Application Example • 10/2016

PCS 7 Water Unit Template – External Pump Station of a Wastewater Treatment Plant (WWTP) with S7-300

SIMATIC PCS 7 V8.1 SP1, TIA Portal V13 SP1

Warranty and liability

Note

The Application Examples are not binding and do not claim to be complete regarding the circuits shown, equipping and any eventuality. The Application Examples do not represent customer-specific solutions. They are only intended to provide support for typical applications. You are responsible for ensuring that the described products are used correctly. These Application Examples do not relieve you of the responsibility to use safe practices in application, installation, operation and maintenance. When using these Application Examples, you recognize that we cannot be made liable for any damage/claims beyond the liability clause described. We reserve the right to make changes to these Application Examples at any time without prior notice.
If there are any deviations between the recommendations provided in these Application Examples and other Siemens publications – e.g. Catalogs – the contents of the other documents have priority.

We do not accept any liability for the information contained in this document. Any claims against us – based on whatever legal reason – resulting from the use of the examples, information, programs, engineering and performance data etc., described in this Application Example shall be excluded. Such an exclusion shall not apply in the case of mandatory liability, e.g. under the German Product Liability Act (“Produkthaftungsgesetz”), in case of intent, gross negligence, or injury of life, body or health, guarantee for the quality of a product, fraudulent concealment of a deficiency or breach of a condition which goes to the root of the contract (“wesentliche Vertragspflichten”). The damages for a breach of a substantial contractual obligation are, however, limited to the foreseeable damage, typical for the type of contract, except in the event of intent or gross negligence or injury to life, body or health. The above provisions do not imply a change of the burden of proof to your detriment.
Any form of duplication or distribution of these Application Examples or excerpts hereof is prohibited without the expressed consent of the Siemens AG.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks. In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens’ products and solutions only form one element of such a concept.
Customer is responsible to prevent unauthorized access to its plants, systems, machines and networks. Systems, machines and components should only be connected to the enterprise network or the internet if and to the extent necessary and with appropriate security measures (e.g. use of firewalls and network segmentation) in place.
Additionally, Siemens’ guidance on appropriate security measures should be taken into account. For more information about industrial security, please visit http://www.siemens.com/industrialsecurity.

Siemens’ products and solutions undergo continuous development to make them more secure. Siemens strongly recommends to apply product updates as soon as available and to always use the latest product versions. Use of product versions that are no longer supported, and failure to apply latest updates may increase customer’s exposure to cyber threats.
To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under http://www.siemens.com/industrialsecurity.
Preface

Aim of the Application Example

The aim of this Application Example is to provide you with a ready-made and unified example project for a wastewater treatment plant as a quick introduction and to aid the development of knowledge. The example project is based on Water Templates. This example project can be flexibly adapted to your individual requirements and integrated into your own multiprojects.

Core contents

The following main topics are covered in this application example:

- Structure of an external pump station of a wastewater treatment plant
- Description of the individual functions
- Working with the Application Example

Validity

To configure S7-300 Hardware from

- SIMATIC PCS 7 V8.1 SP1 with Industry Library (IL) Version V8.1 SP1
- CFC V8.1 SP1 Upd4

The configuration of Comfort Panels is implemented with TIA Portal WinCC Comfort from V13 SP1 Upd 8.

Note

You can install the software components on a system. Their compatibility can be checked with the compatibility tool for automation and drive technology via the following link: https://support.industry.siemens.com/cs/ww/en/view/64847781
# Table of contents

Warranty and liability .................................................................................................................. 2

1 Description of the task and the solution ................................................................................. 5
  1.1 Task .................................................................................................................................. 5
  1.2 Solution .............................................................................................................................. 6
  1.3 Overview of the complete solution ..................................................................................... 7
  1.3.1 Core functionality ........................................................................................................... 8
  1.3.2 Description of the individual functions ......................................................................... 9
  1.3.3 Control concept ............................................................................................................. 10
  1.3.4 R&I flowchart ................................................................................................................ 11
  1.4 Hardware and software components .................................................................................. 11

2 Structure and Principle of Operation ...................................................................................... 14
  2.1 Project structure ................................................................................................................ 14
  2.1.1 Naming convention of the CFC charts ........................................................................... 14
  2.1.2 Technological view ........................................................................................................ 15
  2.2 Structure of the water-specific unit .................................................................................... 16
  2.3 Coarse rake screen ............................................................................................................ 16
  2.3.1 Structure ........................................................................................................................ 16
  2.3.2 Parameter assignment .................................................................................................... 17
  2.4 Wastewater pumps 1 to 4 ............................................................................................... 17
  2.4.1 Structure ........................................................................................................................ 17
  2.4.2 Parameter assignment .................................................................................................... 19
  2.5 Discharge to the wastewater treatment plant ................................................................. 19
  2.5.1 Structure ........................................................................................................................ 19
  2.5.2 Parameter assignment .................................................................................................... 19
  2.6 Pump sump ....................................................................................................................... 20
  2.6.1 Structure ........................................................................................................................ 20

3 Integration and starting Water Unit Template ........................................................................ 21
  3.1 PCS 7-AS simulation ......................................................................................................... 21
  3.2 Integration and startup PCS 7-AS ...................................................................................... 23
  3.2.1 Preparation ..................................................................................................................... 23
  3.2.2 Configuring the S7-300 Station ..................................................................................... 23
  3.2.3 Configuration of PCS 7 OS single point ....................................................................... 25
  3.2.4 Communication of AS participants for remote data transmission ............................ 27
  3.2.5 Communication of AS participants for telecontrol ....................................................... 28
  3.3 Activation of PCS 7 OS runtime ........................................................................................ 29

4 Integrating and starting the Comfort Panel .......................................................................... 30
  4.1 Preparation of the Comfort Panel ..................................................................................... 30
  4.2 Integration of the TIA Portal project .................................................................................. 31
  4.3 Setting the interface and communication partner in the TIA Portal ................................ 32
  4.4 Commissioning Comfort Panel in the TIA Portal ............................................................ 34
  4.5 HMI Panel Process Screens ............................................................................................. 37

5 Scenario .................................................................................................................................. 39

6 Appendix ............................................................................................................................... 42
  6.1 Service and Support .......................................................................................................... 42
  6.2 References ......................................................................................................................... 43
  6.3 History ................................................................................................................................. 43
1 Description of the task and the solution

1.1 Task

The standardization of automation engineering for urban water management plants, such as in water treatment, is a major challenge. Different process steps and procedures, different equipment and flexibility in the plant configuration make the task even more difficult.

The largely automated operation of wastewater facilities (sewage systems and sewage treatment plants) is considered state of the art. Compared to process engineering plants in other industries, such as the chemical industry, a wastewater treatment plant has a similarly large amount of actuators, sensors, measurement equipment and control loops. For this reason, the automation of wastewater treatment plants has its own specific challenges:

- The wastewater treatment plant discharges into public watercourses via receiving streams. The wastewater treatment plant operator is therefore liable for complying with legal limits in purified wastewater, such as limits for ammoniac nitrogen, total nitrogen, chemical oxygen demand, and phosphate.
- The influent to a wastewater treatment plant is subject to strong fluctuations – both in terms of quantity and its contents. This is due to weather-related and seasonal fluctuations as well as the behavior of the high numbers of private households and industrial companies that discharge wastewater to the sewer network.
- Based on the typical size of mainly municipal wastewater treatment plants, engineers with relevant know-how about wastewater-specific, biotechnological issues are usually available on-site, but not control engineers. That is why any control engineering solution must have a clear and transparent structure. This enables the wastewater treatment plant personnel to operate the plant easily and promptly, as well as to optimize in line with the specific situation if necessary.

The use of measurement, control and regulation technology in wastewater treatment plants has the following fundamental objectives:

- Improvement of purification effect in order to meet effluent limit values.
- Minimization of operating costs, especially energy costs.
- Saving of investment costs through optimum use of existing infrastructures.

You will find the whitepaper "Optimization of Wastewater Treatment Plants with Advanced Process Control" under industry solution "Wastewater" [http://w3.siemens.com/mcms/water-industry/en/your-water-plant/Pages/wastewater.aspx](http://w3.siemens.com/mcms/water-industry/en/your-water-plant/Pages/wastewater.aspx)

A principal standardization feature includes the configuring of the plant according to the physical model of the DIN EN 61512 or ISA-106 standards. This specifies the lower four levels, i.e. plant, unit, technical systems and control module. A plant always consists of plant sections. The plant sections can in turn contain standardized equipment modules, also known as technical functions. The structure of the Water Templates obeys NAMUR recommendations NE33 and ISA S88.01.
1.2 Solution

The Application Example “S7 Water Unit Template – External Pump Station of a Wastewater Treatment Plant” is a preassembled wastewater treatment plant section with mutually coordinated electronic and procedural contents. Depending on the dimensions of the plant section, a degree of pre-assembly of at least 70 percent can be achieved. You can complement any missing components or functions by the use of the Water Templates and the Industry Library.

The Unit Template offers you:

- all the typical components for open-loop and closed-loop control
- the necessary logics and the interlocks
- the corresponding visualization images from field (panel) to the Web (Operator Station via WebNavigator)
- a modular structure based on standardized functions with Water Templates (WCMT = Water Control Module Types and WEMT = Water Equipment Module Types).

Its utilization offers the following advantages:

- A reduction of the knowledge necessary to develop applications
- Less effort needed for configuration
- Flexible installation and adjustment with Water Templates
- Standardized structures
1.3 Overview of the complete solution

Description

The Unit Template includes several pre-built, unified and ready-connected Water Templates connected together to form a plant section sample solution. Starting out from this solution, numerous instances can be generated with different parameter assignments and widely integrated in automation solutions with adapted style depth. The S 7 project is configured to be hardware-independent. It can be flexibly incorporated in existing projects.

The unit template has been implemented as a PCS 7 multiproject as follows:

- In the component view there is a project available for every automation system (AS).
- Visualization of all the automation system (AS) is at an Operator Station (OS).

In the AS project, all open- and closed-loop control functions are implemented in the form of CFC (Continuous Function Chart) charts.

All the instances are based on the control module types (WCMT) of the project’s master data library. The instances contain - if S7-300 or S7-400 is chosen - function blocks from the following Libraries:

- PCS 7 Advanced Process Library (APL)
- Industry Library (IL)
- SITRANS Library

The OS project visualizes an external pump station and further components of a wastewater treatment plant.

Note

This example focuses on the external pump station.
Required knowledge

Basic knowledge of the following specialist fields is a prerequisite:

- Engineering with PCS 7, Advanced Process Library (APL) and Industry Library (IL)
- Engineering in TIA Portal V13 for connection to Comfort Panels
- Closed-loop control
- Water and wastewater process technology

1.3.1 Core functionality

The individual parts of an external pump station are described in the following. Entry is via the process pictures of the visualization screen in the PCS 7 and TIA portal.

Figure 1-3: Process pictures (PCS 7 and TIA Portal) of the external pumping station

Process picture

The process picture (Figure 1-3) of an external pump station consists of the following parts:

- Schematic representation of the wastewater plant section with the supplied components (at left: influent to external pump station) and effluent components (at right: discharge from external pump station) to wastewater treatment plant.
- Faceplates for controlling the individual components (units)
- Overview of the relevant parameters (Key Performance Indicators)
In the process picture, the operator is given an overview of the entire plant section and can make the necessary operator interventions.

1.3.2 **Description of the individual functions**

The process picture of an external pump station consists of the following main parts:
1. Coarse rake screen
2. Wastewater pumps 1 to 4
3. Discharge to the sewage treatment plant
4. Pump sump
5. Total electrical energy (kWh)

Figure 1-4: Functions of the external pump station

1. **Coarse rake screen**

   The wastewater flows through a coarse rake screen into the external pump station intake. Coarse materials are removed mechanically. Thereafter the wastewater is stored in the pump antechamber. The coarse materials captured are disposed of in a container.

2. **Wastewater pumps 1 to 4**

   Wastewater pumps 1 to 4 pump the wastewater from the antechamber onwards to the wastewater treatment plant. The number of wastewater pumps actuated depends on the fill level.

3. **Discharge to the wastewater treatment plant**

   In order to guarantee a uniform inflow to the wastewater treatment plant, the affluent quantity to the wastewater treatment plant is measured and the wastewater pumps are controlled via their flow volume.
1. Description of the task and the solution

(4) **Pump sump**

Excess water is collected in the pump sump. In the event of maintenance work or of overflow in the pumphouse, this water is automatically pumped back into the wastewater system.

(5) **Electrical energy**

In conjunction with a higher-order energy management and/or the optimum sewer resource management, the entire electrical energy of the wastewater pumping station is registered and stored in the remote control station (RTU).

**Parameters (KPI = Key Performance Indicators)**

In the project the electrical energy of the external pump station is calculated and are displayed in the process picture.

**Note**

You can expand the S7 project with KPI calculations of your own, e.g. electrical energy or energy of the wastewater pumps.

**Operating hours counter**

The Faceplates contain a display of the operating hours for the wastewater pumps. These are used, e.g.: for maintenance planning.

1.3.3 **Control concept**

The flow control in the discharge enables the inflow to the wastewater treatment plant to remain constant. This prevents too great fluctuations at the inflow to the wastewater treatment plant. The target value for the wastewater flow volume is raised or lowered depending on the amount of pumps in action at the same time. All the functions of the external pump station (drive, measurements, etc.) are controlled via CFCs.
1.3.4 R&I flowchart

The following figure shows the individual components of the external pump station in the P&ID (Piping and Instrumentation Diagram).

Figure 1-5: P&ID of the external pump station

1.4 Hardware and software components

The application example was created with the following components:

Hardware components

<table>
<thead>
<tr>
<th>Component</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMATIC PCS 7 ES/OS IPC847C W7</td>
<td>For the PCS 7 V8.1 SP1 example project with TIA V13 SP1</td>
</tr>
<tr>
<td>CPU 315-2PN/DP</td>
<td>As of firmware version V3.1</td>
</tr>
</tbody>
</table>

Note

In case of different hardware, please observe the minimum requirements for installing the software components. Their compatibility can be checked with the compatibility tool for automation and drive technology via the following link: https://support.industry.siemens.com/cs/ww/en/view/64847781
1. Description of the task and the solution

Standard software components

Table 1-2: Standard software components

<table>
<thead>
<tr>
<th>Component</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMATIC PCS 7 V8.1 SP1</td>
<td>Part of SIMATIC PCS 7 ES/OS IPC847C W7</td>
</tr>
<tr>
<td>S7 module of the SIMATIC Industry Library (V8.1 SP1)</td>
<td>Does not form part of PCS 7 V8.1 SP1</td>
</tr>
<tr>
<td>TIA Portal V13 SP1 Update 8</td>
<td>For adjustment of the WinCC Comfort Panels</td>
</tr>
</tbody>
</table>

Figure 1-6: SW installed in SIMATIC Manager (without TIA portal)

Figure 1-7: SW installed in the TIA Portal
1 Description of the task and the solution

**Note**
The standard measurement for the flow rate can be carried out with the SITRANS Library V3.0 (MAG6000). The corresponding Water Template can be found in the master database library.

**Note**
For information on SIMATIC PCS 7 Industry Library (V8.1 SP1), see the following link: [https://support.industry.siemens.com/cs/ww/en/view/109477851](https://support.industry.siemens.com/cs/ww/en/view/109477851)

**Example files and projects**
The following table contains all the files and projects you will need for this application example.

**Table 1-3: Example files and projects**

<table>
<thead>
<tr>
<th>File</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>109478073_WUT_ExternalPumpStation_PROJ_S7.zip</td>
<td>PCS 7 V8.1 SP1 example project</td>
</tr>
<tr>
<td>109481486_WUT_ExternalPumpStation_DOC_PCS7_en.pdf</td>
<td>This document</td>
</tr>
<tr>
<td>109481486_WUT_ExternalPumpStation_PROJ_TIAV13.zip</td>
<td>Comfort panel images</td>
</tr>
</tbody>
</table>

**Note**
Apart from the external pump station, the Sample projects contain additional wastewater plant sections - including a wastewater treatment plant - that are not a part of this Description.
2 Structure and Principle of Operation

2.1 Project structure

2.1.1 Naming convention of the CFC charts

A unified naming convention has been used to name the process tags. A uniform naming convention was used for identifying the process tags, the function according to European standard EN 62424, while the system itself according to ATV 260. The following figure shows the composition of a process tag name:

Figure 2-1: Process tag designation

The system name in accordance with ATV DVWK-M260 consists of two letters for the system name and one number. The number is optional and is used if there are several identical system components.

The designation of the type of measuring points is in accordance with European standard EN 62424. The tables below list the most important designations.

Table 2-1

<table>
<thead>
<tr>
<th>First letter</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Analysis</td>
</tr>
<tr>
<td>I</td>
<td>Electrical voltage</td>
</tr>
<tr>
<td>F</td>
<td>Flow rate</td>
</tr>
<tr>
<td>G</td>
<td>Distance, length, position</td>
</tr>
<tr>
<td>J</td>
<td>Electrical power</td>
</tr>
<tr>
<td>L</td>
<td>Fill level</td>
</tr>
<tr>
<td>N</td>
<td>Pump drive</td>
</tr>
<tr>
<td>P</td>
<td>Pressure</td>
</tr>
<tr>
<td>U</td>
<td>Control function</td>
</tr>
<tr>
<td>Y</td>
<td>Valve</td>
</tr>
</tbody>
</table>

Table 2-2

<table>
<thead>
<tr>
<th>Subsequent letter</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Alarm</td>
</tr>
<tr>
<td>C</td>
<td>Control</td>
</tr>
<tr>
<td>I</td>
<td>Indication</td>
</tr>
<tr>
<td>Q</td>
<td>Quantity</td>
</tr>
<tr>
<td>R</td>
<td>Record</td>
</tr>
<tr>
<td>S</td>
<td>Binary control function or switching function (not safety-relevant)</td>
</tr>
</tbody>
</table>

The sequential number consists of 2 digits, the first of which is zero, and is determined according to the system component.
2.1.2 Technological view

For every Unit Template, as an S7-300 station that can be deployed in a decentralized manner, an AS Project is created. The first hierarchy level of AS Project “S7_ASSWT_Prj” contains the folders of system component “Sewer”. The subordinate hierarchy level of the “External Pump Station” contains all the necessary process tags (control module instances of the master data library).

The first hierarchy level of OS project “S7_OS” contains typical system components of a wastewater treatment plant. In the “Sewer” folder, the station “External Pump Station” is stored under the process image “WCMT_Ext_Pump_Station.pdl”

The following figure depicts the structure of the PCS 7 multiproject:

Figure 2-2: Structure of the PCS 7 multiproject
2.2 Structure of the water-specific unit

The Unit Template is made up of the following prepared Water Templates: In the S7 Project all process tags are based on Water Equipment Module Types (WEMT), Water Control Module Types (WCMT) and standard modules of the “SWL S7 V81” master data library.

You will find detailed information on individual Water Templates in the “Standard S7 Water Templates for the Water Industry” under the following link: https://support.industry.siemens.com/cs/ww/en/view/78604785

The application example “External Pump Station of Wastewater Treatment Plant” comprises the following equipment modules:

- Coarse rake screen
- Wastewater pumps 1 to 4
- Discharge to the wastewater treatment plant
- Pump sump

The following subsection describes the individual functions and structure.

2.3 Coarse rake screen

The coarse rake screen clears the water from the sewage of coarse objects, e.g. branches, twigs, plastic, wood and paper. After this the wastewater flows into the pump antechamber of the external pump station.

For the drive of the coarse rake screen the control module type “WCMT_MotLean” from the master data library is used, for the fill levels upstream and downstream of the coarse rake, the control module type “WCMT_MonAnalog08” is employed.

2.3.1 Structure

When the fill level P_LISA_26 upstream of the coarse rake screen exceeds a certain level, the cleaning cycle for the coarse rake is started.

The coarse rake screen is lowered by the P_NS_01 drive from its home position to collect coarse solids from the wastewater. After cleaning time T1 the coarse rake screen is lifted to its eject position in order to transfer the solids to a container.

When the fill level P_LISA_26 upstream of the coarse rake screen falls below a certain level, the remaining cleaning cycles are finished and the coarse rake screen is returned to its home position.

The following table provides you with an overview of the elements and water control module types used.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Template</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_NS_01</td>
<td>WCMT_MotLean</td>
<td>Coarse rake screen - tilting</td>
</tr>
<tr>
<td>P_NS_02</td>
<td>WCMT_MotLean</td>
<td>Coarse rake screen – lowering / lifting</td>
</tr>
<tr>
<td>P_LISA_26</td>
<td>WCMT_MonAnalog08</td>
<td>Fill level upstream of coarse rake screen</td>
</tr>
<tr>
<td>P_LISA_27</td>
<td>WCMT_MonAnalog08</td>
<td>Fill level downstream of coarse rake screen</td>
</tr>
<tr>
<td>P_GS_35</td>
<td>WCMT_MonDigital</td>
<td>Coarse rake screen - home position</td>
</tr>
<tr>
<td>P_GS_36</td>
<td>WCMT_MonDigital</td>
<td>Coarse rake screen - disposal position</td>
</tr>
<tr>
<td>P_GS_37</td>
<td>WCMT_MonDigital</td>
<td>Coarse rake screen - tilting forwards</td>
</tr>
<tr>
<td>P_GS_38</td>
<td>WCMT_MonDigital</td>
<td>Coarse rake screen - tilting back</td>
</tr>
</tbody>
</table>
2.3.2 Parameter assignment

The user can determine the number of cleaning cycles with C1. Time T1 determines the length of time the coarse rake screen remains in its end position.

2.4 Wastewater pumps 1 to 4

Wastewater pumps 1 to 4 impel the wastewater from the antechamber further onwards to the wastewater treatment system. The number of wastewater pumps actuated is determined depending on the fill level in the pump antechamber. Each wastewater pump is equipped with a shutoff valve on the discharge and suction side of the pump incl. a pressure measurement. A pump manager controls the pump settings.

The following Water Templates are used for the implementation:

- “WCMT_MotSpdCon_FbDrv” for the wastewater pumps
- “WCMT_VlvMot_FbMMS” for shut-off valves
- “WCMT_MonAnalog08” for pressure measurement
- “WEMT_Aggr08” unit modules for pump management

2.4.1 Structure

In dry weather a maximum of two wastewater pumps are in operation at the same time. When fill level P_LIRCA_20 of the pump antechamber exceeds the limit value “SL” for time “T1”, the first wastewater pump is activated.

The second pump is activated after limit value “WH” of the P_LIRCA_20 fill level and delay time “T1” are exceeded. Both wastewater pumps are deactivated after fill level “SL” limit value is undercut.

In order to be able to react in good time to increased water volumes caused by a rain event, the “G1” gradient of the pump antechamber P_LIRCA_20 fill level is continuously monitored. If a rain event occurs, the wastewater pumps are started if the predetermined gradient limit is exceeded.

If the gradient is greater than “G1” and fill level P_LICRA_20 exceeds limit value “SH”, the second wastewater pump is activated. If limit level “AH” is exceeded the third wastewater pump starts up. If limit value “AHH” is also exceeded, the fourth wastewater pump is activated. If the fourth wastewater pump is not available a high water level alarm is emitted.

Before a wastewater pump is started, the shut-off valves on the suction and pressure sides of the pump are opened at a set value of 50%. If within a predetermined runtime both shut-off valves do not register “open”, the wastewater pump is locked and both shut-off valves are closed again.

| CAUTION | If the shut-off valves are not closed automatically, the valves must be put in their home position manually. This way the home position is established and the availability of the drive group is ensured. |

© Siemens AG 2016 All rights reserved
Stopping the wastewater pump proceeds in the following sequence:
1. Wastewater pump deactivated
2. Shut-off valve on pressure side closed
3. Shut-off valve on suction side closed

**CAUTION** If the shut-off valves are not closed automatically, the valves must be put in their home position manually. This way the home position is established and the availability of the drive group is ensured.

Selection of the wastewater pumps is carried out via Pump Manager P_US_24. The pump manager operates according to the guiding aggregate principle.

The following table provides you with an overview of the elements and water control module types used.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Template</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_NIC_04</td>
<td>WCMT_MotSpdCon_FbDrv</td>
<td>Wastewater pump 1</td>
</tr>
<tr>
<td>P_Y5_05</td>
<td>WCMT_VlvMotor_FbMMS</td>
<td>Shut-off valve before wastewater pump 1 (suction side)</td>
</tr>
<tr>
<td>P_Y5_06</td>
<td>WCMT_VlvMotor_FbMMS</td>
<td>Shut-off valve after wastewater pump 1 (pressure side)</td>
</tr>
<tr>
<td>P_PIA_07</td>
<td>WCMT_MonAnalog08</td>
<td>Pressure measurement after wastewater pump 1 (pressure side)</td>
</tr>
<tr>
<td>P_NIC_08</td>
<td>WCMT_MotSpdCon_FbDrv</td>
<td>Wastewater pump 2</td>
</tr>
<tr>
<td>P_Y5_09</td>
<td>WCMT_VlvMotor_FbMMS</td>
<td>Shut-off valve before wastewater pump 2 (suction side)</td>
</tr>
<tr>
<td>P_Y5_10</td>
<td>WCMT_VlvMotor_FbMMS</td>
<td>Shut-off valve after wastewater pump 2 (pressure side)</td>
</tr>
<tr>
<td>P_PIA_11</td>
<td>WCMT_MonAnalog08</td>
<td>Pressure measurement after wastewater pump 2 (pressure side)</td>
</tr>
<tr>
<td>P_NIC_12</td>
<td>WCMT_MotSpdCon_FbDrv</td>
<td>Wastewater pump 3</td>
</tr>
<tr>
<td>P_Y5_13</td>
<td>WCMT_VlvMotor_FbMMS</td>
<td>Shut-off valve before wastewater pump 3 (suction side)</td>
</tr>
<tr>
<td>P_Y5_14</td>
<td>WCMT_VlvMotor_FbMMS</td>
<td>Shut-off valve after wastewater pump 3 (pressure side)</td>
</tr>
<tr>
<td>P_PIA_15</td>
<td>WCMT_MonAnalog08</td>
<td>Pressure measurement after wastewater pump 3 (pressure side)</td>
</tr>
<tr>
<td>P_NIC_16</td>
<td>WCMT_MotSpdCon_FbDrv</td>
<td>Wastewater pump 4</td>
</tr>
<tr>
<td>P_Y5_17</td>
<td>WCMT_VlvMotor_FbMMS</td>
<td>Shut-off valve before wastewater pump 4 (suction side)</td>
</tr>
<tr>
<td>P_Y5_18</td>
<td>WCMT_VlvMotor_FbMMS</td>
<td>Shut-off valve after wastewater pump 4 (pressure side)</td>
</tr>
<tr>
<td>P_PIA_19</td>
<td>WCMT_MonAnalog08</td>
<td>Pressure measurement after wastewater pump 4 (pressure side)</td>
</tr>
<tr>
<td>P_LIRICA_20</td>
<td>WCMT_MonAnalog08 WCMT_OpAn</td>
<td>Fill level, pump antechamber</td>
</tr>
</tbody>
</table>
2.4.2 Parameter assignment

The operator can enter values for the following parameters:
- “T1”: Delay time before pump is activated
- “G1”: Gradient for monitoring of filling level rise in pump antechamber

2.5 Discharge to the wastewater treatment plant

The flow rate control at the discharge of the external pump station is determined by the inflow quantity to the wastewater treatment plant.

2.5.1 Structure

The flow rate \( P_{FQIRA_21} \) in the discharge to the sewage treatment plant is registered and used for flow control. All active pumps are given the same target value by the flow control \( P_{UC_25} \). Four different target values are predefined depending on the number of active wastewater pumps.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Template</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_{FQIRA_21} )</td>
<td>WCMT_MonAnalog08</td>
<td>Flow rate, discharge to wastewater treatment plant</td>
</tr>
<tr>
<td>( P_{UC_25} )</td>
<td>Software function</td>
<td>Flow control</td>
</tr>
</tbody>
</table>

2.5.2 Parameter assignment

The operator can predetermine the four different target values for the operation of the pumps.
2.6 Pump sump

In the pumphouse pump sump the water is collected that flows out in the case of maintenance work, problems or flooding in the pumphouse. The pump sump is emptied automatically.

2.6.1 Structure

When the fill level in the pump sump exceeds a certain level, fill level switch P_LSA_24 engages the pump sump P_NS_22. When the fill level in the pump sump falls below a certain level, fill level switch P_LSA_23 switches off pump sump P_NS_22.

The following table provides you with an overview of the elements and water control module types used.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Template</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_NS_22</td>
<td>WCMT_MotLean</td>
<td>Sump pump</td>
</tr>
<tr>
<td>P_LSA_23</td>
<td>WCMT_MonDigital</td>
<td>Fill level switch, pump sump full</td>
</tr>
<tr>
<td>P_LSA_24</td>
<td>WCMT_MonDigital</td>
<td>Fill level switch, pump sump empty</td>
</tr>
</tbody>
</table>
3 Integration and starting Water Unit Template

3.1 PCS 7-AS simulation

The following instructions describe the commissioning of the Water Unit Template (WUT) by simulating the controller with the "S7-PLCSIM" program. In the case of real control, further information can be found in Section 3.2.

1. Copy file "109481486_WUT_ExternalPumpStation_PROJ_S7.zip" to any folder on the configuration PC and then open SIMATIC Manager.
2. Click on "File > Retrieve" in the menu bar and select the file "109481486_WUT_ExternalPumpStation_PROJ_S7.zip". Then click on "Open" to confirm.
3. Choose the folder where you want to save the project and click on "OK" to confirm. The project is retrieved.
4. Confirm the "Retrieve" dialog with "OK" and then click on "Yes" in the dialog to open the project.
5. Right-click on "S7_OS > VMES001 > WinCC Appl. > OS" and then click on the menu command "Open object".
6. Confirm the "Configured server not available" dialog with "OK".
7. In the WinCC Explorer, open the properties of your computer and, in the opened Characteristics dialog, click on the "Use local computer name" button. Confirm the "Change computer name" message with "OK".
8. In the WinCC Explorer, click on "File > Exit" and in the subsequent dialog select "Terminate WinCC Explorer and close project". Then confirm with "OK".
3 Integration and starting Water Unit Template

Starting the simulation (S7 PLCSIM)

Proceed as follows to initiate the simulation:

1. In the SIMATIC Manager, select "Extras > Simulate Modules" from the menu. The "S7 PLCSIM" dialog window opens.
2. In the "Open project" dialog, select "Open project from file".
3. Select the file "S7_ASEPS.plc" from the path `<Projektpfad>\WWUT_S7\WWUT_S7\S7_ASEPS.plc`.
4. In the menu, select "Execute > key switch position > RUN-P".
5. Switch to component view of SIMATIC Manager and highlight "S7_ASEPS > ASEPS".
6. On the menu bar, click on "Target system > Load" and confirm the "Load" dialog with "Yes".
7. Confirm the "Stop target group" dialog with "OK" and the subsequent "Load" dialog with "Yes".

Starting process visualization (PCS 7 OS Runtime)

Starting PCS 7 OS runtime is described in Section 3.3
3.2 Integration and startup PCS 7-AS

3.2.1 Preparation

The following instructions describe the integration of the Water Unit Templates in a PCS 7 project where the following steps have been completed:

- Usage of a uniform master data library
- Settings for the hierarchy folders
- Configuring and loading HW Config
- Configuring and loading communication between AS and OS (NetPro)

**Note**

Detailed information for the configuring and commissioning of a PCS 7 project can be found in the PCS 7 Compendium, Part A – Configuration Guidelines:

**Procedure**

1. Copy the file "109481486_WUT_ExternalPumpStation_PROJ_S7.zip" to the configuration PC and then open the SIMATIC Manager.
2. Click on "File > Retrieve" in the menu bar and select the file "109481486_WUT_ExternalPumpStation_PROJ_S7.zip". Then click on "Open" to confirm.
3. Select the folder in which the project is to be saved and confirm by clicking on the "OK" button.
The project will be extracted.
4. In the "Retrieve" dialog, click on the "OK" button and then click on "Yes" in the dialog to open the project.

3.2.2 Configuring the S7-300 Station

The unpacked project already contains in its HW Config the preconfigured Station and all components installed/set up. In the description it has been refrained from describing how to interconnect and set up the individual parameters.

1. Switch to the project component view.
2. In Multi-project, select “WWUT_S7 > S7_AEPS” and double-click on the Hardware.
3. In the HW Config, adapt all the addresses (PROFINET, Industrial Ethernet, MAC, TCP/IP with subnet mask, and if applicable Profibus DP/PA) and the channel assignment of the decentralized periphery in accordance with your AS components.

4. Compile and download the HW Config.
5. Open NetPro and check / adapt the communication connections.
6. Compile and download the changes in NetPro.
7. Switch to the "Technological view".
8. Open any CFC diagram in the hierarchy folder “External Pump Station”.

© Siemens AG 2016. All rights reserved.
9. Compile and load the AS project without activating the option “generate module driver”.

CAUTION Generating a module driver in connection with an S7-300 station before compiling the program creates error messages. Compilation must be carried out without the option “generate module driver”.

3.2.3 Configuration of PCS 7 OS single point

When you start WinCC Explorer for the first time you will have to change the device name, PC-Name Proceed as follows:

1. In SIMATIC Manager select Component view.
2. Highlight the OS in multiproject “S7_OS > VMES001 > WinCC Appl.” and select “Compile” in the context menu.

3. Select, in the window “Settings: Compile OS”, the system component “Sewer” and the S7 program “S7_ASEPS\ASEPS”, and click on the button “Connection...”
4. Select the connection “PlantBus” and click on the “OK” button:

Note

The network connection is the connection configured in NetPro. The automation system and the Operator Station communicate via the network connection.

5. When you compile the OS project the first time, select the option “Entire OS” and click on the “Finish” button.

6. In the SIMATIC Manager, right-click on “S7_OS > VMES001 > WinCC Appl. > OS” and then click on the menu command “Open object”.

7. Confirm the “Configured server not available” dialog with “OK”.


8. In the WinCC Explorer, open the characteristics of your computer and, in the opened Properties dialog, click on the "Use local computer name" button. Confirm the "Change computer name" message with "OK".

![WinCC Explorer screenshot](image)

9. In the WinCC Explorer, click on "File > Exit" and in the subsequent dialog select "Terminate WinCC Explorer and close project". Then confirm with "OK".

### 3.2.4 Communication of AS participants for remote data transmission

The IP addresses and subnet masks are already preconfigured in the sample projects.

Table 3-1:

<table>
<thead>
<tr>
<th>Component</th>
<th>Interface</th>
<th>Address</th>
</tr>
</thead>
</table>
| CPU (HW Config) | PN-IO (Ethernet) | IP address: 10.120.10.30  
                       |                | Subnet: 255.255.255.0 |
| OS (configuration) | IE General | IP address: 10.120.10.99  
                       |                | Subnet: 255.255.255.0 |

**Note**

Adapt the IP address in project-specific manner to your system configuration.

For more detailed information, refer to the following:

3.2.5 Communication of AS participants for telecontrol

In telecontrol, access to the net is of the greatest importance. This WUT can be additionally used in an S7 RTU station via telecontrol (SINAUT ST7, IEC, DNP 3) or remote data transmission. Marshalling blocks are available for consistent engineering (CFC) decentralized RTU stations with Telecontrol (TC) for SIMATIC PCS 7 and the SIMATIC Water Library SWL.

The Marshalling blocks are available for motors, measurements, gates, controllers, etc and are adjusted to the SINAUT ST 7 remote control transmission. These blocks, including block icons and APL-compliant faceplates, form part of the PCS 7 Telecontrol.

For more detailed information, refer to the following:

- Application example “Standard PCS 7 and S7 Water Templates for the water industry” at: https://support.industry.siemens.com/cs/ww/en/view/78604785

You will find further information on the Siemens industrial security concepts for plants, networks and system integrity under the following links:

- Concepts and Solutions for Industrial Security
  http://www.siemens.com/industrialsecurity
- PCS 7 Compendium Part F - Industrial Security (V8.1) at
3.3 Activation of PCS 7 OS runtime

**Note**
The following designations and the technological hierarchy of the PCS 7 project are components of application example “109481486_ExternalPumpStation_PROJ_S7.zip”. You can modify these according to your project-specific requirements.

To activate the OS, proceed as follows:

1. Right-click on "S7_OS > VMES001 > WinCC Appl. > OS" and then click on the menu command "Open object".
2. Select "File > Activate" in the WinCC Explorer menu.
3. In the "System Login" dialog, enter the user name “Siemens” as "Login" and “siemens” as the password and then confirm with "OK".
4. Select the Unit template “Sewer” in the image area.

5. Click the “External Pump Station” button.

**Note**
Some of the components of the external pump station can be controlled and monitored from the process screen. No process simulation is installed in the Project. For this reason there are messages already present when you start the OS.
4 Integrating and starting the Comfort Panel

If in addition to SIMATIC PCS 7 you are also using a Comfort Panel, you must integrate it, too. This section shows you the steps required to do so.

Note

The TIA portal example project is preconfigured for several stations and includes several AS telecontrol stations. The components do not influence the project integration procedure.

4.1 Preparation of the Comfort Panel

The panel interface must be configured in order for the project data to be transferred to the Operator Panel or Touch Panel.

1. Activate the Control Panel and double-click on the “Transfer” icon.

2. In the “General” worksheet select transfer option “Automatic” with transfer channel “Ethernet” and click on the “Properties...” button.

3. Double-click on the icon “Ethernet Driver”.

4. In Worksheet “IP Address”, assign a specific IP address with its corresponding subnet mask.
5. Close all windows and select the “Transfer” button on the Control Panel.

![Transfer button on the Control Panel](image)

**CAUTION** The IP addresses of the Operator Panel and the Computer must be located in the same subnet mask.

### 4.2 Integration of the TIA Portal project

1. Unpack the TIA sample project “109481486_WUT_ExternalPumpStation_PROJ_TIAV13.zip” into any folder on the configuration PC. Then open TIA V13 Portal in the Project view.
2. To open the project, select “Project > retrieve...”

3. Click on the "Browse" button and select the unpacked TIA project “SWTS7_TIAv13.zap13”.

4.3 Setting the interface and communication partner in the TIA Portal

The interface must be configured in the TIA Portal in order for the project data to be transmitted to the Operator Panel or Touch Panel.

1. Highlight the “HMI” panel in the project tree of the TIA portal project.

2. Select “Properties” in the context menu.
3. In the “General” Worksheet, in the sector “PROFINET Interface [x3]” enter the IP address and subnet mask that have been entered in the Panel.


5. Activate the “Mode” connection in the network view and connect via drag-and-drop the PROFINET interfaces of the S7 300 Station “ASEPS” Station with the “HMI” panel.

**CAUTION** For the acknowledgment of messages from the HMI Comfort Panel to the S7 300 it is essential to configure “HMI Connection”.
4.4 Commissioning Comfort Panel in the TIA Portal

Commissioning requires that the example project already be open in the TIA Portal and that the project has been selected in the project view.

Compiling and downloading to Panel

1. Highlight “HMI” panel in project tree and select “Compile… > Hardware and software (only changes)” in context menu.

2. Highlight “HMI” panel in project tree and select “Download to device > Software (all)” in context menu.

Note

In every subsequent loading procedure the menu item “Online > Extended download to device…” can be used.
4. Use the “Start search” button to locate the panel that is in the same subnet.

5. In the overview “Compatible devices in target subnet”, select target panel and load program to the panel via the “Load” button.

6. Use the “Start search” button to locate the S7-300 Station that is in the same subnet as the Panel. Then load the program.
Displaying the participants

The TIA Portal offers several possibilities to display segment participants:

- Using menu item “Online > Go online”

- Or using menu item “Online > Accessible devices…”
4.5 HMI Panel Process Screens

The TIA portal example project is preconfigured for several stations and includes several process screens.

You can see the following process screens in the “HMI” project tree of the sample project.

Figure 4-1: Overview image of a Wastewater treatment plant including upstream wastewater plants
Figure 4-2: Process image of an external pump station
5 Scenario

The external pump station can be operated both with PCS 7 OS and with Comfort Panels. The corresponding projects are available for both variants. The following scenario refers to the adjustment of the variables / measured values to be transferred.

Introduction

Panels need the instance DB number for the interface block of the technological function which is to be operated on the panel. For this, there is a static data block in the S7 program with a separate integer variable for each configured panel block. The integer variables are described using the value of the IDB number.

In the sample project the appropriate panel blocks are already pre-configured and the panel data block DB25 is already set up for communication with Comfort Panels.

Expansion of Panel Block

1. In SIMATIC Manager in the component view, open the DB25 “PanelConDB” of the “ASEPS” S7 300 Station.
5 Scenario

2. For each new panel block, generate an “INT”-type parameter in the data block, e.g. at address 18 the variable “P_YS_09” for additional fill level recording and display, and save the changes.

Figure 5-1:

3. Open the respective CFC with the new panel block and select DB25 for the block output “IDBNc” and the address (variable).

---

**Note**

A detailed description of the required architecture and engineering steps in the SIMATIC Manager for communication with Panels can be found in the Application Example “Integration of Comfort Panels in SIMATIC PCS 7 via Industry Library”: [https://support.industry.siemens.com/cs/ww/en/view/50708061](https://support.industry.siemens.com/cs/ww/en/view/50708061)
Expansion of Panel Block in the TIA Portal

1. Open the TIA V13 project “WUT” in the project view. In project navigation, select “ASEPS” device proxy and expand the project folder.

This represents the corresponding S7-300 and is derived from the S7 project.

2. Highlight the Device Proxy and then select “Update data of the device proxy” from the context menu.

The additional variable (address 18) is added in the “Blocks” subfolder.

3. In the next step the measured values display must be configured on the panel process screen.

Note: A detailed description for the configuration of a panel project including the interconnection to one variable can be found in the application example “Integration of Comfort Panels in SIMATIC PCS 7” via the Industry Library: https://support.industry.siemens.com/cs/ww/en/view/50708061
6 Appendix

6.1 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 at:
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. You send queries to Technical Support via Web form: www.siemens.com/industry/supportrequest.

Range of services
Our range of services includes, inter alia, the following:

- Product trainings
- 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:
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
6.2 References

Table 6-1

<table>
<thead>
<tr>
<th>Topic</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Siemen Industry Online Support</td>
<td><a href="https://support.industry.siemens.com">https://support.industry.siemens.com</a></td>
</tr>
<tr>
<td>2. Download page of this entry</td>
<td><a href="https://support.industry.siemens.com/cs/ww/view/109481486">https://support.industry.siemens.com/cs/ww/view/109481486</a></td>
</tr>
<tr>
<td>3. PCS 7 Water Unit Template – Efficient Management of Storm Water Tank</td>
<td><a href="https://support.industry.siemens.com/cs/ww/view/109481487">https://support.industry.siemens.com/cs/ww/view/109481487</a></td>
</tr>
<tr>
<td>4. SIMATIC PCS 7 overview (collection of links for FAQ, manuals, compendia, forum, application examples and multimedia)</td>
<td><a href="https://support.industry.siemens.com/cs/ww/view/63481413">https://support.industry.siemens.com/cs/ww/view/63481413</a></td>
</tr>
<tr>
<td>5. Standard PCS 7 and S7 Water Templates for the water industry</td>
<td><a href="https://support.industry.siemens.com/cs/ww/view/78604785">https://support.industry.siemens.com/cs/ww/view/78604785</a></td>
</tr>
<tr>
<td>6. Equipment Modules for PCS 7 using the Chemical Industry as an example</td>
<td><a href="https://support.industry.siemens.com/cs/ww/view/53843373">https://support.industry.siemens.com/cs/ww/view/53843373</a></td>
</tr>
<tr>
<td>7. How can a controller optimization be carried out with the PID tuner?</td>
<td><a href="https://support.industry.siemens.com/cs/ww/view/8031495">https://support.industry.siemens.com/cs/ww/view/8031495</a></td>
</tr>
<tr>
<td>8. How do you procure documentation for PCS 7 (including the PCS 7 Manual Collection)?</td>
<td><a href="https://support.industry.siemens.com/cs/ww/view/59538371">https://support.industry.siemens.com/cs/ww/view/59538371</a></td>
</tr>
<tr>
<td>10. Integration of Comfort Panels, Operator Panels and S7-300 Package Units in SIMATIC PCS 7 with PCS 7 Industry Library</td>
<td><a href="https://support.industry.siemens.com/cs/ww/view/50708061">https://support.industry.siemens.com/cs/ww/view/50708061</a></td>
</tr>
</tbody>
</table>

6.3 History

Table 6-2

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1.0</td>
<td>10/2016</td>
<td>First edition</td>
</tr>
</tbody>
</table>