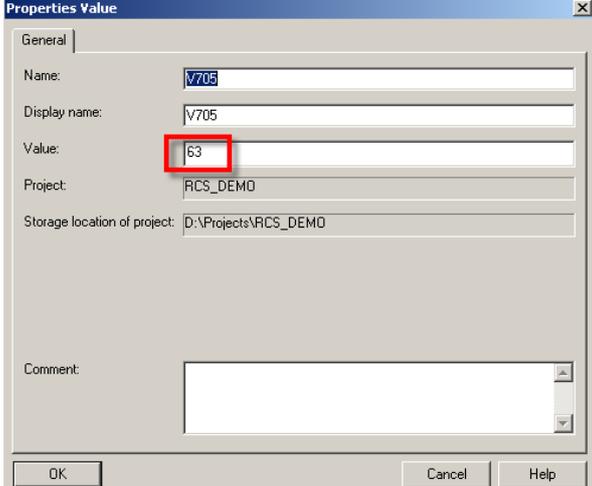
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<p>3.</p>	<p>Four more location types must be created for the planned plant extension.</p> <p>Create the „Equipment Properties“ „V705HA, V705VA, V705HB and V705VB“ analogously to the previous steps 4-5.</p> <p>None of the option boxes mentioned in step 2 will be ticked for these four location types.</p>	 <table border="1"> <thead> <tr> <th>Object name</th> <th>Version</th> <th>Display name</th> <th>Type</th> <th>Author</th> </tr> </thead> <tbody> <tr><td>T604VC</td><td>0.1</td><td>T604VC</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>T604VD</td><td>0.1</td><td>T604VD</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>T.TANK</td><td>0.1</td><td>TANK</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V701HA</td><td>0.1</td><td>V701HA</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V701HB</td><td>0.1</td><td>V701HB</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V701VA</td><td>0.1</td><td>V701VA</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V701VB</td><td>0.1</td><td>V701VB</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V702HA</td><td>0.1</td><td>V702HA</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V702HB</td><td>0.1</td><td>V702HB</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V702VA</td><td>0.1</td><td>V702VA</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V702VB</td><td>0.1</td><td>V702VB</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V703HA</td><td>0.1</td><td>V703HA</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V703HB</td><td>0.1</td><td>V703HB</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V703VA</td><td>0.1</td><td>V703VA</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V703VB</td><td>0.1</td><td>V703VB</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V704HA</td><td>0.1</td><td>V704HA</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V704HB</td><td>0.1</td><td>V704HB</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V704VA</td><td>0.1</td><td>V704VA</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V704VB</td><td>0.1</td><td>V704VB</td><td>Equipment Property</td><td>OHIO</td></tr> <tr><td>V705HA</td><td>0.1</td><td>V705HA</td><td>Equipment Property</td><td>ohio</td></tr> <tr><td>V705HB</td><td>0.1</td><td>V705HB</td><td>Equipment Property</td><td>ohio</td></tr> <tr><td>V705VA</td><td>0.1</td><td>V705VA</td><td>Equipment Property</td><td>ohio</td></tr> <tr><td>V705VB</td><td>0.1</td><td>V705VB</td><td>Equipment Property</td><td>ohio</td></tr> <tr><td>V.TANK</td><td>0.1</td><td>VTANK</td><td>Equipment Property</td><td>OHIO</td></tr> </tbody> </table>	Object name	Version	Display name	Type	Author	T604VC	0.1	T604VC	Equipment Property	OHIO	T604VD	0.1	T604VD	Equipment Property	OHIO	T.TANK	0.1	TANK	Equipment Property	OHIO	V701HA	0.1	V701HA	Equipment Property	OHIO	V701HB	0.1	V701HB	Equipment Property	OHIO	V701VA	0.1	V701VA	Equipment Property	OHIO	V701VB	0.1	V701VB	Equipment Property	OHIO	V702HA	0.1	V702HA	Equipment Property	OHIO	V702HB	0.1	V702HB	Equipment Property	OHIO	V702VA	0.1	V702VA	Equipment Property	OHIO	V702VB	0.1	V702VB	Equipment Property	OHIO	V703HA	0.1	V703HA	Equipment Property	OHIO	V703HB	0.1	V703HB	Equipment Property	OHIO	V703VA	0.1	V703VA	Equipment Property	OHIO	V703VB	0.1	V703VB	Equipment Property	OHIO	V704HA	0.1	V704HA	Equipment Property	OHIO	V704HB	0.1	V704HB	Equipment Property	OHIO	V704VA	0.1	V704VA	Equipment Property	OHIO	V704VB	0.1	V704VB	Equipment Property	OHIO	V705HA	0.1	V705HA	Equipment Property	ohio	V705HB	0.1	V705HB	Equipment Property	ohio	V705VA	0.1	V705VA	Equipment Property	ohio	V705VB	0.1	V705VB	Equipment Property	ohio	V.TANK	0.1	VTANK	Equipment Property	OHIO
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<p>4.</p>	<p>The location for the new destination tank must be inserted locally in the unit folder „V705“.</p> <p>For this purpose make the following selection via the context menu:</p> <p>„Insert New Object > Equipment Properties“</p> <p>Assign the name “V705” also here.</p>																																																																																																																														
<p>5.</p>	<p>This new location must be assigned the location type „VTANK“ which has been created globally before. For this purpose open the context menu and insert an "Equipment Property":</p> <p>„Insert New Object > Equipment Property“</p>																																																																																																																														

	Activity	Screenshot
6.	<p>The newly created location type is selected from the drop-down list in the properties of the location now.</p> <p>Click "OK" to activate the selection.</p>	

Enumerations

Due to the additional destination tank V705 another destination must be defined in "Enumerations".

Table 3-4: Enumeration

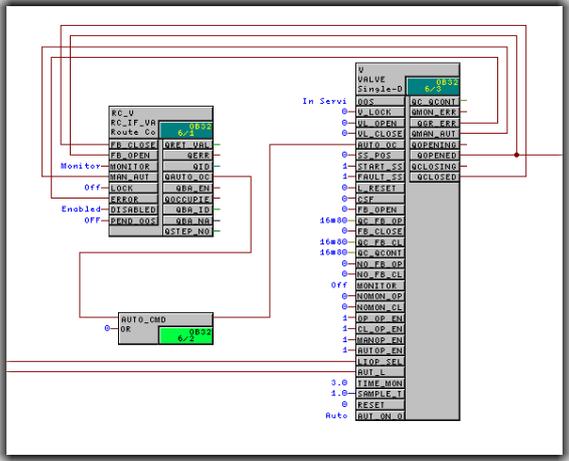
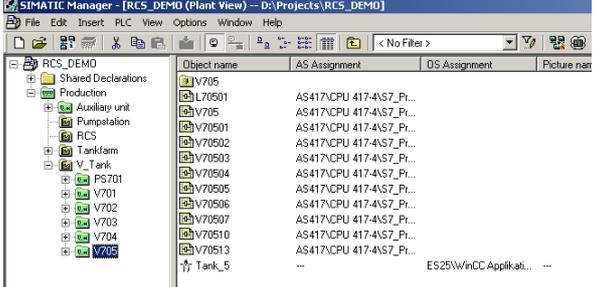
	Activity	Screenshot																														
<p>1.</p>	<p>Create a new enumeration object for the destination tank "V705" via the context menu of the enumeration "Destination": „Insert New Object > Value“</p>	 <table border="1"> <thead> <tr> <th>Object name</th> <th>Display name</th> <th>Value</th> <th>Type</th> <th>Comment</th> </tr> </thead> <tbody> <tr> <td>NO</td> <td>NO</td> <td>0</td> <td>Value</td> <td></td> </tr> <tr> <td>V701</td> <td>V701</td> <td>5</td> <td>Value</td> <td></td> </tr> <tr> <td>V702</td> <td>V702</td> <td>6</td> <td>Value</td> <td></td> </tr> <tr> <td>V703</td> <td>V703</td> <td>7</td> <td>Value</td> <td></td> </tr> <tr> <td>V704</td> <td>V704</td> <td>8</td> <td>Value</td> <td></td> </tr> </tbody> </table>	Object name	Display name	Value	Type	Comment	NO	NO	0	Value		V701	V701	5	Value		V702	V702	6	Value		V703	V703	7	Value		V704	V704	8	Value	
Object name	Display name	Value	Type	Comment																												
NO	NO	0	Value																													
V701	V701	5	Value																													
V702	V702	6	Value																													
V703	V703	7	Value																													
V704	V704	8	Value																													
<p>2.</p>	<p>Enter the value which you get from the properties of the location "VTANK" in the properties now. Click "OK" to apply the value.</p>																															

3.2.2 Duplicating CFCs

CFCs required for the extension

The additional valves and the fill level sensor of the plant extension must be created in the PH folder V705. The required charts V705, V70501, V70502, V70503, V70504, V70506, V70507, V70510, V70513 and L70501 are created analogously to the other unit blocks.

Table 3-5: CFC configuration

	Activity	Screenshot
1.	From the PH folder "V704" copy the corresponding CFCs of the elements (V70401,...) to the PH folder "V705".	
2.	Rename the CFCs according to the unit ID.	
3.	After all required control and sensor elements have been duplicated, the view shown on the right is obtained in the PH folder "V705".	

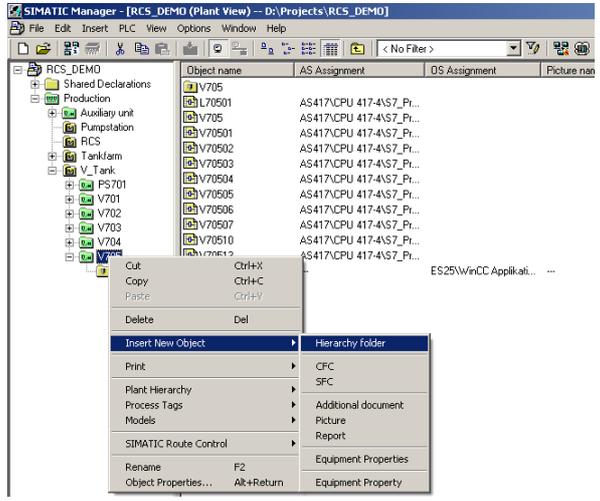
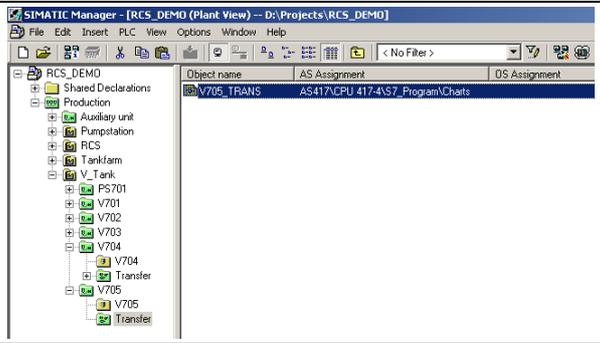
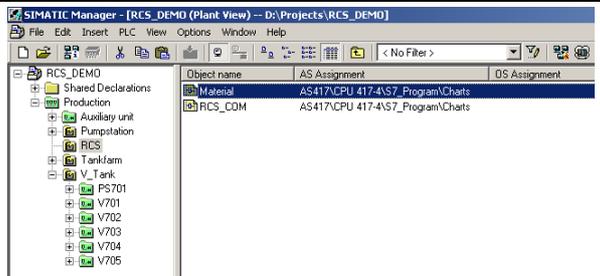
Note

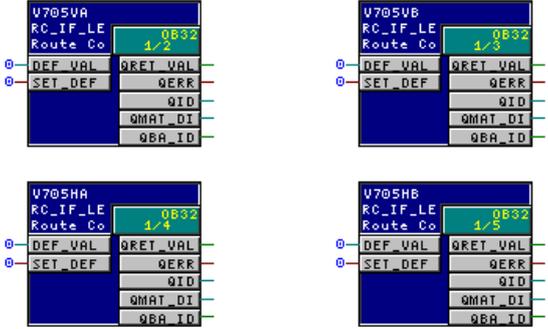
The valves V70405 and V70407 in the PH folder V704 must be renamed to V70420 and V70430, respectively, due to the plant change. The valves V70404 and V70406 can be deleted from the folder as they were added to the plant extension (V705) (V70504 and V70506).

Engineering the material transfer

From the RC view no other SFC typical (from RC library) needs to be created for the automatic mode. The material transfer can be executed with the existing SFCs already. But due to the consistency of the configuration another SFC typical instance will be created for the newly created unit. In addition the link elements (LE) per partial route must be added in SIMATIC Manager to achieve material compatibility. Link elements store the information what material is actually on a partial route.

Table 3-6: Configurations for material transfer

	Activity	Screenshot
1.	<p>Enter a new PH folder via the context menu of the unit folder "V705":</p> <p>„Insert New Object > Hierarchy folder“</p> <p>The folder gets the name "Transfer".</p>	
2.	<p>To facilitate the material transfer to the destination tank, copy the SFC „V704_TRANS“ from the PH folder "V704 – Transfer" and paste it to the PH folder "V705 – Transfer".</p> <p>Rename the SFC duplicate to "V705_TRANS".</p>	
3.	<p>To configure the link elements, open the CFC "Material" in the PH folder "RCS".</p>	

	Activity	Screenshot
<p>4.</p>	<p>Insert the block „RC_IF_LE“ (FB828) for each of the locations V705VA, ..., V705HB into the CFC.</p> <p>Rename the blocks according to the locations.</p>	

Note

For more information about the configuration of valves, motors, sensors and the special Route Control blocks (RC_IF_ROUTE, RC_IF_VALVE,...) refer to the manual “SIMATIC Route Control > Configuring in SIMATIC Manager”

<http://support.automation.siemens.com/WW/view/en/27002783>

and to the manual „Getting Started Route Control > Route Control Configuration in the Automation System”

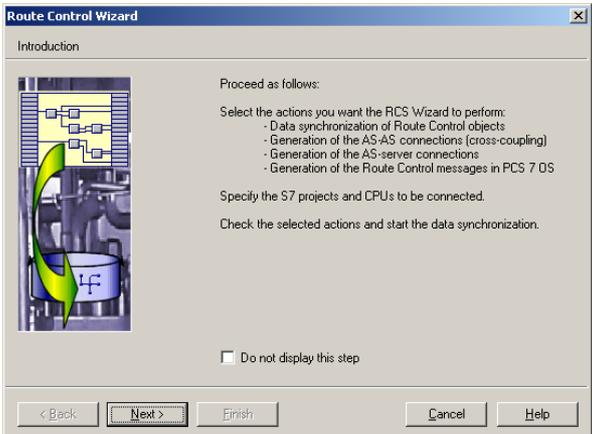
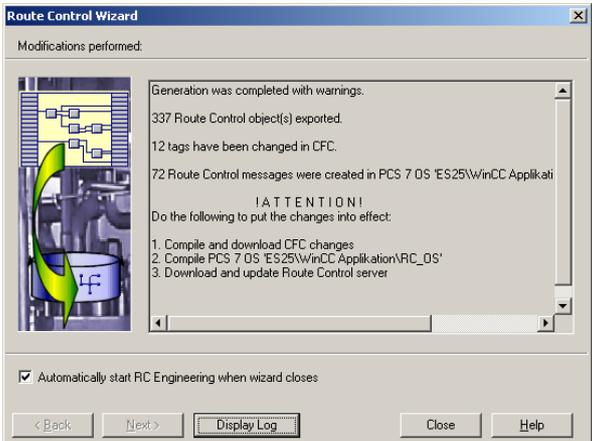
<http://support.automation.siemens.com/WW/view/en/27002720>

3.2.3 Project data import with the RC Wizard

The Route Control Wizard facilitates the transfer of RC-relevant data from SIMATIC Manager to Route Control Engineering.

In addition the Route Control Wizard assigns the IDs for the transport route elements and links. They are inserted by it automatically at the RC blocks in the respective CFCs.

Table 3-7: Configurations for material transfer

	Activity	Screenshot
<p>1.</p>	<p>Start the RC Wizard from SIMATIC Manager via the menu option: "Options > SIMATIC Route Control > Follow the instructions. Data synchronization is sufficient for the modifications which were made.</p>	
<p>2.</p>	<p>Finally you can check the result of the data transfer in the "Wizard Log". Note the instructions with regard to compilation and download of the CFC modifications, compilation of OS and download und updating of the Route Control Server.</p>	

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Note

For more information about the Route Control Wizard and its execution refer to the manual "Getting Started Route Control > Route Control Wizard"

<http://support.automation.siemens.com/WW/view/en/27002720>

3.2.4 Loading the project modifications

Automation System

Following the engineering of the CFCs and the data import through the RC Wizard the project modifications must be made known to the automation system.

Compile and download the S7 user program into the automation system. Proceed as usual but note the selected options and change them if necessary.

For transferring the configuration modifications made it is sufficient to perform a delta download. A CPU stop of the AS is not necessary here. Modifications can be entered „online“.

In the case of an entire download of an AS make sure that all routes in which the AS is involved are deactivated.

Operator Station

After the S7 program has been downloaded to the automation system, the Operator Station must get the new data as well.

The OS compilation is performed from out of the SIMATIC Manager. Proceed as usual but note the selected options and change them if necessary.

Note

For information about delta download/entire download refer to the manual "Engineering System > Compiling and downloading"

<http://support.automation.siemens.com/WW/view/en/27002802>

and to the manual „Operator Station > Downloading and Activating a Project“

<http://support.automation.siemens.com/WW/view/en/27002758>

3.2.5 Configuring in RC Engineering

In Route Control Engineering mode tables, partial routes and materials/material successors are configured.

The imported data of the RC Wizard from the S7 project are used in Route Control Engineering to implement the plant extension.

Mode table in RC Engineering

Mode tables contain all partial routes which exist in the material transport network. Each partial route is assigned to a mode table.

To be complete the existing mode table must be extended by the new partial routes.

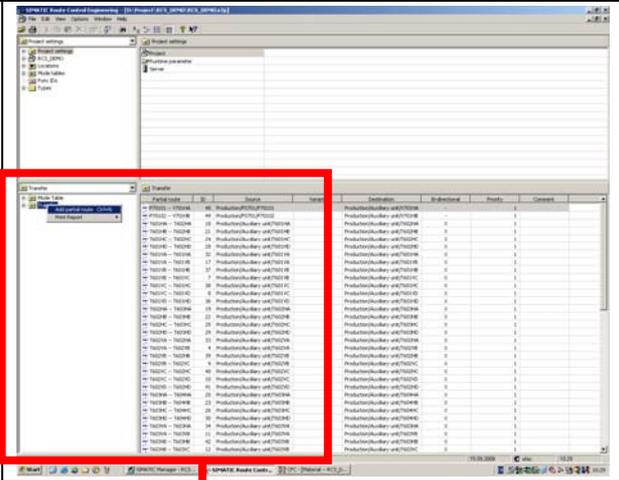
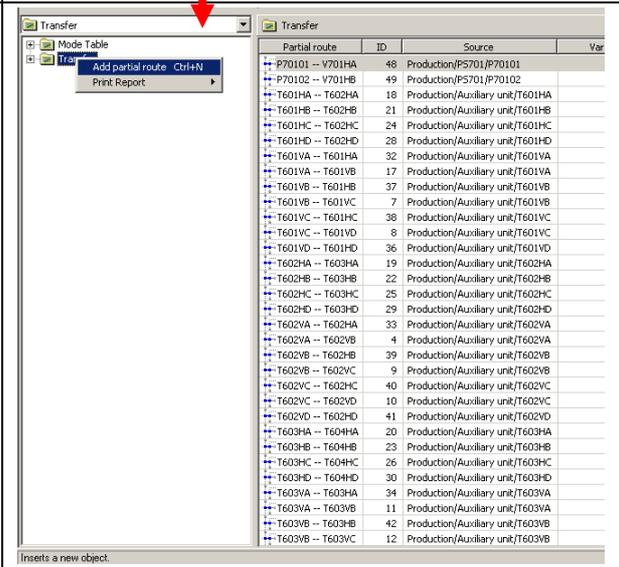
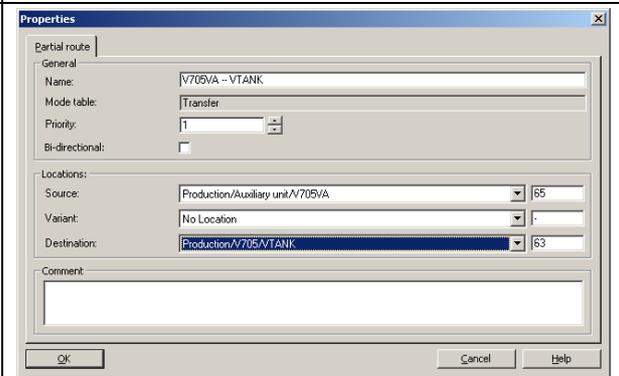
Partial routes in RC Engineering

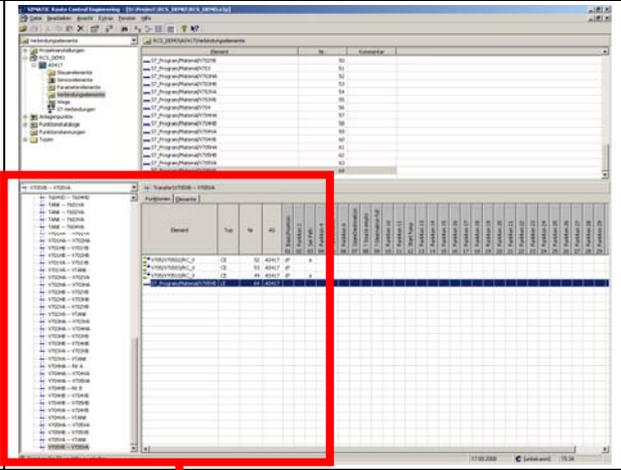
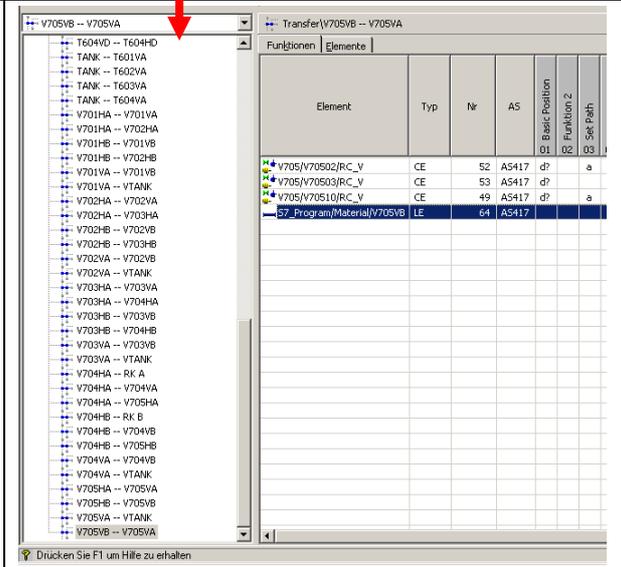
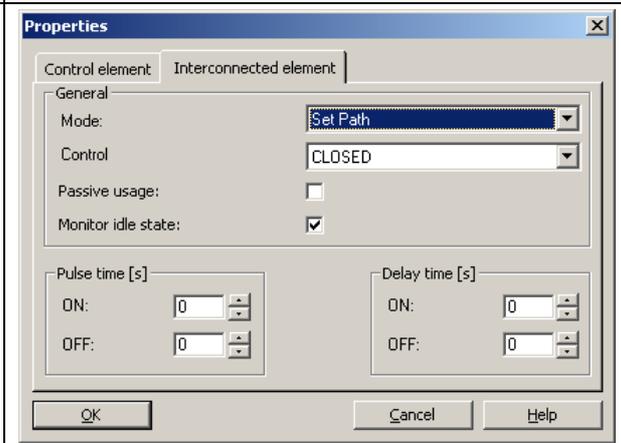
Partial routes are the smallest sections of a route network (e.g. pipelines) in the sense of route control. The task of the route control is to set routes and transport materials on them. The partial routes get elements assigned to them.

A total route request is calculated via the RC Server in runtime. The RC Server uses an algorithm for this to find the shortest possible route through the plant network. The configured partial routes are combined with each other in a suitable way for this.

Extending the mode table by new partial routes

Table 3-8: Creating new partial routes

	Activity	Screenshot
1.	<p>In Route Control Engineering the material transport routes must be configured with the respective elements.</p>	
2.	<p>To add a new partial route, go to the context menu of the mode table and select the menu option: "Add partial route"</p>	
3.	<p>At „Name“ enter the name of the partial route. From the drop-down lists of source and destination select the required location of the partial route. Click "OK" to apply your settings.</p>	

	Activity	Screenshot																																			
4.	<p>After the partial routes have been defined, route elements (valves, sensors,...) are assigned to every partial route.</p>																																				
5.	<p>For this purpose select a partial route from the mode table. Use drag & drop to drag the respective element from one of the "... elements" folders to the list of the "Elements" tab of the partial route.</p>	 <table border="1"> <thead> <tr> <th>Element</th> <th>Typ</th> <th>Nr</th> <th>AS</th> <th>Basic Position</th> <th>Function 2</th> <th>Set Path</th> </tr> </thead> <tbody> <tr> <td>V705/N70502/RC_V</td> <td>CE</td> <td>52</td> <td>A5417</td> <td>d?</td> <td></td> <td>a</td> </tr> <tr> <td>V705/N70503/RC_V</td> <td>CE</td> <td>53</td> <td>A5417</td> <td>d?</td> <td></td> <td></td> </tr> <tr> <td>V705/N70510/RC_V</td> <td>CE</td> <td>49</td> <td>A5417</td> <td>d?</td> <td></td> <td>a</td> </tr> <tr> <td>37_ProgramMaterial/V705VB</td> <td>LE</td> <td>64</td> <td>A5417</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Element	Typ	Nr	AS	Basic Position	Function 2	Set Path	V705/N70502/RC_V	CE	52	A5417	d?		a	V705/N70503/RC_V	CE	53	A5417	d?			V705/N70510/RC_V	CE	49	A5417	d?		a	37_ProgramMaterial/V705VB	LE	64	A5417			
Element	Typ	Nr	AS	Basic Position	Function 2	Set Path																															
V705/N70502/RC_V	CE	52	A5417	d?		a																															
V705/N70503/RC_V	CE	53	A5417	d?																																	
V705/N70510/RC_V	CE	49	A5417	d?		a																															
37_ProgramMaterial/V705VB	LE	64	A5417																																		
6.	<p>A window opens automatically where you have to enter the mode level for controlling the element. You can revise them later, if necessary, via the "Modes" tab.</p> <p>To configure the elements on the partial routes proceed according to the following control tables.</p>																																				

Control tables

The following control tables contain all route elements of the partial route which must be configured. The elements shall be controlled in the individual mode levels as shown in the following tables.

The symbols which are contained in the control tables are defined as follows:

Table 3-9

Symbol	Description
a	Activation
d	Deactivation
?	Check
a?	Check for activation
d?	Check for deactivation
2	Delay time Off

Required partial routes

Control table of the partial route V704HA-V705HA

Table 3-10: Partial route V704HA - V705HA

Element	Initial position	Set path	Pump on	Open source	Open destination	Source not empty	Dest. not full
CE_V70320	d?						
CE_V70402	d?						
CE_V70420	d?	a					
CE_V70502	d?						
LE_V704HA							

Control table of the partial route V705HA-V705VA

Table 3-11: Partial route V705HA - V705VA

Element	Initial position	Set path	Pump on	Open source	Open destination	Source not empty	Dest. not full
CE_V70420	d?						
CE_V70501	d?						
CE_V70502	d?	a					
CE_V70510	d?						
CE_V70504	d?						
CE_V70505	d?						
LE_V705HA							

Control table of the partial route V705VA - VTANK

Table 3-12: Partial route V705VA - VTANK

Element	Initial position	Set path	Pump on	Open source	Open destin.	Source not empty	Dest. not full
CE_V70501	d?				a		
CE_V70502	d?						
CE_V70510	d?						
SE_L70501-RC-SE-HL							d?
PE_L70501-RC-Level			2				
LE_V705VA							

Control table of the partial route V704HB - V705HB

Table 3-13: Partial route V704HB - V705HB

Element	Initial position	Set path	Pump on	Open source	Open destin.	Source not empty	Dest. not full
CE_V70330	d?						
CE_V70403	d?						
CE_V70430	d?	a					
CE_V70503	d?						
LE_V704HB							

Control table of the partial route V705HB-V705VB

Table 3-14: Partial route V705HB - V705VB

Element	Initial position	Set path	Pump on	Open source	Open destin.	Source not empty	Dest. not full
CE_V70430	d?						
CE_V70503	d?	a					
CE_V70510	d?						
CE_V70513	d?						
CE_V70506	d?						
CE_V70507	d?						
LE_V705HA							

Control table of the partial route V705VB - V705VA

Table 3-15: Partial route V705VB - V705VA

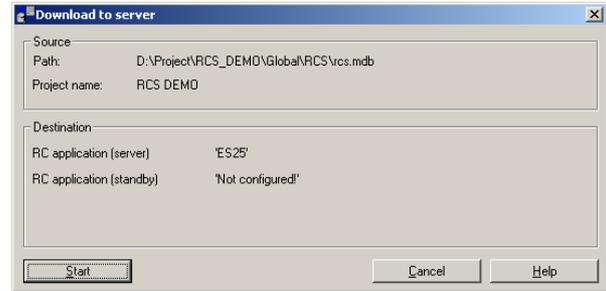
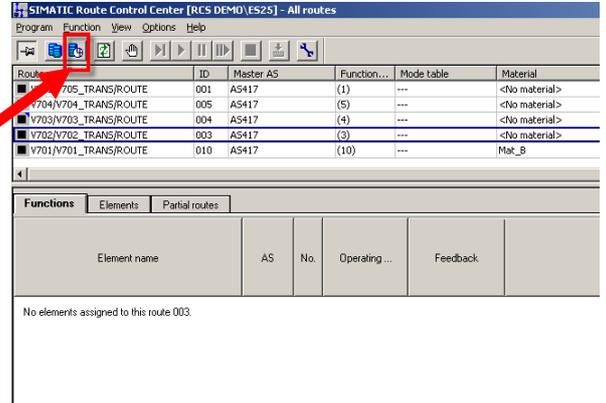
Element	Initial position	Set path	Pump on	Open source	Open destin.	Source not empty	Dest. not full
CE_V70501	d?						
CE_V70502	d?	a					
CE_V70503	d?						
CE_V70510	d?	a					
LE_V705VB							

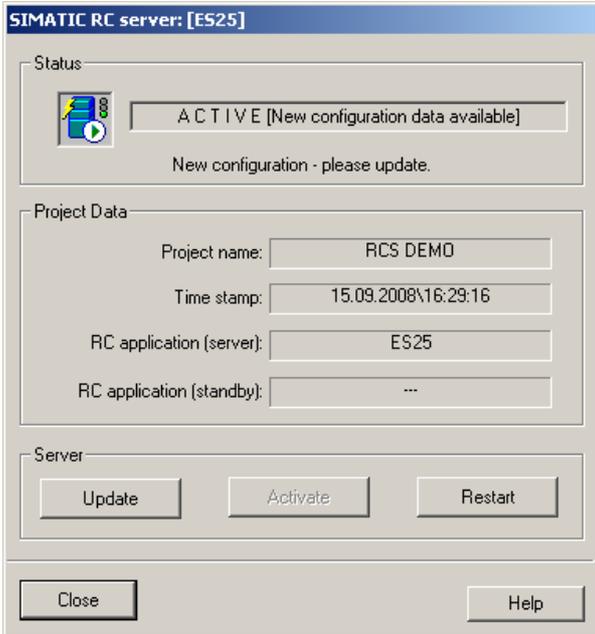
Loading and updating the Route Control Server

The Route Control Server determines a suitable path from source to destination based on the configured partial routes and loads this information to the automation system.

Start the runtime of the OS project beforehand.

Table 3-16: Creating new partial routes

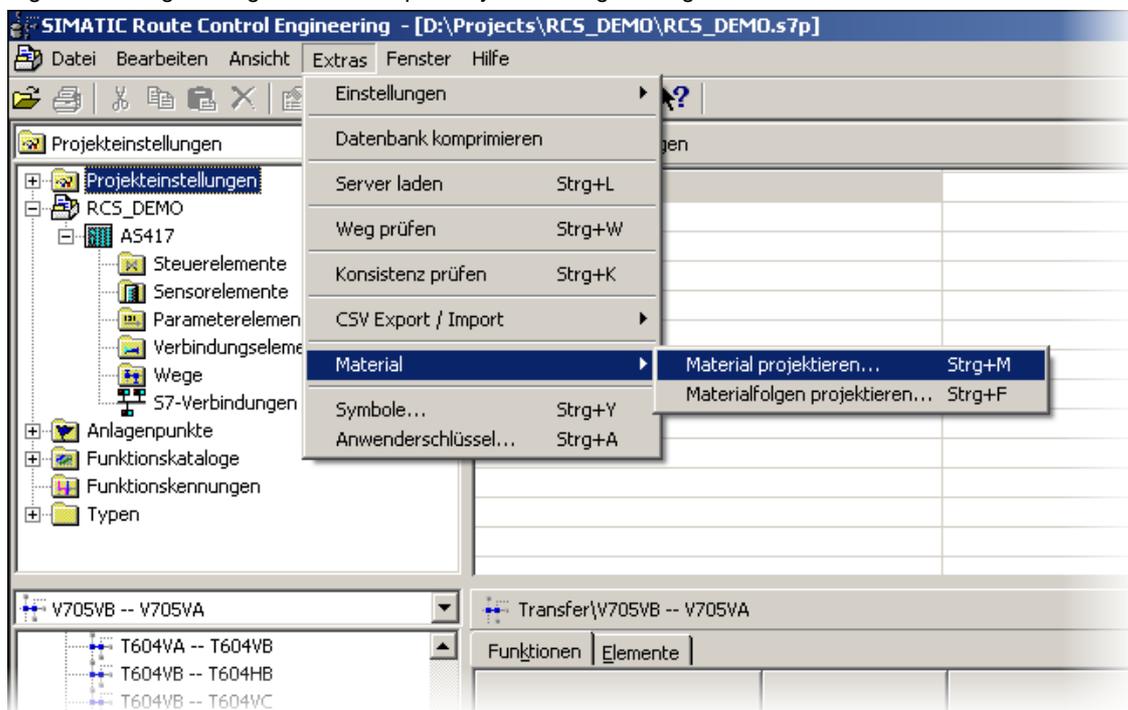
	Activity	Screenshot																																				
1.	<p>Start the server via the start menu: "Start > SIMATIC > Route Control > Server" The server is shown as an icon in the task bar now.</p>																																					
2.	<p>Go to RC Engineering and select the menu option: "Options > Download to server" Then click the "Start" button.</p>																																					
3.	<p>Open the RC Center via the start menu: "Start > SIMATIC > Route Control > Center" From the menu bar select the icon "Show server status".</p>	 <table border="1"> <thead> <tr> <th>Route</th> <th>ID</th> <th>Master AS</th> <th>Function...</th> <th>Mode table</th> <th>Material</th> </tr> </thead> <tbody> <tr> <td>V705/V705_TRANS/ROUTE</td> <td>001</td> <td>AS417</td> <td>(1)</td> <td>---</td> <td><No material></td> </tr> <tr> <td>V704/V704_TRANS/ROUTE</td> <td>005</td> <td>AS417</td> <td>(5)</td> <td>---</td> <td><No material></td> </tr> <tr> <td>V703/V703_TRANS/ROUTE</td> <td>004</td> <td>AS417</td> <td>(4)</td> <td>---</td> <td><No material></td> </tr> <tr> <td>V702/V702_TRANS/ROUTE</td> <td>003</td> <td>AS417</td> <td>(3)</td> <td>---</td> <td><No material></td> </tr> <tr> <td>V701/V701_TRANS/ROUTE</td> <td>010</td> <td>AS417</td> <td>(10)</td> <td>---</td> <td>Mat_B</td> </tr> </tbody> </table>	Route	ID	Master AS	Function...	Mode table	Material	V705/V705_TRANS/ROUTE	001	AS417	(1)	---	<No material>	V704/V704_TRANS/ROUTE	005	AS417	(5)	---	<No material>	V703/V703_TRANS/ROUTE	004	AS417	(4)	---	<No material>	V702/V702_TRANS/ROUTE	003	AS417	(3)	---	<No material>	V701/V701_TRANS/ROUTE	010	AS417	(10)	---	Mat_B
Route	ID	Master AS	Function...	Mode table	Material																																	
V705/V705_TRANS/ROUTE	001	AS417	(1)	---	<No material>																																	
V704/V704_TRANS/ROUTE	005	AS417	(5)	---	<No material>																																	
V703/V703_TRANS/ROUTE	004	AS417	(4)	---	<No material>																																	
V702/V702_TRANS/ROUTE	003	AS417	(3)	---	<No material>																																	
V701/V701_TRANS/ROUTE	010	AS417	(10)	---	Mat_B																																	

	Activity	Screenshot
<p>4.</p>	<p>Click "Update" to transfer the new RC project data to the RC Server.</p>	 <p>The screenshot shows the SIMATIC RC server interface for server ES25. The status is 'ACTIVE [New configuration data available]' with a sub-message 'New configuration - please update.' Below this, the 'Project Data' section contains: Project name: RCS DEMO, Time stamp: 15.09.2008\16:29:16, RC application (server): ES25, and RC application (standby): ... The 'Server' section has buttons for 'Update', 'Activate', and 'Restart'. At the bottom are 'Close' and 'Help' buttons.</p>
<p>5.</p>	<p>The RC Server has been loaded and updated with the new project data now. Push "Close" to close the window while the RC Server process continues in the background.</p>	 <p>The screenshot shows the SIMATIC RC server interface for server ES25. The status is 'ACTIVE'. The 'Project Data' section contains: Project name: RCS DEMO, Time stamp: 24.09.2008\09:42:26, RC application (server): ES25, and RC application (standby): ... The 'Server' section has buttons for 'Update', 'Activate', and 'Restart'. At the bottom are 'Close' and 'Help' buttons.</p>

3.3 Materials in RC Engineering

Certain materials must not follow each other or be transported on the same route in many parts of industry. Therefore route control provides the option to engineer material compatibility (material successors). The information what material is being transferred along what partial route is temporarily stored during runtime in a link element (LE) which is interconnected on the partial route. With this information the route control checks whether or not the partial route may be used for the next material transport with the next material (interlocking by means of material).

Figure 3-3: Engineering material compatibility in RC Engineering



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Note

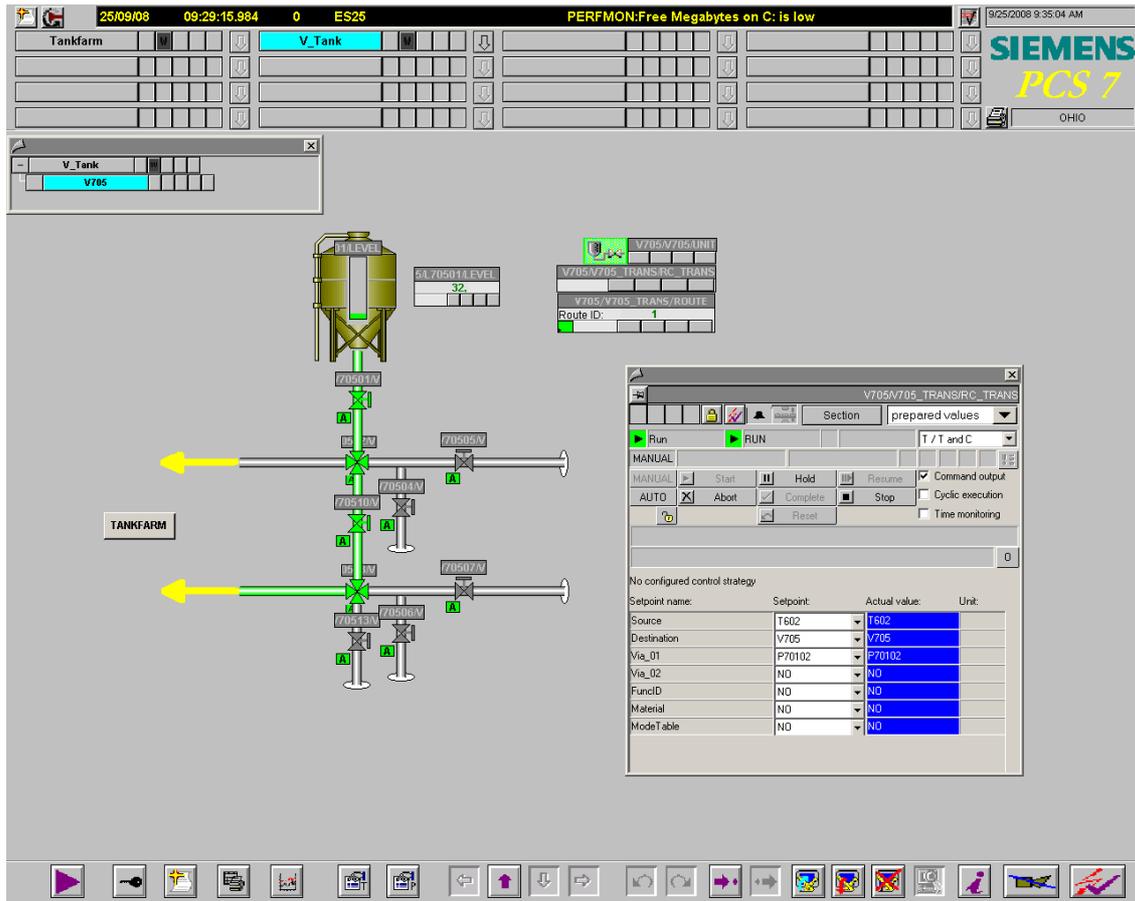
For more information about Route Control Engineering and the engineering of material successors refer to the manual "Getting Started Route Control > Materials and material successors"

<http://support.automation.siemens.com/WW/view/en/27002720>

3.4 System management

With regard to material transport the OS provides several options of starting or controlling a route. The material transport can be routed via the RC faceplate, the SFC faceplate or the RC Center.

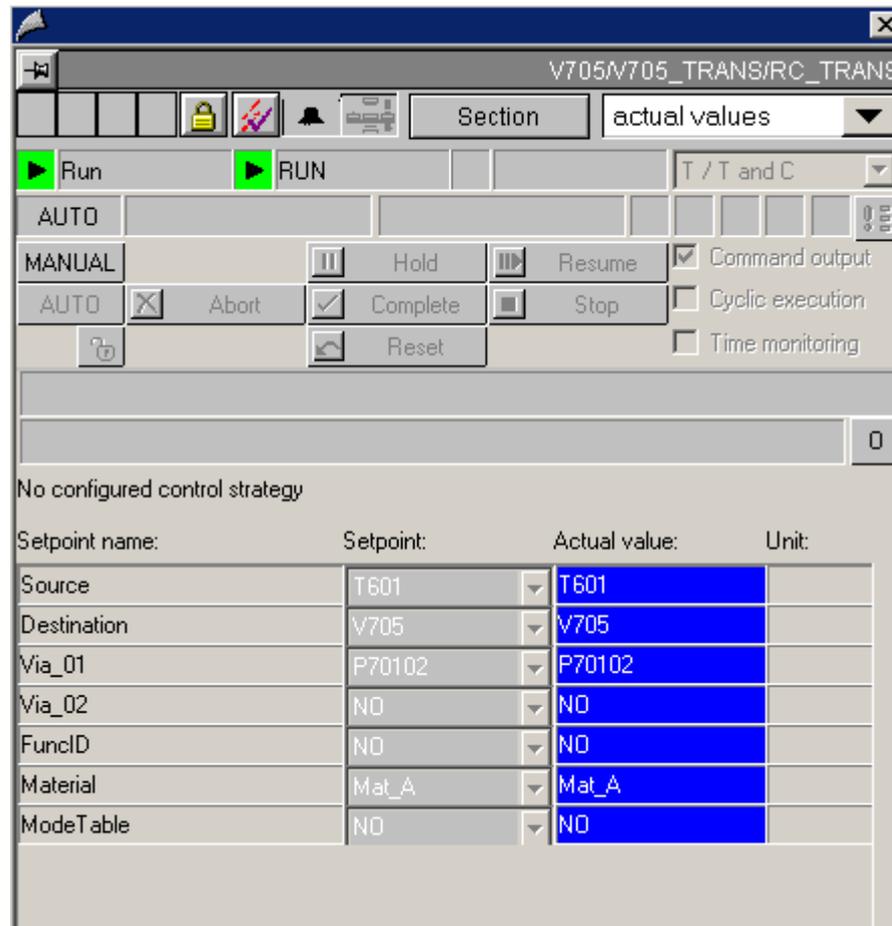
Figure 3-4: Runtime view of the plant extension with SFC faceplate opened



SFC faceplate

With a sequential control which is created in SFC Editor both discontinuous and continuous modes of operating plants can be implemented. The SFC faceplate permits to trigger and/or interrupt this sequential control in WinCC Runtime.

Figure 3-5: SFC dialog for transport route control



The locations which have been configured before can be displayed in the lower drop-down lists to be considered for the route selection. The settings tell the system what source tank is emptied, what destination tank is filled and via what pump the material flow shall take place.

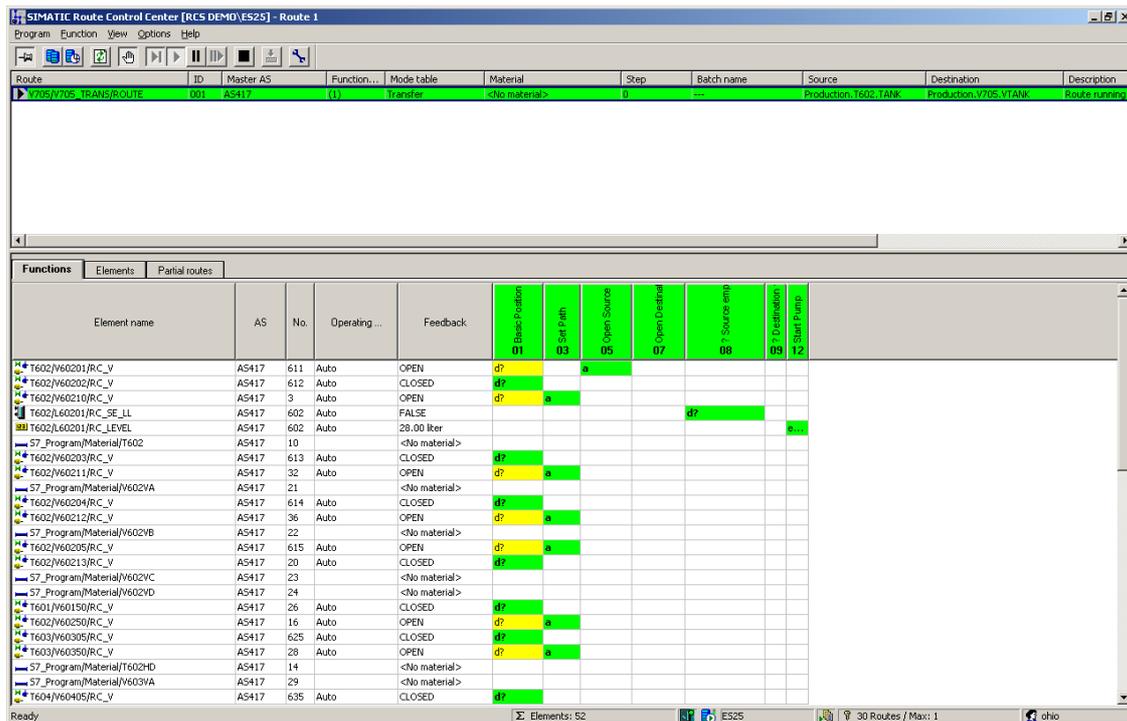
The material transport is controlled via the buttons. Switching from manual operation to automatic mode is also possible.

RC Center

The RC Center provides information about the transport route and the route elements contained in it and about control options.

In addition the RC Server can be selected and updated from here.

Figure 3-6: Route Control Center



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The upper part of the RCC window shows the information about a route. The lower part shows the respective route elements.

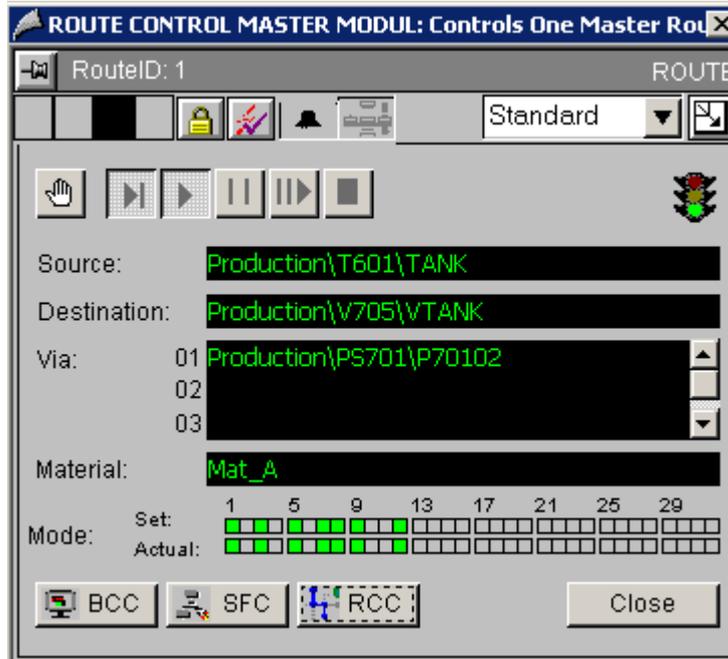
In addition three tabs can be selected in the lower part:

- "Functions" tab
Displays the element control in the different mode levels.
- "Elements" tab
Displays the setpoint and actual positions of the respective elements.
- "Partial routes" tab
Displays all partial routes of a route.

RC faceplate

The RC faceplate facilitates the control of the transport routes as well.

Figure 3-7



In the manual mode there is the option to request, start, stop, finish and continue a route.

The overview shows the source and destination locations and the intermediate locations through which the material transport is executed. However these locations cannot be changed in the RC faceplate.

The mode levels displayed in the lower part tell whether the mode fulfils the defined behaviour.

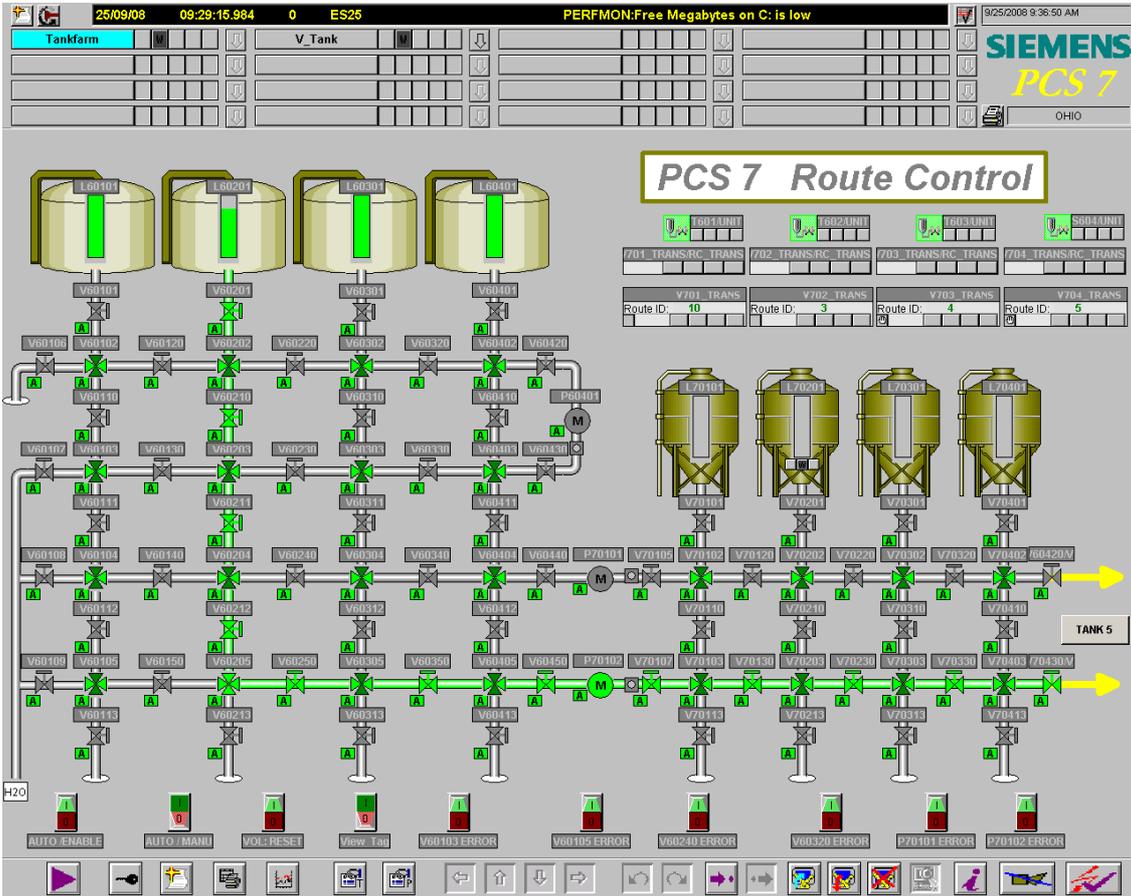
Note

For more information about the RC faceplate and its display and control elements refer to the manual "SIMATIC Route Control > Operator Control and Monitoring"

<http://support.automation.siemens.com/WW/view/en/27002783>

Overview Tankfarm

Figure 3-8: Runtime view of the Tankfarm plant



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The entire plant should be in automatic mode. Thus the RC will open or activate the elements required for route selection, such as valves and motors, as soon as this is required. For this purpose the automatic mode switch must be set to "Auto".

4 Benefits

4.1.1 Engineering

SIMATIC Route Control is fully integrated in SIMATIC PCS 7 and can be adapted easily to the existing plant size.

The possibility of using templates of model charts (CFC) and model blocks (SFC) saves time needed for creating customized charts and blocks and helps avoiding engineering errors. Thus control and sensor elements can be added fast.

The engineering costs can be cut through simplified modelling and engineering as the unit can be mapped directly to the Plant Hierarchy, locations and partial routes.

4.1.2 Operation/maintenance

The operator can continuously monitor the operation thanks to the operation and monitoring supports provided by SFC, RC Center and the RC faceplate and quickly and safely respond and manipulate the process if required.

If maintenance must be carried out, all running route transfers will be finished and at the same time the start of new material transfers will be halted until the maintenance is completed.

4.1.3 User of the system

The specific requirements for the plant extension can be integrated into the existing project fast and clearly.

Engineering changes can be applied "online", i.e. during runtime without having to stop the process ("delta download").

5 Appendix and List of Further Literature

5.1 Glossary

Location (also node)

Locations are the start, intermediate (via) and end locations of partial routes or routes. Each location is an instance of a location type. Locations are configured in SIMATIC Manager as equipment properties of units and imported to Route Control Engineering for the creation of partial routes.

Element

Interface block from the Route Control library for the connection of process blocks. The names of these interface blocks start with RC_IF_. In Route Control Engineering elements are inserted in partial routes. Here it is configured how the element is controlled in the various mode levels.

Equipment Properties

The TH folder "Equipment Properties" in "Global Declarations" of the PCS 7-Projekt contains all node-types.

All nodes will be engineered as "Equipment Property" in the respective unit of the SIMATIC Manager.

Mode table

A mode table comprises up to 32 modes or mode levels grouping levels which belong together under a process point of view.

Example: Brewery / brewing room (mode table)

- Initial position (mode level)
- Open transport valves (mode level)
- Switch on pump (mode level)
- Open source valve (mode level)

Model levels

The elements of a route or partial route need not be activated or deactivated all together but they can be installed in up to 32 groups, the so-called mode levels, and controlled differently.

It is the responsibility of the user program to link the individual mode levels in a suitable way.

Examples:

- If "initial position is reached",
- then "open transport valves"
- if "transport valves are open"

- then “switch on pump”

“Initial position is reached” means in this case that the output parameter value QMODE of RC_IF_ROUTE linked with the bit of the mode level via an “OR” must be 1.

“Open transport valves” means that the bit of the mode level for the input parameter MODE at RC_IF_ROUTE must be set to 1.

Location

Location

Material compatibility

The pipelines of industrial plants may be used for transporting different materials. Since these materials show various degrees of compatibility among each other, material successors are determined in RC to ensure material compatibility.

RC

Route Control

Sensor element

A sensor element SE is an object which feeds back a value from the process and indicates whether an expected actual value corresponds to the current actual value. SEs are not controlled.

Example: Limit switch, flow meter,...

Server

(here Route Control Server)

Own computer or also redundant computer pair for the processing of route queries from the Route Control automation systems and as a link between these and the clients (Route Control Center).

SFC

SFC stands for “Sequential Function Chart” (sequential control).

Typical applications of sequential control systems involve processes and plants with discontinuous characteristics. Sequential control can also be used for continuous processes and plants, for example, for approaching and withdrawing movements, operating point changes, and state changes due to faults.

Control element

A control element (CE) is an object which can be controlled and which can also feed back a value.

Example: Motor, valve,...

Partial route

Partial routes are the individual sections of a route. They are defined by the source and destination locations. When partial routes are engineered elements are inserted in them. All partial routes together form the route network from which the search algorithm selects certain partial routes and combines them to form routes.

Link element

A link element (LE) is an object which represents a material in a transport medium, e.g. pipeline or conveyor belt.

Route

A route always consists of 1 to n partial routes. The partial routes are selected during runtime. The route comprises all elements which are used on its partial routes and it stretches from the source to the destination of the material transport. In Route Control engineering only partial routes are configured. A total route is generated during runtime only when a route is requested stretching from the source to the destination of the material transport.

Route element

A route element can be, for instance, control, sensor, link or parameter elements which are part of a partial route.

5.2 Literature

Bibliographic references

Table 5-1

	Topic	Title
/1/	Route Control	Prozessleitsystem PCS 7 Route Control V7.0 SP1
/2/	Route Control	Prozessleitsystem PCS 7 V7.0.1 Getting Started Route Control

Internet links

Table 5-2

	Topic	Title
/1/	Siemens A&D Customer Support	http://support.automation.siemens.com