Shadow Manager 4.2.34.0

Software for operating the Shadow Master Unit V4
(system for shadow impact monitoring and species conservation)

Manual

Revision information

Rev. 1.0, 14 August 2023, IHA: initial version

Liability

We have prepared this manual with due care and checked it carefully, but we cannot guarantee that it is free of errors.
Furthermore, NorthTec GmbH & Co. KG reserve the right to make changes to this manual or the products described therein at any time without notice. NorthTec GmbH & Co. KG will not be liable for any loss or damage arising directly or indirectly (including special, incidental, or consequential loss or damage) from the use of this manual or the products described therein.

Trademark information

Windows, Microsoft, Microsoft Office and Excel are trademarks or registered trademarks of Microsoft Corporation in the United States and/or other countries.

1 About the manual

This manual documents the range of functions of Shadow Manager 4 (SM4), the operating software for the Shadow Master Unit V4 for our system for shadow impact monitoring and species conservation. As the software we describe here offers even more options than its predecessor, the user handbook has become significantly bigger. But don't worry, we have designed the SM4 user interface to be user friendly and intuitive to operate so that experienced users will be able to perform many tasks even without the manual.

If you are not yet familiar with SM4, please carefully read through the relevant information in this manual to ensure that the system for shadow impact monitoring and species conservation operates correctly at all times. This will ensure that your wind turbine generators are only shut down when it is necessary to satisfy residents and the authorities – *as often as necessary, as infrequently as possible*.

1.1 Structure of the manual – what is relevant for whom

This documentation serves as a guideline for the beginner, but at the same time as a reference document for experienced users.

How to use this manual:

- Information on a specific topic can be found in the **Contents**.
- Step-by-step instructions on standard tasks can be found using the **Practical section** (chapter 3).
- An explanation of all menus, parameters etc. can be found in the **Reference section** (chapter 4).
- Information on a specific term can be found using the **Index** (Appendix).
- Special SM4 terms are explained in the **glossary** 371.
- If SM4 does not operate as expected at any time, you can find helpful information in the **Troubleshooting** chapter.

1.2 Conventions

The following conventions apply in this manual:

Designation	Meaning
Bold	The names of menus, windows, buttons etc. in the body text are written in bold. Example: Open the **Places of Immission** window. **Bold** type is also used to highlight important parts within a text block.
Italics, blue	Path names are printed in blue and italics. Example: *Project > Project Settings > Ethernet settings*
	This sign indicates that a parameter/setting/function needs to be defined particularly carefully, as an error could result in serious consequences.
	This symbol refers to a practical example or a practical tip that exists for the respective topic.
	This symbol indicates helpful information.
	This symbol identifies step-by-step instructions.
Blue, underlined	Cross-references are highlighted in blue font color and underlined. Click on the cross-reference to jump to its target.
Green background	In the explanation for the parameters, you will find information on the default, input format, input range, etc. highlighted green, where applicable and appropriate.

1.3 Abbreviations

The following abbreviations are used in this manual:

Abbr.	Term	Information
POI	Place of immission	Building with walls and areas to be protected from shadow impact.

Abbr.	Term	Information
LS	Light sensor	• measures the sunlight's direct intensity of illumination to enable the SMU to determine whether shadow impact effects are possible at all at a given point in time • provides information on time and location to the SMU (via a GPS receiver)
OSS	On-Demand Shadow Shutdowns	OSS can be used to allow residents of places of immission to switch off WTGs that cause shadow impact using an app on their smartphone.
SM4	Shadow Manager 4	The operating software for the system for shadow impact monitoring and species conservation described in this manual.
SMU	Shadow Master Unit	The central unit of the system for shadow impact monitoring and species conservation.
SIIU	Shadow Impact Interface Unit	Hardware component that receives analog measurement signals (e.g., wind speed) in a WTG and transmits them to the SMU via a TCP network.
SNU	Sensor Node Unit	Standalone optional hardware used to connect sensors in such a way that commands and answers can be communicated in a cyber-secure manner.
SS	Special shutdown	Shutdown conditions not involving shadow impact (e.g. for bat or bird protection).
TP	Third Party	–
WTG	Wind Turbine Generator	–
CMDR	Cyclic Multi Data Recording	A data set defined in SM4 for automatic regular recording of measured values including specifications for providing the results in .csv format.

1.4 Digital navigation aids

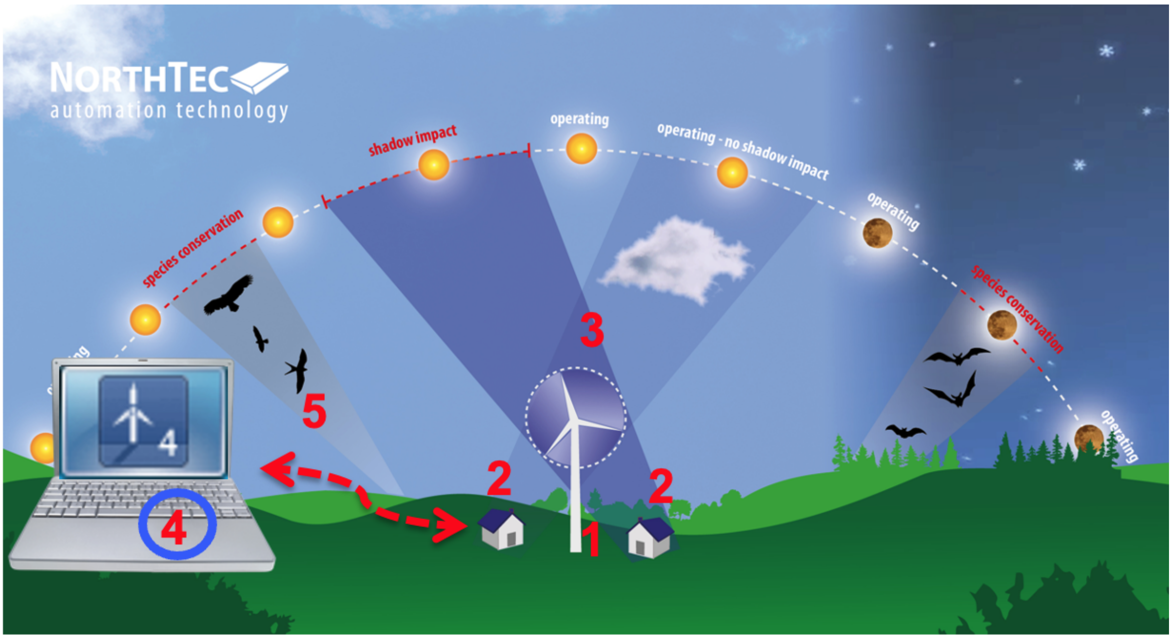
If you read this manual in digital form on a screen, in many places you can click on a cross reference to jump directly to a section with further information. Cross-references are highlighted in blue fonts and underlined. In PDF Reader, you can also display the content at the left-hand side of the window and use it to navigate.

2 Introduction

The purpose of the Shadow Manager 4 (SM4) software is to configure and monitor the Shadow Master Unit (SMU), the central component of the system for shadow impact monitoring and species conservation. Users include predominantly commissioning engineers, service personnel and technical system management employees.

User identification and a password are required to log in to an SMU. The user is set to **admin** and the password to **admin** upon delivery. A dongle is always required to make changes to the SMU settings.

Our system for shadow impact monitoring and species conservation enables you to comply with a large number of permit conditions that apply to wind turbine generators (WTG), primarily with reference to shadow impact and species conservation. The following illustration and the corresponding brief information will help you gain an initial overview of the system and, in particular, identify which element takes on which function and/or role.



1 **Shadow Master Unit (SMU)** - is located in the WTG or in the hand-over station.The SMU receives the project data via Shadow Manager 4, calculates shadow impact periods, shuts down the WTGs when required, records measurement data and alarms, sends the corresponding email notifications and records log data.

2 **Places of Immission (POI)** - Buildings with walls and areas requiring protection

3 **Light sensor** - mounted on the nacelle of a WTG, primarily measures the intensity of illumination of the sunlight.

4 **Shadow Manager 4 (SM4)** - operating software

The project data (coordinates of the WTGs and POIs, permitted shadow impact periods, shutdown conditions for species conservation and other shutdown specifications) is defined in SM4. It also reads out measurement data and logs.

5 **Ethernet connection** with encrypted data transmission - is used to transfer project data from SM4 to the SMU and measurement data as well as for retrieving the SMU logs.

The configuration of the Shadow Master Unit (SMU) can only be performed via SM4. Unlike earlier versions, operation and thus configuration can **no** longer be carried out directly on the SMU.

After you have gained an initial overview of the basic elements of the system for shadow impact monitoring and species conservation, you will find more detailed information on the overall system including its optional components in the next section.

2.1 The hardware components of the system for shadow impact monitoring and species conservation

The system consists of the Shadow Master Unit (SMU) and, depending on the application, different sensors. The required meteorological readings can be obtained via the communication interface to the wind turbine generators (WTG), on the one hand. On the other, there is also the option to connect other measurement units to the SMU, e.g., a climate sensor, laser precipitation sensor or hygro-thermo sensor. At least one light sensor must be installed when using the system for shadow monitoring.

The following table lists the functions and tasks of all core and optional hardware components of the system for shadow impact monitoring and species conservation.

Component	Function
Shadow Manager Unit (SMU for short, central component of the system for shadow impact monitoring and species conservation)	• contains all configuration data of Shadow Manager 4 (SM4) (e.g., coordinates of the WTGs and places of immission, permitted shadow impact periods, shutdown conditions for species conservation) • calculates the shadow impact periods • communicates with the connected sensors • requests the current operating data from the WTG • sends stop and start commands to the WTG • logs all the relevant events • records measurement data • calculates the potential shadow impact one day in advance Purpose: If a place of immission (POI) is already "preloaded" due to the shadow impact of another WTG that you are unable to switch yourself, you should then surmise a worst-case scenario and assume that the WTG runs continuously, and the rotor is always in a 90 °position with respect to the sun.)
Light Sensor (mounted on the nacelle of at least one WTG)	• measures the sunlight's direct intensity of illumination to enable the SMU to determine whether shadow impact effects are possible at all at a given point in time • provides information on time and location to the SMU (via a GPS receiver)
Laser precipitation sensor	• measures the precipitation amount and optionally the outside temperature
Hygro-thermo sensor	• measures humidity and outside temperature
Climate sensor	• measures, e.g., temperature, precipitation amount, relative humidity and atmospheric pressure

Component	Function
iSpin sensor	• enables for example the monitoring and optimization of the performance of WTGs
Sensor Node Unit (SNU)	• standalone optional hardware used to connect sensors in such a way that commands and answers can be communicated in a cyber-secure manner
Signal converter unit	• enables communication between the SMU and the sensors via a network

The following section provides information on the options offered by SM4 and how this software is used to configure the SMU.

2.2 Overview of Shadow Manager 4 functions

The configuration and monitoring of the Shadow Master Unit (SMU) is performed in SM4. Unlike earlier, operation and thus configuration can **no** longer be carried out directly on the SMU.

Because SM4 not only enables you to set the project-specific data, but also offers other helpful options, a corresponding overview of its functions is provided in this section.

2.2.1 Functions relevant to a project

To ensure the system can fulfill its most important task, namely shutting down wind turbine generators because of shadow impact or for bat protection, data specific to the project must first be created in SM4 and then stored in the SMU.

Moreover, further settings you can make project-specific settings – the most important functions are listed below.

Several functions can only be used together with the dongle, which you can purchase from us.

The logged-in users must be authorized for specific right groups in order to transfer a configuration to the SMU, download logs and use the online communication with the SMU (see Shadow Manager Interface User Management window 277).

Set main elements of a shadow impact scenario

- Project data (see Project Data window 89)
- Wind Turbine Generators (see Wind Turbine Generators window 92)
- Places of Immission (see Places of Immission window 122)
- Walls and Areas of the POI to be protected (see Edit Walls and Areas sub window 135)

Amongst other things, data on the length of time permitted to be impacted by shadow (per day and year) according to the authorities is specified when defining places of immission (POI). The project is complete once the elements listed above have been correctly defined. Project data can then be transferred to configure the SMU, making it possible to adhere to requirements by carrying out the corresponding shutdown operations.

Create optional elements of a shutdown scenario

The scenario can also be extended by the following shutdown processes and shutdown elements:

- Calendar periods for WTG shutdown (see section Shutdown Calendar window 229)
- Time periods with/without monitoring (see Shadow Impact Monitoring Periods sub window 131)
- Complex special shutdowns for species conservation (see Special Shutdowns window 193)

- Power thresholds for the purpose of yield optimization (see “Combinations” under WTG Combinations sub window 101)
- Exclude individual combinations of WTGs and POIs, e.g., due to obstructions (see WTG Combinations sub window 101

Define measurement data recordings

You can configure the SMU in such a way that it logs user-defined measurement data automatically. The following options are available:

- Single Data Recordings: record individually selectable measurement data and connect/compare them. The corresponding data is output as a separate log.
- Cyclic Multi Data Recording (CMDR): have a set of readings recorded periodically and define settings for outputting the results in .csv format.

See also:

Single Data Recordings window 236

Cyclic Multi Data Recordings window 239

Perform alarm settings

You can specify when the SMU triggers an alarm for which system/unit and whether an email notification is sent at the same time.

See also Alarm Settings window 145.

Perform hardware settings

Here you can change the defaults of the SMU and the sensors connected to it.

See also Hardware 169.

Visually check the locations of WTG and POI

You can open an overview map to visually check the locations of the WTGs and the POIs. It is also possible to export the data to Google Earth, see Overview Map window 142.

2.2.2 Online communication with the Shadow Master Unit (SMU)

In addition to the configuration of the SMU, SM4 also offers the option of calling up the live data of the sensors and WTGs connected to the SMU and performing switching tests and test alarms. For further information on this topic, please refer to the SMU menu 269 section in the reference part.

2.2.3 Log functions

The SMU generates various logs, which you can download and display in SM4 as well as filter, export, and print.

For further information, please refer to Logs menu 325.

2.2.4 Practical tools

Simulate shadow impact scenario

You can calculate the defined shadow impact scenario according to the most unfavorable conditions (worst-case) for different periods of time. This calculation is performed in SM4. See also Simulation window 351.

Check project integrity

SM4 has an integrity module installed, which can be used to test for plausibility in a project (incomplete references, missing parameters and other “errors”) prior to uploading to the SMU. See also Project Integrity window 345

Check the availability of the SMU

SM4 provides a window in which you can identify at a glance whether the SMU is ready for a connection. This prevents you from making unsuccessful attempts to connect to the SMU. See also SMU Connectivity window 360.

WTG Types

You can call up a window that lists what types of WTGs can be selected when creating wind turbine generators in the project. See also WTG Types window 365.

2.3 Notes on the working environment

The menu structure, the assignment of the mouse keys and the design of the software are based on the standard Windows interface and the corresponding operating elements.

If you are not familiar with using Windows, please get up to date with basic Windows operations (using a mouse, menu technique, changing sizes of windows etc.).

2.4 Shadow Manager 4 – Requirements and Installation

There are 2 versions of SM4:

- desktop version that is installed on a PC like a conventional program
- mobile version that is started from a USB stick.

The latest version of the Shadow Manager software can be downloaded from our website (**www.northtec.de**).

The following technical requirements must be fulfilled before using Shadow Manager 4 (SM4):

Prerequisites	Description
SMU	Shadow Master Unit 4.0 or higher
PC	• a minimum of 4 GB RAM • at least 100 MB free hard disk space • USB port for software dongle • network port/internet connection
Operating system	• SM4 runs on computers with Windows 7 or a higher Microsoft operating system • Limited functionality is also available for Windows XP, which is no longer supported.
Rights	Running the desktop version: administrator rights required Running the mobile version: no administrator rights required
Dongle	To enable the SM4 to be used to its full extent, purchase a USB hardware dongle from us, which we will then send to you.

After you have downloaded the desired version, double-click on the .exe file and follow the instructions on the screen.

2.5 General properties of the software

SM4 is implemented as an MDI (multiple document interface) application, i.e., there is a main window in which other sub windows can be opened.

The size of the sub windows can be changed, and they can be freely placed in the main window. If a sub window is closed and then opened at a later point in time, it will be displayed in the same position.

The user is thus able to create a specific arrangement of windows, which will remain in place even after restarting. Each sub window only has one visible instance at a time. If you attempt to reopen a window that is already open, it will simply display at the uppermost display level.

If an opened sub window takes up more space than is available, a scroll bar will appear. You can use it to scroll to windows that are not displayed or not fully displayed.

The following windows deviate from the MDI structure:

- information or error windows (must be acknowledged)
- windows that require input to be entered before it makes sense to work in other windows (e.g. Walls and Areas window)

If you enter an invalid value into an input field (incorrect value or incorrect input format), it will appear highlighted in red:

Press the Enter key or the Tab key to complete the current entry and jump to the next input field.

In certain windows, some buttons, e.g., **Apply** and **Add**, will not be activated until the mandatory fields of the window have been filled out correctly.

i **If an input window for the menu item that you selected is not displayed**, one reason could be that the size of the SM4 main window has been reduced and the input window has opened outside the visible area.

Check whether a scroll bar has appeared at the right-hand side or bottom edge of the SM4 main window, which you can use to move to the visible area.

2.6 Operating the windows in SM4

You can press the Enter key or the Tab key to complete the current entry and jump to the next input field in most input windows in SM4.

Many windows and sub windows in SM4 can be differentiated based on the type of operation as follows:

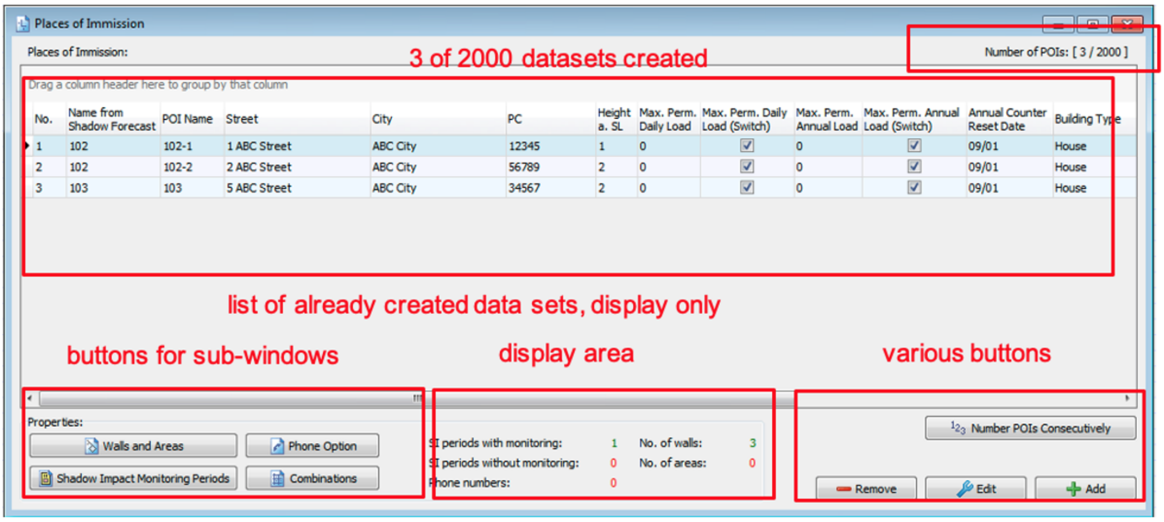
- horizontally divided windows (e.g. Wind Turbine Generators and Places of Immission)
- vertically divided windows (e.g. Special Shutdowns, Night Slice Shutdowns, Hardware Assignments, Interface Cards)
- menu tree windows (e.g. Application Settings)

The following section provides basic details on working with the different types of windows.

2.6.1 List windows

Examples of list windows in SM4:

Wind Turbine Generators, **Places of Immission** , **Logs from Local LogPool**



List window, example: **Places of Immission**

Operating notes for list windows

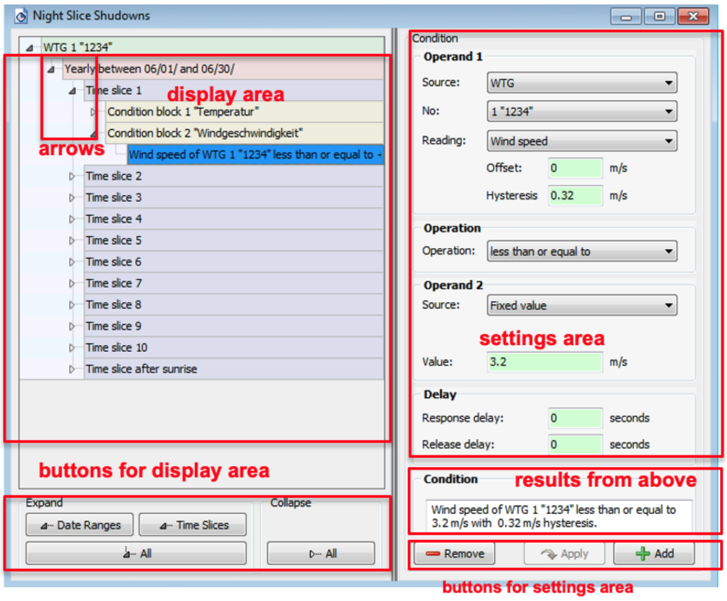
- The list area is a pure display area, no editing is possible.
- To edit a record, select it in the list by clicking on it (record will be highlighted in blue) and then click **Edit** on the bottom right.

- If you click on one of the buttons to sub-windows, a window opens, which refers in each case to the dataset selected in the list (highlighted in blue).
- To add a record, click **Add** on the right.
- The numbers in the middle box below refer to the record selected in the list.
- Move columns: columns can be moved by drag and drop.
- Sort by columns: You can sort by a column title by clicking on it; if you click on the same column title again, the sort order will change from ascending to descending or vice versa.
  You can also sort by multiple column titles (criteria). To do this, first press and hold the Shift key and then click on the desired column titles. The sorting is then carried out in the order in which you click on the titles.

For some lists, you can copy the data from existing records so that you do not have to redefine all the data for each new object.
For more information, see the practical tip in the Wind turbines window 93.

2.6.2 Vertically divided windows

Vertically split windows in SM4 include: **Special Shutdowns, Night Slice Shutdowns, Single Data Recordings, Interface Cards, Interface Connectors, Hardware Assignments**



Vertically divided window, example **Night Slice Shutdowns**

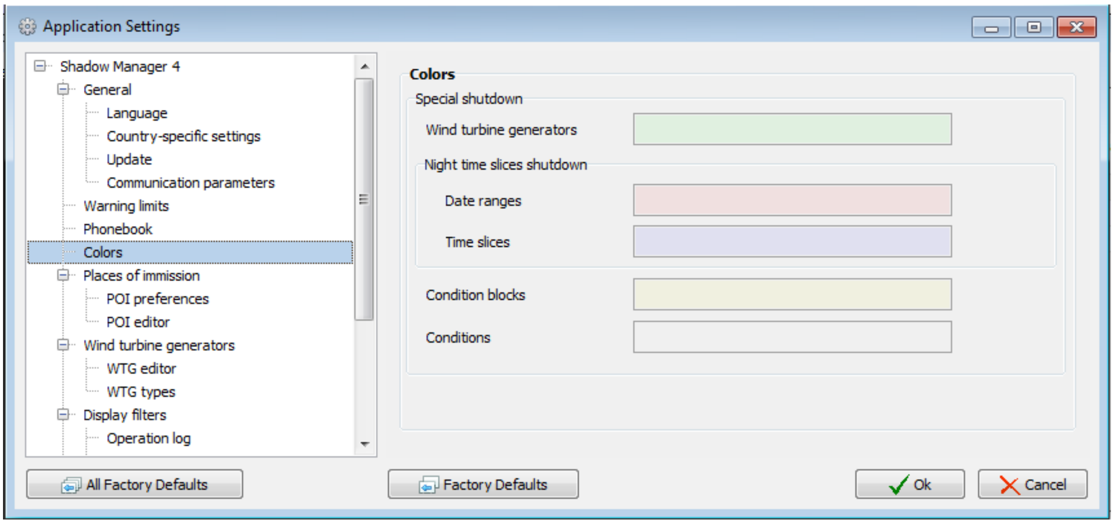
Operating instructions for vertically divided windows

- Display area: Here, already created data records can be shown/hidden. To show/hide records individually, click on the small arrows displayed directly in front of a record.
- To show/hide all records at once, corresponding buttons are available at the bottom left.
- To show/hide a single sub-level, right-click on the respective level and select **Collapse All** or **Expand**All.
- Settings area: Here you make the settings for the data set that you have previously selected in the left area.
- If no data set is displayed on the left, you must first add a data set on the right by selecting a WEA at the top and then clicking on Add at the bottom.
- If no record appears in the right pane, you probably did not select a record or an editable record on the left. Select a dataset on the left - you may need to click on the small arrow in front of the dataset to get to an editable dataset. Make sure that the record you want to edit is highlighted in blue on the left side of the window.
- Logical links can be created in windows such as **Special Shutdowns**, **Bat Shutdowns**, and **Individual Records**. If there are several conditions within a condition block, then these are linked by AND, i.e. only if all conditions are fulfilled, the switch-off takes place. If there are several condition blocks, then these blocks are linked by OR, i.e. even if the conditions of one block are fulfilled, the shutdown takes place.

2.6.3 Menu tree windows

Menu tree windows in SM4:

Application Settings, **Project Settings**



Menu tree windows, example **Application Settings**

Operating instructions for menu tree windows

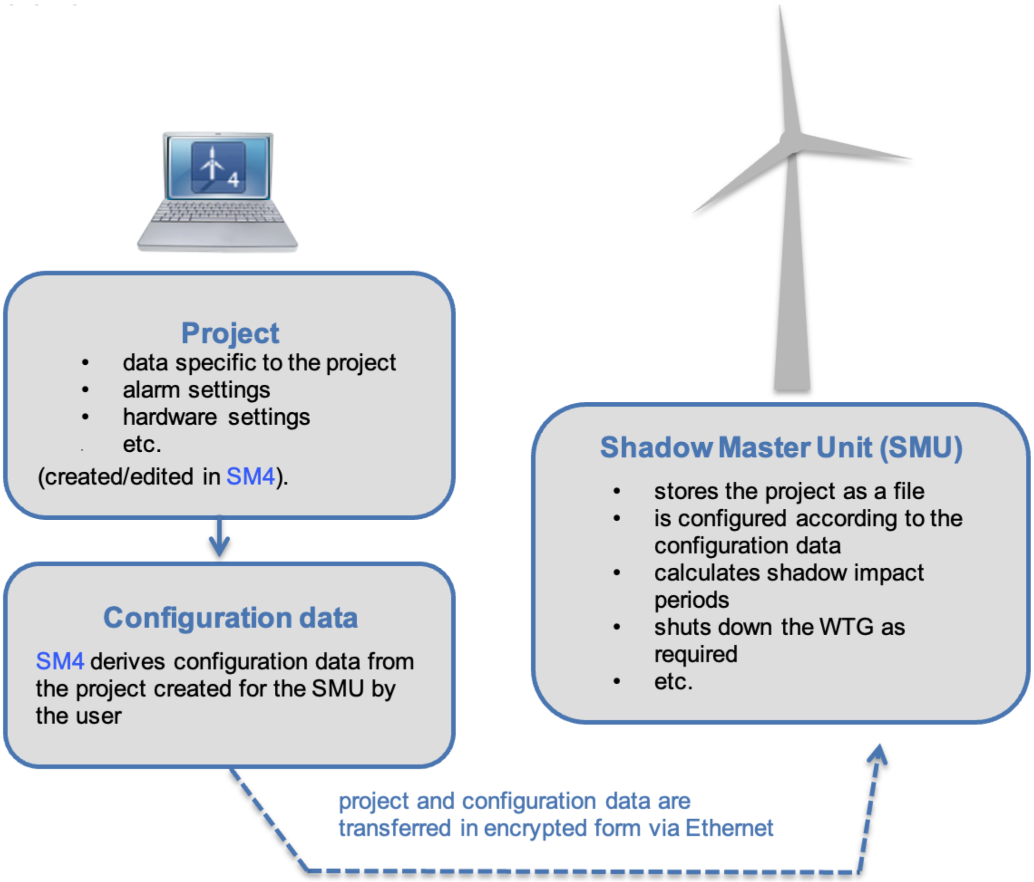
- A menu tree is located at the left-hand side. Click on + and - to expand or collapse it.
- The settings area selected on the left can be edited in the right half of the window.
- The **Application Settings** window must be closed by clicking on **OK** or **Cancel** before another process can be carried out.

2.7 Sequence of a configuration session in SM4

It is important to understand in general how SM4 is used to configure the Shadow Master Unit (SMU). For this reason, this chapter is intended for you to familiarize yourself with a configuration session and to explain what takes place in the background.

To ensure the system for shadow impact monitoring and species conservation is able to fulfill its most important task, namely shutting down wind turbine generators because of shadow impact or bat protection etc., it is necessary that data specific to the project is first created in SM4.

To do so, a project is created or an existing one is opened in SM4. This project contains all data and settings relevant to a specific wind park or its SMU and the connected sensors. If a project is complete and inherently consistent, SM4 can derive the configuration data for the SMU. The project and the configuration data are then encrypted and transferred to the SMU. Once it is there, the SMU stores the project as a file and is then configured according to the configuration data. Only then is it possible for it to fulfill its main task: shutting down and (restarting) WTGs according to the specifications of the authorities and other factors (e.g., yield optimization). This sequence is exemplified in the following overview.



The sequence of a configuration session in SM4 can be divided into three steps:

Step 1: Create/open a project 25

Step 2: Edit project 25

Step 3: Configure the SMU 26

2.7.1 Configuration step 1: Create/open project

In most cases, you will use Shadow Manager 4 (SM4) to perform changes to an existing configuration of a Shadow Master Unit (SMU). To do so, you should open the project stored in the SMU and not, if applicable, the project saved locally on the computer. This will prevent possible conflicts between different project versions. Only if you are absolutely certain that an up-to-date project file is stored on your computer, and that it corresponds to the configuration of the SMU, can you forgo opening the SMU project.

You therefore have 3 options for Step 1.

- **Create a new project**: Open the **File** menu, select **New Project** and follow the instructions on the screen.

OR

- **Open a locally saved project**: Open the **File** menu, select **Open Project (Local)** and select the project that you want to edit.

OR

- **Open a project from the SMU**: Click on **File**, select **Open Project (SMU)** and follow the instructions on the screen.
  NOTE: This option is only available if you are connected to the SMU!

2.7.2 Configuration step 2: Edit project

In this step, you define or edit all data and settings that are relevant to the respective wind park or its SMU and the connected sensors based on the information in the Practical section 27 and Reference part 51 od these instructions.

NOTE

You should document every change you perform to a configuration in the Project Data window (*Project > Project Data*) under **Log book**, to ensure you and other people are able to track changes at all times (see Project Data window 89).

2.7.3 Configuration step 3: Configure SMU

After you have completely created the project or performed all changes, select the **Configuration** menu item from the **Project** menu. The **Check Configuration** window will now open, where you can first test whether the configurations derived from the project fulfill all the requirements. Only when this is the case can you initiate the actual transfer of the configuration to the SMU (see section Check Configuration window 159).

NOTE

Step 3 can only be performed if there is a **connection to the respective SMU**, the user **has been authorized to configure the SMU** and a **dongle** is present.

! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

- Where possible, download an already existing project from the SMU prior to editing it. This will ensure that you work with the version that corresponds to the current configuration of the SMU.
- Document every change that you perform on a project in the Log book in the **Project Data** window.

3 Practical part

This chapter contains basic step-by-step instructions, which even SM4beginners can use to operate the software.

Based on examples, we describe typical operating sequences that you can use as a basis for your own projects. If more complex setting steps are required or are optional, we will make reference to the corresponding section in this manual where you can find more detailed information.

> If **SM4** does not operate as expected, consider whether the reason for this could be the application settings (*File > Application Settings*) or the project settings (*Project > Project Settings*).
>
> Example
>
> You enter the value "3.0" for the "Hub distance" in the **Add/Edit WTG** window but SM4 does not accept the value (the field remains highlighted in red). You may have set a "," (comma instead of a point) in the Application Settings as the **Decimal separator** in the **Country-Specific Settings**.

> **If an input window for the menu item that you selected is not displayed**, one reason could be that the size of the SM4 main window has been reduced and the input window has opened outside the visible area.
>
> Check whether a scroll bar has appeared at the right-hand side or bottom edge of the SM4 main window, which you can use to move to the visible area.

We will now describe the steps that you need to perform before and after changing a project in SM4.

Preparation: Load current configuration

If you do not want to create a new project but would like to make changes to the current configuration of the SMU, first open the current project from the SMU as follows:

- Click on  or select *File > Connect*.
- Enter **Parameters**, **User** and **Password** and click on **Connect**. For more information, see Connect 54.
- Select *File > Open Project (SMU)* and open the current project.

OR (only if you are absolutely certain that an up-to-date project file is stored on your computer, and that it is 100 % identical to the current configuration of the SMU)

- Click on  or select *File > Open Project*.
- Select the current configuration file (.smp4).

Post-processing: Send Configuration

So that the SMU can work with the new configuration, the data must be transferred as follows.

- Select *Project > Configuration*. The **Check Configuration** window will open.
- Now click on **Test Config.** in the **Configuration** window.
- If a green checkmark is now displayed in front of all 6 test points, you can click on **Send Config.** (Otherwise, you will need to conclude any pending tasks, see Check Configuration window 159).
- The configuration you changed will now be sent to the SMU. Wait until the procedure is concluded.

3.1 Example 1: Set up new WTG with new POI

An existing project (sample project) that already contains five wind turbine generators (numbers 1-5) and seven places of immission (numbers 1-7) is expanded by a WTG. Within the range of that WTG, there is a POI which has not yet been defined.

You will find corresponding step-by-step instructions below (remember to load the current project file before you begin; please also read sections “Preparation“ and “Post-processing“ at the beginning of chapter 3 27.

3.1.1 Define new wind turbine (WTG)

- Click on or select *Project > Wind Turbine Generators*.
- In the **Wind Turbine Generators** window a) click on **Add WTG** at the bottom right OR b) select the dataset of an already defined WTG as a template from the list at the top of the window and select **Edit WTG** OR c) double-click on a WTG to be used as a template.
- If you used option b) or c) in the previous step, the **WTG number** field will now be highlighted in orange. Enter the next free number here (in this example, this would be the No. 6) and then enter an identifier that does not yet exist into the **WTG identifier** field. All fields should then again be highlighted in green.
- Enter or change the parameters for the new WTG in the **Add/Edit WTG** window. See **Add/Edit WTG window** 94 for an explanation of the individual parameters.
- Click on **Add** to save the dataset of the new WTG.

> i If entries in the window should **NOT** be applied, close the window with and confirm the question whether you want to discard the changes.

3.1.2 Define new immission point (POI)

- Click on or select *Project > Places of Immission*.
- In the **Places of Immission** window, a) click on **Add** at the bottom right OR b) select the dataset of an already defined POI as a template from the list at the top of the window and select **Edit** OR c) double-click on a POI to be used as a template.
- If you used option b) or c) in the previous step, the **No. of place of immission** field will now be highlighted in orange. Enter the next free number here (in this example, this would be the

No. 8) and then enter a name that does not yet exist in this configuration in the **Name of place of immission** field. All fields should then again be highlighted in green.

- Enter the parameters of the new POI in the **Add/Edit Place of Immission** window. For an explanation of the individual parameters see Add/Edit Place of Immission sub window 126.

- Click on **Add** to save the dataset of the new POI.

3.1.3 Define patio

- Ensure that the newly added POI is selected in the Places of Immission window. Click on Walls and Areas at the bottom left to open the like-named window. Click on + in the input area at the bottom left and enter the coordinates of the corner points of the area to be protected. The value under Length will be automatically determined and serve as a control. See also Edit Walls and Areas sub window 135.

- Click on **Apply** to save the new area.

> **!** **Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.**
>
> If the field **Length** to a wall or area in meters (last field of the line) is highlighted in yellow (instead of green), the entered values are not plausible or the maximum length of a wall or side of an area according to the warning limit (*File > Application Settings > Warning limits*) has been exceeded. Check that you have entered the coordinates correctly. For further information, please refer to section Application Settings window, Warning limits 74.

3.2 Example 2: Check the position of POIs and WTGs visually

Visually check whether the locations of the POIs and WTGs are correctly defined for an existing project. You will find corresponding step-by-step instructions below (remember to load the current project file before you begin; please also read sections “Preparation“ and “Post-processing“ at the beginning of Chapter 3 27).

3.2.1 Open overview map

- Click on or select *Project > Overview Map*.
- If applicable, select the option **OSM** (Open Street Map) at the top right under **Maps**.
- All hidden maps of all WTGs (**red**), all POIs (**green**) and the geographical central point of the WTGs, i.e., the project center (**orange**) will now be displayed in the map.
- You can show/hide all individual elements by setting/removing checkmarks at the top right under **Elements**.
- In the map display area, you can zoom in (turn the mouse wheel or move two fingers outwards on a touchpad) and shift the displayed section (hold down the left mouse button and move mouse).
- To move the “project center” back into the center of the display, click on **Center Project** on the bottom right.

3.2.2 Display coordinates of WTGs and POIs in Google Earth

- In the **Overview Map** window, click on **Export Google Earth** and save the export file (.kml).
- Open the exported .kml file with Google Earth.
- The WTGs and the POIs are also represented here by red squares or green dots.
- If you click on a WTG in Google Earth, a window with data relating to the respective WTG (type, meters above sea level, hub height, etc.) will be displayed.
- If you click on a POI in Google Earth, a window with data relating to the respective POI (address, building type, max. load, etc.) will be displayed.
- Using the Google Earth functions, you can also zoom in so far that you can identify, e.g., walls and areas defined for a POI.

3.3 Example 3: Changed load times & utilization times of a POI

The authorities have changed the permitted load times for a POI. In the future, moreover, new working hours and annual closures will apply to this POI that is used as a commercial property:

Old working hours	**New working hours**
Mon–Fri, 09:00 AM to 05:00 PM, Sat 09:00 AM–02:00 PM	Mon–THU, 09:00 AM to 06:00 PM, Fri 09:00 AM–04:00 PM, Sat closed
Annual closures: none	Annual closures: every year from 15 to 31 July

You will find corresponding step-by-step instructions below (remember to load the current project file before you begin; please also read sections “Preparation“ and “Post-processing“ at the beginning of chapter 3 27.

3.3.1 Change maximum load times

- Click on or select *Project > Places of Immission.*
- Select the POI whose load times must be changed from the list of POIs in the **Places of Immission** window.
- Click on **Edit** at the bottom right.
- Enter the new value in minutes under **Maximum permissible daily load**.
- Enter the new value in minutes under **Maximum permissible annual load**.
- Click on **Apply**.

3.3.2 Change weekly recurring utilization times of the POI

- Ensure that the POI to be changed is selected (highlighted in blue) in the **Places of Immission** window.
- Click on **Shadow Impact Monitoring Periods** on the bottom left.
- All the periods of time in which the building is monitored are displayed with a red square in the calendar in the **Shadow Impact Monitoring Periods** window at the right-hand side. Select the currently defined time for Monday to Friday by clicking on the corresponding square or

select the corresponding line below right in the window. A black arrow will be displayed in front of the selected time:

	Comment	Start	End	Color	Repetitions
▸	Mon to Fri				every Monday, Tuesday, Wednesday, Thursday and Friday from 09:00 AM to 05:00 PM
	Sat				every Saturday from 09:00 AM to 02:00 PM

- Replace “Mon–Fri” with, e.g., “Mon–Thu” in the **Comment** field at the top left under **Periods**, remove the checkmark set for **Friday**, replace 05:00 PM with 06:00 PM at **End time** and click on **Apply** under **Weekly**.
- Enter, e.g., “Fri” under **Comment** in the same input area, change the **End time** from 06:00 PM to 04:00 PM, remove all the checkmarks at the weekdays, set a checkmark for **Friday** and click on the **Add** button under **Weekly**.
- Select the “old time” for Saturday, 09:00 AM–02:00 PM at the right in the calendar or in the list at the bottom right and click on the **Delete** button under **Weekly**.

3.3.3 Change periods without shadow monitoring (annual closures)

- In the **Periods** area at the top left, select the option **without shadow impact monitoring**.
- Also in the **Periods** area, enter, e.g., "Annual closure" at **Comment**.
- In the **Time range** area, enter 15.07.2017 as the **Start date** and 31.07.2017 as the **End date**.
- Check the box **Repeat annually** and then click on the **Add** button below.
  If you have defined everything correctly, the following will now be displayed at the bottom right of the **Shadow Impact Monitoring Periods** window:

	Comment	Start	End	Color	Repetitions
	MON to THU				every Monday, Tuesday, Wednesday and Thursday from 09:00 AM to 06:00 PM
	FRI				every Friday from 09:00 AM to 04:00 PM
▸	Annual closure	07/15/2021	07/31/2021		every July 15 from 12:00 AM to 07/31/2021, 12:00 AM

- Click on at the top right to close the window.

> ! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

3.4 Example 4: Editing the combination of POI and WTG

Up to now, WTG 2 has caused shadow impact on POI 4 within an existing project. In the meantime, a high building has been erected between POI 4 and WTG 2 meaning that, with immediate effect, WTG 2 can no longer cause shadow impact on POI 4. Moreover, you have found out that POI 2, a house, will not be lived in for an indeterminate period.

To accommodate these changes, you must disable the combination of WTG 2 andPOI 4 and all combinations with POI 2 in SM4. You will find corresponding step-by-step instructions below (re-member to load the current project file before you begin; please also read sections “Preparation“ and “Post-processing“ at the beginning of chapter 3 27).

3.4.1 Deactivate combination of WTG 2 and POI 4

- Click on or select *Project > Wind Turbine Generators*.
- Select **WTG 2** in the list in the **Wind Turbine Generators** window and click on **Combinations** at the bottom left.
- Remove the checkmark at POI 4 in the **WTG Combinations** window.
- Click on **Apply** and then click on **Close**.

3.4.2 Deactivate all POI 2 combinations

- Click on or select *Project > Places of Immission*.
- Select POI 2 in the list in the **Places of Immission** window and click on **Combinations** (bot-tom9.
- Click on **Wizard** at the bottom left in the **POI Combinations** window.
- Ensure that the option **Apply to selected POI** is selected in the **Combinations Matrix Wizard** window.
- Click on the **Deactivate Combinations** button in the **Combinations** area and then click on **Close** below.
- All checkmarks will now be removed under **Combination Active** in the **POI Combinations** window. Click on **Close**.

! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

3.5 Example 5: Requirements for bat protection w/ night windows

The authorities have prescribed a time slices shutdown for a WTG:

- The night is to be divided into 10 time slices for the wind speed condition.
- A further Time slice before sunset should make up 15 % of the night.
- The temperature conditions are the same for the individual months of the monitoring period.
- To prevent the system from being switched on and off repeatedly during gusty winds (high wear) due to the WTG operating around the wind speed threshold value, it is permitted, according to the requirements, that the WTG be switched off only when the wind speed condition has been fulfilled constantly for a period of 30 minutes. The system may only be switched on again, however, when the corresponding conditions have remained continuously absent for the same period. Response delay and Release delay have been added to SM4 to ensure that these requirements can be met.
- Moreover, it is known that the temperature measured by the WTG is always 1 °C below the actual temperature. This can be corrected by configuring the **Offset** parameter.

The precise shutdown conditions for the individual slices are listed in the following table.

	June	July	August	September	October
	Temperature [°C]				
	16.0	15.0	14.5	15.5	9.0
Night time	Wind speed [m/s]				
-0.15–0.0	3.2	3.8	3.7	2.9	2.7
0.0–0.1	5.0	5.3	5.3	4.7	4.6
0.1–0.2	5.5	5.7	5.7	5.2	5.1
0.2–0.3	5.2	5.4	5.5	5.0	4.8
0.3–0.4	5.2	5.3	5.4	5.0	4.6
0.4–0.5	5.1	5.2	5.3	4.9	4.5
0.5–0.6	4.8	5.0	5.0	4.6	4.2
0.6–0.7	4.8	5.0	5.0	4.6	4.2
0.7–0.8	4.4	4.7	4.6	4.1	3.8
0.8–0.9	4.2	4.6	4.6	4.1	3.8
0.9–1.0	2.5	3.2	3.1	2.5	2.1

You will find corresponding step-by-step instructions below (remember to load the current project file before you begin; please also read sections “Preparation“ and “Post-processing“ at the beginning of Chapter 3[27]).

3.5.1 Set up time slices

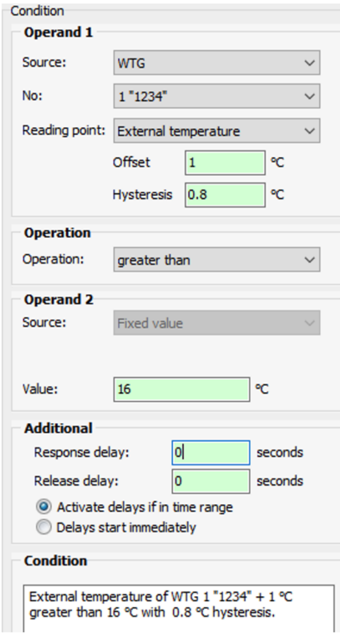
- Open the **Night Slice Shutdowns** window (*Switching & Measurement*).
- Select the respective **WTG** from the menu at the top right and click on **+ Add** below.
- Click on the small arrow in front of the selected WTG at the top left in the window.
- Click on the red highlighted **Date range** and enter 06/01 and 06/30 at the right. (If you do not define a year, the conditions will also apply to subsequent years.) Click on **Apply** at the bottom right in the window.
- Click on the small arrow in front of the date range at the top left in the window. Now click on the new Time slice 1 that appears (it will be highlighted in blue).
- Select **Time slice before sunset** in the drop-down list at the right in the window, enter the value 15 % for **Time slice length** and click on **Add** at the bottom in the window.
- Set up 10 Night time slices in the same way.

3.5.2 Rename condition blocks (optional)

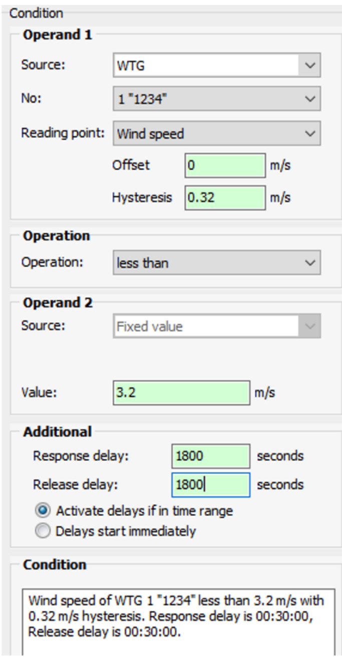
- Click on the arrow in front of **Time slice before sunset** and then on **Condition block 1**. Now enter a block name on the right and click on **Apply**.
- Repeat this procedure for Night time slice 1 to Night time slice 10.

3.5.3 Define conditions for time slice before sunset

- Click on the arrow in front of **Condition block 1** and then on **<empty>**. The **Condition** input area will now appear on the right. Now define the first condition for **Condition block 1** in the **Conditions** input area as follows:



- Click on **Add** at the bottom right in the window and then define the second condition for **Condition block 1** in the **Conditions** input area as follows:



- Subsequently set up all other Time slices and Condition blocks according to the requirements of the authorities. For further information on the **Shutdown condition** input area, please refer to Shutdown condition input area 201.

! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

3.6 Example 6: Special shutdowns

WTG 4 “1234” has been approved with the following requirements:

Bat protection

Shutdown is prescribed in the **months of May to September inclusive** during the period of **one hour before sunset to one hour after sunrise** if

- the wind speed is less than 6 m/s for at least 15 minutes and
- the outside temperature is +10 °C or more for at least 20 minutes

The same minimum time periods shall apply for starting up again, i.e., if, for example, the wind speed is more than 6 m/s again, then this state must last for at least 15 minutes before the WTG is started up again.

Bird protection

The same WTG should be shut down in the months of **February to June inclusive** every day **from 7 minutes after sunrise to 257 minutes after sunrise**.

Noise protection

The authorities prescribe that WTG 1 with the identification “1234” is to be shut down during the period from 10:00 PM to 07:00 AM, if the nacelle is at an angle of between 90° and 180° and wind speed is less than 7 m/s.

You will find corresponding step-by-step instructions below (remember to load the current project file before you begin; please also read sections “Preparation“ and “Post-processing“ at the beginning of Chapter 3 27).

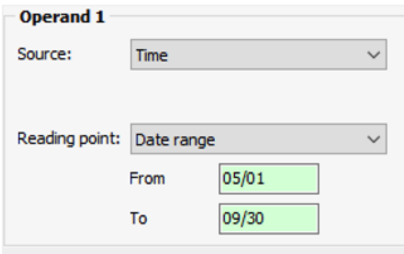
3.6.1 Define bat protection condition block

- Click on or select *Switching & Measurement > Special Shutdowns* to open the **Special Shutdowns** window.
- At the right-hand side of the screen, select the WTG for which a special shutdown needs to be defined for from the **WTG** drop-down list.
- Click on **+ Add** at the bottom right of the screen. The selected WTG will now appear on the left-hand side of the screen.
- Click on the small arrow in front of the blue highlighted WTG on the left-hand side of the screen. **Condition block 1, special shutdown** will now be displayed underneath.

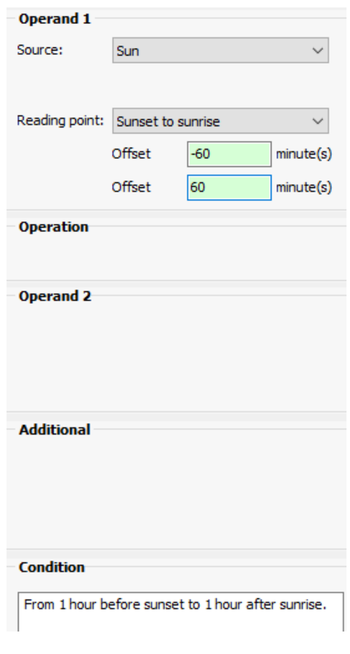
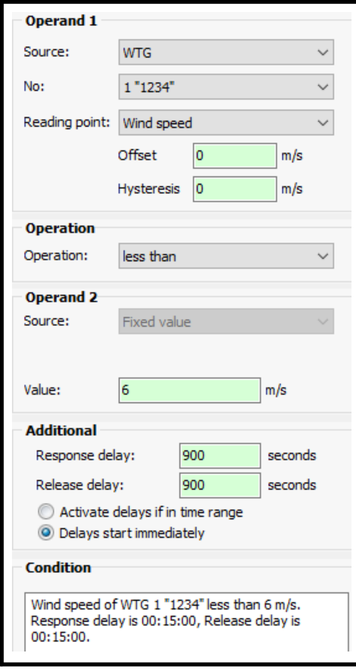
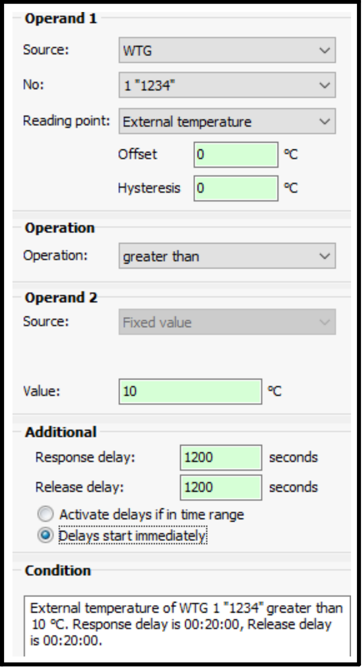
- Click on the small arrow in front of **Condition block 1, special shutdown** on the left-hand side. **<empty>** will now be displayed below, which will later be replaced by the first condition.
- Assign a name for the condition block at the right-hand side of the screen under **Block name** (e.g., bat protection May–September) and select, for example, **Bat protection** in the **Switch reason** drop-down list.

> **!** The switch reason is important on three accounts:
>
> - When entering a condition block for bat or bird protection, the correct switch reason must be defined so that SM4 can run the applicable plausibility check 202.
> - The **Switch reason** also tells the SMU in which particular log a shutdown is to be recorded.
> - For the WTG type "via relay", additional DOs can be assigned a switch reason, see Communication Parameters input area 113.

- Click on **Apply** at the right-hand side of the screen.
- Click on **<empty>** on the left-hand side of the screen. This line will then be highlighted in blue, and the right-hand side of the screen will display the **Condition** input area.
- Now define the first condition (**from May to September**) in the **Condition** area as follows:

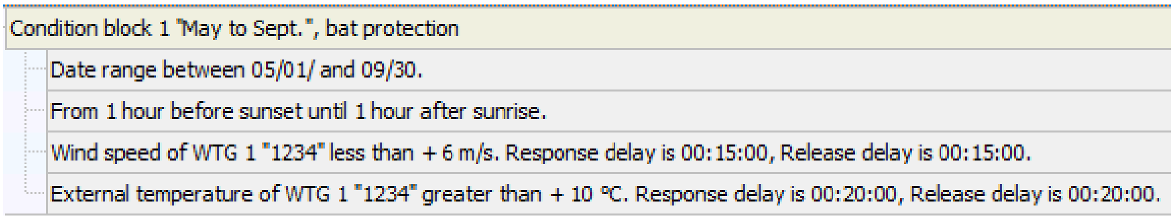


- Click on **Add** at the bottom right in the window.
- Define the remaining three conditions of the first condition block in the same way:

Condition 2	Condition 3	Condition 4
		

For more information, for example, on the **Additional** input area, which is refelcted in conditions 3 and 4, see the section on special shutdowns under Shutdown condition with Source = WTG 210.

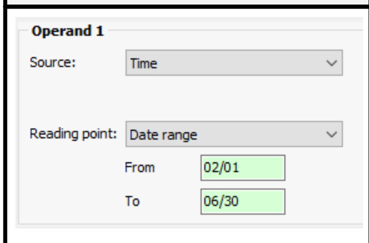
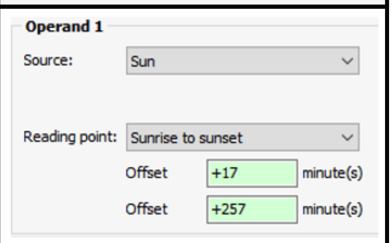
Once all conditions have been correctly defined, Condition block 1 will be displayed on the left-hand side of the window as follows:



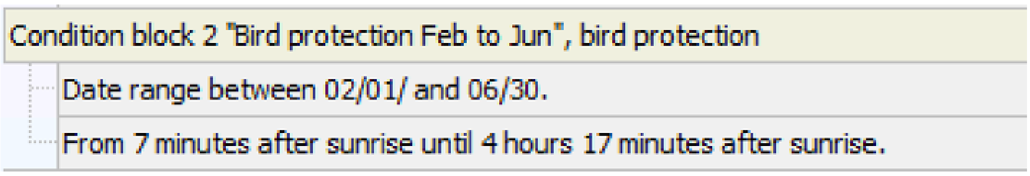
3.6.2 Define bird protection condition block

The WTG should be shut down in the months of **February to June inclusive** every day **from 7 minutes after sunrise to 257 minutes after sunrise**.

Now define condition block 2 with 2 conditions as follows:

Condition 1	Condition 2
	

Once all conditions have been correctly defined, Condition block 2 will be displayed on the left-hand side of the window as follows:



3.6.3 Define noise protection condition block

The authorities prescribe that WTG 4 with the identification 1234 should be shut down from 10:00 PM to 07:00 AM if the nacelle's angle is between 90° and 180° and the current wind speed is less than 7 m/s.

Now define Condition block 3 with 4 conditions as follows:

	Condition 1	Condition 2	Condition 3	Condition 4
	10:00 PM.–07:00 AM	**Nacelle. ≥ 90°**	**Nacelle. ≤ 180°**	**Wind speed < 7 m/s**
Operand 1	**Operand 1**	**Operand 1**	**Operand 1**	**Operand 1**
Source	Time	WTG	WTG	WTG
Number	-	1 “1234”	1 “1234”	1 “1234”
Reading	Time range	Nacelle angle	Nacelle angle	Wind speed
From	10:00:00 PM	-	-	-
To	07:00:00	-	-	-
Offset	-	-	-	-
Hysteresis	-	-	-	-
Operation	**Operation**	**Operation**	**Operation**	**Operation**
Operation	-	greater than or equal to	less than or equal to	less than
Operand 2	**Operand 2**	**Operand 2**	**Operand 2**	**Operand 2**
Source	-	Fixed value	Fixed value	Fixed value
Fixed value	-	90 °	180 °	7 m/s

Once all conditions have been correctly defined, Condition block 3 will be displayed on the left-hand side of the window as follows:

Condition block 3 "Noise protection", noise protection
- Time range between 10:00:00 PM and 07:00:00 AM .
- Nacelle angle of WTG 1 "1234" greater than or equal to + 90 °.
- Nacelle angle of WTG 1 "1234" less than or equal to + 180 °.
- Wind speed of WTG 1 "1234" less than + 7 m/s.

> ! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

3.7 Example 7: Supplement a bat shutdown with condition flags

A project contains a bat shutdown with night slices for May through September. It includes shutdown conditions for wind speed and outdoor temperature. It has now been decided that the emitting WTGs need not be shut down for the rest of the night once precipitation of 0.01 mm/h intensity has been measured, even if it stops raining again in the course of the same night.

In order to take precipitation into account, you could simply add the shutdown condition "Intensity of climate sensor X less than + 0.1 mm/h" to the condition blocks in the **Night Slice Shutdowns** window. However, to ensure that once precipitation has been measured, the system will not be switched off again for the rest of the night, **regardless of precipitation**, the "Precipitation present" status must be stored until the next morning. This requires the definition of a **condition flag**, which will then be included in the night slice shutdown.

Prerequisite for the carrying out this practical example

Since we do not list each operating step individually in this practical example, the user is assumed to have basic knowledge of SM4.

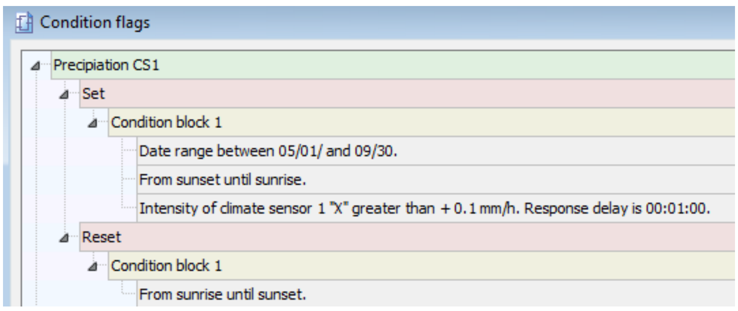
The structure and operation of the vertically divided **Condition Flags** window essentially corresponds to the **Special Shutdowns** window. If you are not familiar with the latter, please start by reading the sections Vertically divided windows 21 and Special Shutdowns window 193.

In addition, before executing this practical example, you should have executed **Example 6** 39 and read the information in the Condition Flags window 244 section.

You will find corresponding step-by-step instructions below (remember to load the current project file before you begin; please also read sections “Preparation“ and “Post-processing“ at the beginning of chapter 3 27).

3.7.1 Define condition flags

Select *Switching & Measurement> Condition Flags* and in the **Condition Flags** window, define the **Set** and **Reset** conditions to match the following screenshot:

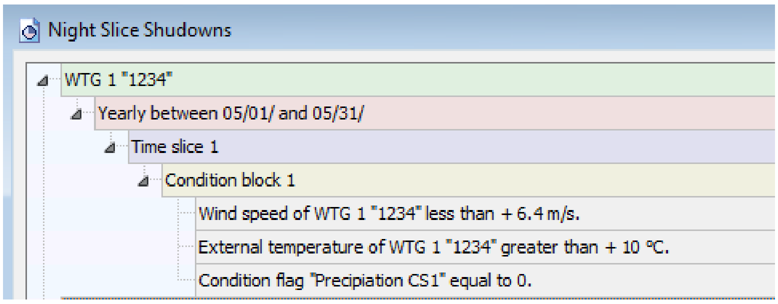


Notes on the above screenshot

- Under **Set**, you define the conditions that must apply for the flag to be set, i.e. for the result "1" to be returned.
- The **Response delay** field is designed to prevent the WTG from being switched too often.
- Since all of the defined conditions must apply, they are defined in one and the same condition block (logical AND link).
- **Reset** defines the condition that must apply for the flag to be reset, i.e. for the result "0" to be returned (during the day).

3.7.2 Include condition flags in night slice shutdown

Select *Switching & Measurement > Night Slice Shutdowns* and include the previously defined condition flags in the **Night Slice Shutdowns** window as shown in the following screenshot:



Notes on the above screenshot

- The condition block with the shutdown conditions for wind speed and external temperature was supplemented here by the condition flag defined in the previous section.
- As soon as this third shutdown condition is no longer fulfilled because climate sensor 1 measures more than 0.1 mm/h of precipitation during the night in the period from 1 May to 30 September and therefore no longer returns the result "0" but "1" instead, the emitting WTG is started up again. If it stops raining the same night, the WTG will not be shut down again, because the flag is not reset until sunrise.

Now, of course, the condition blocks for all other time slices and months must be adjusted as well. To do this, use the drag and drop functions, see section Easily duplicate special shutdowns using drag & drop 222.

For more information on condition flags, see section Condition Flags window 244.

! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

3.8 Example 8: Regular recording of several measured values

For different WTGs of a project X, different measured values are to be recorded at certain time intervals.

1) Data from WTG 17 every 12 minutes:

- Rotor speed (RotSpd) in 1/min
- WTG Status
- Wind speed (WSpd) in m/s
- Outdoor temperature (Temp.) in °C
- Power mean 10 min. (Pwr.)
- Nacelle position (NPos)

2) Wind every 10 minutes, only during the night

- WTG 1
- …
- WTG 10

3) Temperatures every 10 minutes, between 10:00 a.m. and 10:00 p.m.

- Temperature of ISpin sensor 1
- External temperature of WTG 1
- Communication OK from WTG 10

In the output file, each measured value should appear in a separate column; the abbreviation and, if applicable, the unit should be indicated in the title row.

The above task could also be accomplished with the help of single data recordings; however, due to the scale, it is much more convenient and less time-consuming to make use of cyclic multi data recordings (CMDR).

You will find corresponding step-by-step instructions below (remember to load the current project file before you begin; please also read sections “Preparation“ and “Post-processing“ at the beginning of Chapter 3 27).

3.8.1 Define interval timers (10 and 12 minutes)

- Open the **Interval Timer** window (*Switching & Measurement > Interval Timer*).
- Enter, e.g., the following for **Name**: 10min.
- Enter or select 10 for **interval.**
- Click on Add.
- Enter, e.g., the following for **Name**: 12min
- Enter 12 for **interval.**
- Click on Add and close the window.

3.8.2 Define multiple recordings

- Open the **Cyclic Multi Log Recordings** (*Switching & Measurement > Cyclic Multi Data Recordings*).
- For **Name**, in the upper right corner, enter, e.g., the following: Data WTG 17.
- Select the “12 minutes" interval from the **Timer** dropdown list.
- In the **File name** field, enter, e.g.: WTG 17_123417.

NOTE: Observe the Windows file naming conventions and define unique names, since all .csv files are output to the same folder.

- Click on Add.
- For **Name**, in the upper right corner, enter, e.g., the following: Wind 1-10.
- Select the "10 minutes" interval from the **Timer** dropdown list.
- In the **File name** field, enter, e.g.: Wind 1-10 and click on Add.
- For **Name**, in the upper right corner, enter, e.g., the following: Temperatures.
- Select the “10 minutes" interval from the **Timer** dropdown list.
- In the **File name** field, enter, e.g.: Temperatures and click on Add.

> i The file names can still be changed later,
> please refer to (**Export Cyclic Multi Log** window).

The next section explains how to add the reading points (what to record?) and conditions (when to record?).

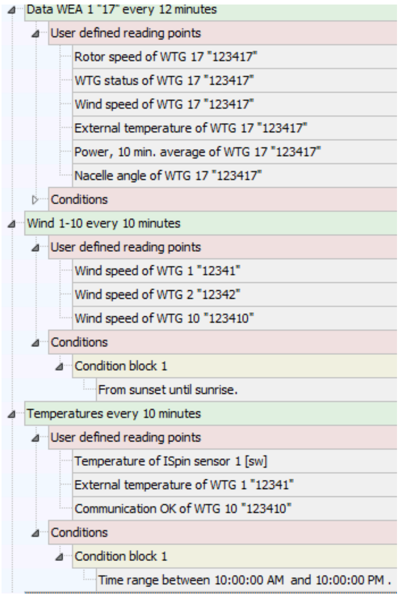
3.8.3 Add reading points and conditions

- Click on Collapse All at the bottom left of the window.
- **For** the first recording (WTG 17), click on **<empty>** under **User-defined reading points**.
- In the input area **Measurement,** select “WTG” for **Source**, 17 “123417” for **No.** and for **Reading point** select the **Rotor speed** option. Click on Add.
- Now define the reading points WTG status, Wind speed, External temperature, Average power and Nacelle position in the same way, see figure below.

- For the second recording (wind), click on **<empty>** under **User-defined reading points**.
- In the input area **Measurement,** select “WTG” for **source,** 1 “12341” for **No.** and for **Reading** select the **Wind speed** option. Click on Add.
- Repeat this procedure for WTGs 2 through 10.
- Also for the second recording (wind), click on **<empty>** under **Condition block 1.**
- In the **Log Condition** input area on the right, select **Sun** for **Source** and then **Sunset to Sunrise** for **Reading point**. Click on Add.

- For the third recording (temperatures), click on **<empty>** under **User-defined reading points**.
- In the **Measurement** input area, select **ISpin sensor** as the **Source** and **Temperature** as **Reading point.** Click on Add.
- Now select the option **WTG** for **Source**, option **1 "12341"** for **No.** and the **Outdoor temperature** option for **Reading point.** Click on Add.
- Now select the option **WTG** for **Source**, **10 “123410”** for **No,** and the **Communication OK** option for **Reading point**. Click on Add.
- Still in the third record (temperatures), click on **<empty>** under **Condition block 1.**
- In the **Log Condition** input area on the right, select the **Time** option for **Source** and then the **Time Range** option for **Reading Point.** Enter the value **10:00:00 AM** for **From** and the value **22:00:00 PM** for **To**. Click on Add.

If you have made all entries as described, the left half of the window should correspond to the following screenshot.



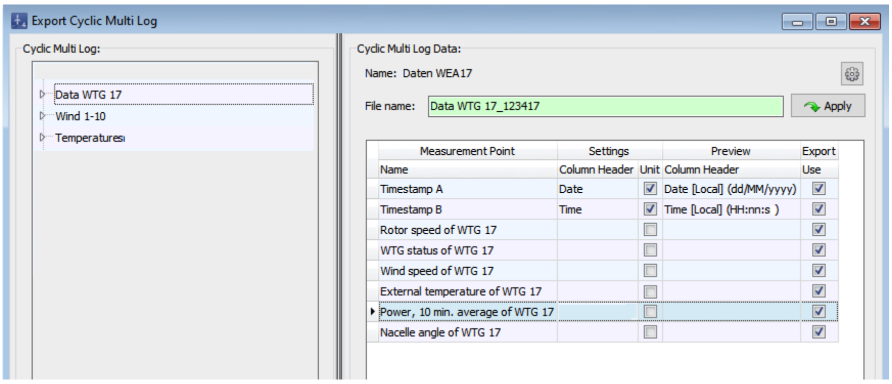
3.8.4 Retrieve recorded data

After the project containing the CMDRs has been sent to the SMU and a certain time has elapsed, in which the SMU was allowed to record values, these can be retrieved as follows:

- Click on or select *File > Connect*.
- Enter **Parameters**, **User** and **Password** and click on **Connect**. For further information see Connect 54.
- Once the **Login** LED at the bottom of the screen lights up green, select *Logs > SMU Log Files*.
- In the **Logs from the SMU** window, click on List.
- Under **Log**, select the desired log of project X and click on Download.
- Select *Logs > Local Log Files* to open the **Logs from Local LogPool** window.
- Select Project X in the list at the top left.
- Select the desired date range on the right and click on **Export**. The **Export Cyclic Multi Log** window opens.

3.8.5 Check the data display and export the data

- In the **Export Cyclic Multi Log**, click on the recording named **Data WTG 17** at the left edge of the window to display it in the right half of the window, see the following screenshot (section):



- Under **Settings, Column Header** now enter the desired abbreviations for the reading points and activate the boxes under **Unit**, see the following screenshot:

Measurement Point	Settings		Preview	Export
Name	Column Header	Unit	Column Header	Use
Timestamp A	Date	☑	Date [Local] (dd/MM/yyyy)	☑
Timestamp B	Time	☑	Time [Local] (HH:nn:ss)	☑
Rotor speed of WTG 17	RotSpd	☑	RotSpd [1/min]	☑
WTG status of WTG 17	WTG Status	☑	WTG Status	☑
Wind speed of WTG 17	WSpd	☑	WSpd [m/s]	☑
External temperature of WTG 17	Temp.	☑	Temp. [°C]	☑
Power, 10 min. average of WTG 17	Pwr.	☑	Pwr. [kW]	☑
Nacelle angle of WTG 17	NPos.	☑	NPos. [°]	☑

- Click on **Export**, select a destination folder, and click on **OK.**

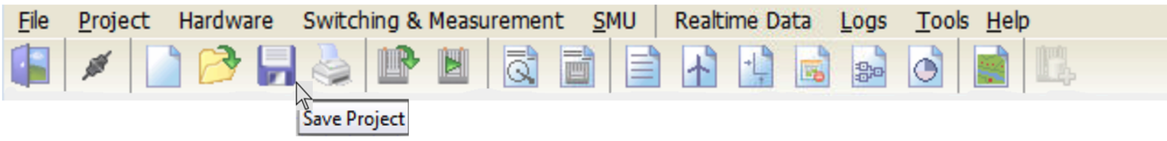
The data is now exported to a CSV file, which you can open with, e.g., Microsoft Excel.

> i The entry of the column headers and the selection and deselection of the unit can also be done when creating the recordings in the **Cyclic Multi Log** window.
>
> - While entering/changing the file name, the respective recording itself must be selected in the directory tree in the left half of the window. Otherwise, the Apply button is not available.
> - If you do not enter anything under **Settings**, **Column Header**, the corresponding measured value will still be exported, but there will be no header.
> - If you don't want to export a certain measured value, you can now deselect it under **Export**, **Use.**

For more information on exporting CMDRs, see section Cyclic Multi Data Recordings 239.

4 Reference part

The Shadow Manager 4 (SM4) setting windows and sub windows are arranged in menus and can be called up through them. Some windows can be directly opened by clicking on the corresponding button in the toolbar of the main window; see following figure. The function of individual symbols will be displayed if you hover the mouse cursor over them for a moment.



Symbols in the SM4 main window (with tool tip)

The following table provide you with an overview of the content of the individual menus.

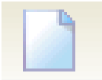
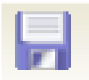
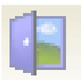
Menu name	What you can do there
File 53	• Establish a connection to the SMU • Open, create, download, save project files • Print configuration log • Application settings (e.g., language, country-specific settings, warning limits, colors etc.)
Project 88	• Define project data, wind turbine generators (WTG), places of immission (POI), walls and areas, special shutdowns etc. • Visually check the location-defined WTG and the POI (Overview Map) • Perform project settings • Send project file to the SMU (Configuration)
Hardware 169	• Define and assign sensors and hardware
Switching & Measurement 192	• Define WTG shutdowns • Define measurement data recordings • Define various accessories, e.g., condition flags, calculations, etc.
SMU 269	• Display and acknowledge alarms • Manage users and assign right groups • Set the Phone option • Manually set the time • Update SMU software

Menu name	What you can do there
Realtime data 287	• Display live data (sensor data, counters, etc.) from the SMU
Logs 325	• Readout, display, filter, print and export logs,
Tools 344	• Simulate a shadow impact scenario • Check project integrity • Check the availability of the SMU • Display WTG types that can be selected • Reset window arrangement and screen detection
Help 367	• Display version information and check for new software version

Click on a menu item to jump directly to more information.

4.1 File Menu

The following table provides you with an overview of the **File** menu.

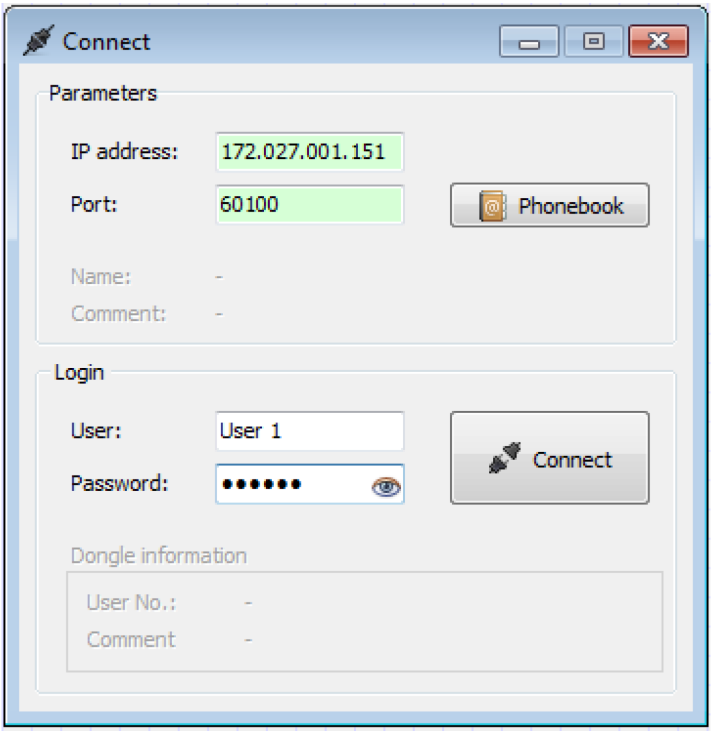
Symbol	Menu item	Purpose
	Connect 54	Establish an online connection to the SMU
	New Project 59	Create a new project
	Open Project (Local) 61	Open an existing project
	Open Project (SMU) 61	Open a project from the SMU (only possible if there is an online connection to the SMU)
	Save Project 62	Save Project
	Print 62	Print configuration log – you can print the configuration log to PDF or as a hard copy (in German or English)
	Import swk file 64	Import a project file that was created using Shadow Manager 1
	Application Settings 68	Define basic settings for SM4
	Close 87	Shadow Manager Exit

Click on a menu item to jump directly to more information.

4.1.1 Connect

Purpose	Establish online connection to SMU
Button	
Path	*File > Connect*
Usage type	Interactive
Reference	Project

In this window you can establish an online connection to the SMU. To do this, you must know the IP address and port of the SMU and be registered as a user.



Connect window

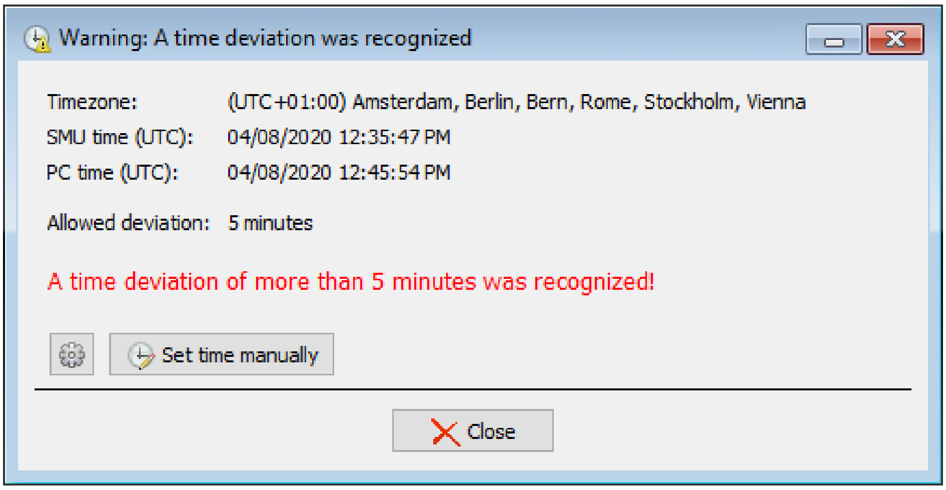
The information, options or buttons are described in the following table

Input field/area	Explanation/Function
IP address	IP address of the SMU to be communicated with
	4 numbers, separated by a period, example: 192.0.2.42
Port	Port number of the SMU you want to communicate with
	Number from 1 to 65535
Phonebook	Opens the **Phonebook** window. Here you can store the communication parameters for various projects so that they can be conveniently selected from the **Connect** window. • In the upper half of the input area the already created entries are listed. • In the lower half of the input area you can remove entries (mark the corresponding entry at the top of the list), edit (**Replace** button) or add (**Add** button; enter information under **IP Address**, **Port** etc. beforehand). • **IP address**, **Port** and **Name** are mandatory fields. • **Comment** is an optional input field.
Name	The name defined in the **Phonebook** window is displayed here.
Comment	The comment that was defined in the **Phonebook** window is displayed here, if applicable.
User	Enter your user name here. Default setting on delivery: **admin** **NOTE** Entries are case-sensitive: "Admin" is a different user than "admin".
Password	Enter your password here. Default setting on delivery: **admin** Click on the eye to show/hide the password. **NOTE** For security reasons, please change the user and the corresponding password (**admin** and **admin**) preset at delivery as soon as you put SM4 into operation (the change is made in the Shadow Manager Interface User Administration window 277 and is only possible with dongle).
Connect	Starts the connection process. This button changes depending on the connection status and user data input: 1. not connected and no user data entered = deactivated 2. not connected and user data entered = activated 3. connected = changes to **Disconnect** button
User No.	The number of the dongle used is displayed here.
Description	The name of the owner of the dongle used is displayed here.

4.1.1.1 Automatic check of the SMU time

When you connect to the SMU, the system automatically checks in the background whether the time of the SMU (UTC) is different from the time of the computer (UTC). The deviation tolerance can be defined in the *Application Settings* (*File > Settings > Warning limits > Allowed deviation*). You can set values from one minute to one year (all values in minutes).

If the deviation determined during automatic check exceeds the permitted value, the following window opens:



Warning: A time deviation was recognized

Information about the **Warning: A time deviation was recognized window**

- This window displays the current time zone of the SMU, the time of the SMU (UTC) and the time of the computer (UTC). The permitted deviation is also displayed.
- If you click on the gear symbol, you are taken directly to the **Allowed deviation** setting.
- The button **Set time manually** only appears if a dongle is connected. Clicking this button takes you directly to the Set time manually window 282.
- Checking the time can also be triggered manually (*SMU > Check Time Deviation*), see Check Time Deviation menu item 283.

4.1.1.2 Information at the bottom of the main window

In the status bar at the bottom of the SM4 main window, you will find information about the state of the connection between SM4 and the SMU (left-hand) and dongle information (right-hand).

Status LED and Dongle information

The status LEDs indicate the connection status of the data traffic between SM4 and the SMU, similar to a telephone modem.

Element	Explanation/function
Login **connected** **not connected**	This LED is lit green if a connection to the SMU via user name/password has been established successfully. The LED turns off as soon as the logout command is sent to the module (*File > Connect >* ***Disconnect*** *button*) or the corresponding **Connect timeout** (*File > Settings > Communication parameters*) has expired while waiting for a reaction from the SMU.
TX: **transmission** **no transmission**	This LED is lit, while SM4 transmits a command or data to the SMU. Since this usually takes only a short time, the LED usually just flashes. This LED is also switched on at the beginning of a connection setup and remains lit until either the connection has been established or the **Connect timeout** has been exceeded.
RX: **reception** **no reception**	If this LED is lit, this means that a readout process has been started in SM4. It remains lit until a response can be read by the module (which takes different lengths of time depending on the request).
ST (session time)	Once a connection to an SMU has been established, the remaining connection time until the connection is automatically terminated due to inactivity is displayed here. Every time you press the left mouse button or use the keyboard in SM4, the session time is reset to the value defined in the Application Settings for **Session time** (*File > Application Settings > General > Communication parameters*). If **ST: 03:36** is displayed, for example, this means that the connection will be automatically terminated in 3 hours and 36 minutes if inactivity persists. If **Session time** is set to 4 hours, clicking the left mouse button would reset the value to 4 hours, and the status bar would display **ST: 04:00**.

<table>
<tr><th>Element</th><th>Explanation/function</th></tr>
<tr><td></td><td>Three different states can be displayed for ST:
<table>
<tr><td>Display only</td><td>Explanation</td></tr>
<tr><td>--:--</td><td>SM4 is not connected to an SMU.</td></tr>
<tr><td>03:36</td><td>SM4 is connected and the Session time is active.</td></tr>
<tr><td>**:**</td><td>SM4 is connected and the Session time was paused. Reason: For some file operations (transferring a configuration/update or requesting/reading out log files), the connection must not be disconnected. If such a file operation takes longe than the remaining session time, an inactive user is automatically logged off once the file operation is complete.</td></tr>
</table></td></tr>
<tr><td>Connection</td><td>From left to right, the IP address, port, and SMU location name for the current connection are displayed here.

If there is currently no connection to an SMU, the information of the last established connection is displayed here.</td></tr>
<tr><td></td><td>The user and number of the dongle used (if connected) are displayed at the bottom right.</td></tr>
</table>

NOTE

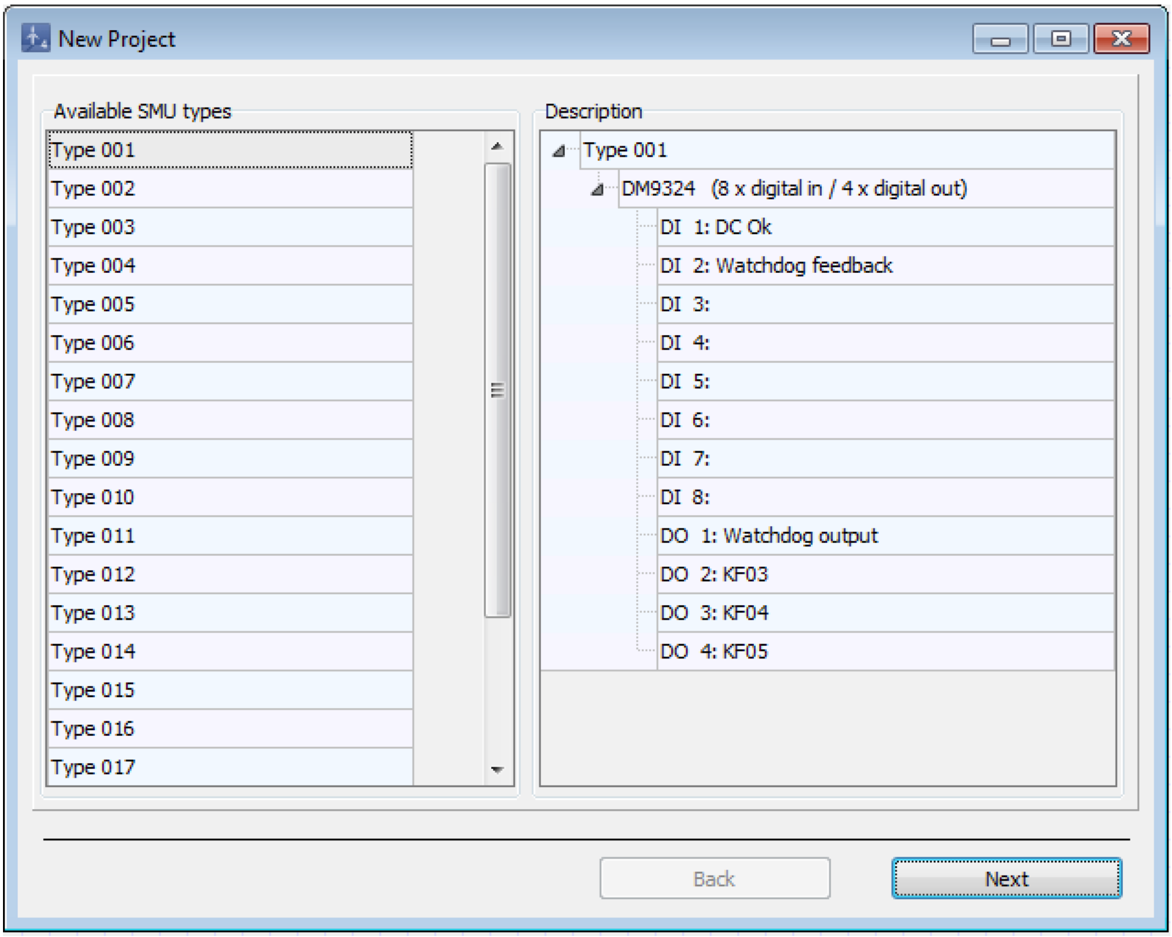
The **TX** and **RX** LEDs may also light up for the following reason:

The only way for SM4 and the SMU to reliably determine whether the connection between them still exists is based on "life signs" from their connection partner. A possible “life sign” may be traffic between the two, such as when a **Live Data** window regularly retrieves data from the SMU. However, if nothing was transmitted over a certain period, SM4 will start a mechanism that sends a ping command to the SMU at regular intervals and receives the corresponding ping response.

4.1.2 New Project

Purpose	Select the SMU type in order to automatically define a range of basic settings
Buttons	
Path	*File > New Project*
Type of use	Interactive
Reference	Project

This window allows you to start to create a new project by selecting the SMU type.

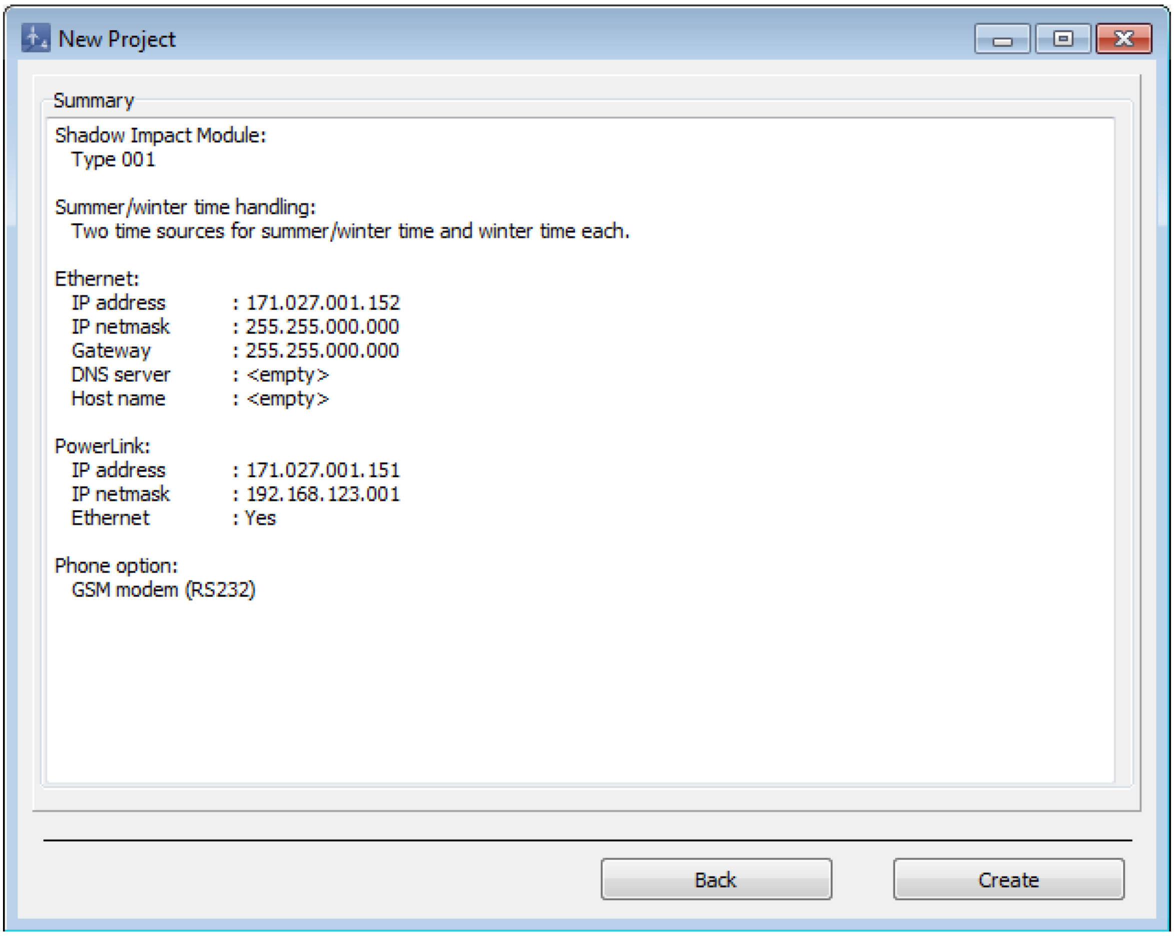


New Project window

Information on the **New Project** window

- The SMU types offered by NorthTec are displayed on the left-hand side of the window and can be selected by clicking. Selecting the wrong SMU type can cause serious malfunctions.

- The hardware components belonging to the selected type are displayed in the right half of the window.
- By clicking **Next** you will be taken, one after the other, to the following windows in which you can make further settings:
  - Project Settings window, SMU, Time settings 149
  - Project Settings window, SMU, Ethernet settings 152
  - Project Settings window, SMU, Additional hardware 158
  - Project Settings window, SMU, Shadow impact calculation 156
- The selected SMU type, Summer/winter time handling, the specified Ethernet address and PowerLink address as well as the Phone option, if applicable will then be displayed in the **New Project / Summary** window (see screenshot).
- If the information is correct, click on **Create** to generate the project.



New Project / Summary window

4.1.3 Open Project (Local)

Purpose	Select already existing project files to open them to edit or display them
Symbol	
Path	*File > Open Project*
Type of use	Interactive
Reference	Project

Follow the instructions on the screen for this menu item.

4.1.4 Open Project (SMU)

Purpose	Readout the current project file of the respective SMU to open it for editing or display purposes.
Symbol	
Path	*File > Open Project (SMU)*
Prerequisites	• Online connection to the SMU (this menu item is not active otherwise) • A project file has been loaded to the SMU
Type of use	Interactive
Reference	Project

Follow the instructions on the screen for this menu item.

4.1.5 Save Project

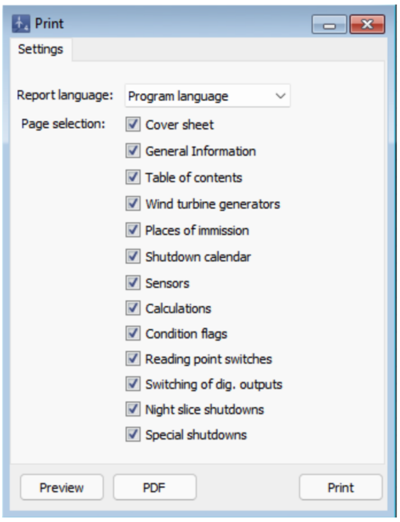
Purpose	Save a newly created or a changed project file.
Symbol	
Path	*File > Save Project*
Type of use	Interactive
Reference	Project

Follow the instructions on the screen for this menu item.

4.1.6 Print

Purpose	Print configuration log
Symbol	
Path	*File > Print*
Type of use	Interactive
Reference	Project

You can print out the configuration log in this window and specify beforehand what information the print version should contain.



Print window

The information, options or buttons are described in the following table

Element	Explanation/function
Report language	In this drop-down list, you can specify in which language the log should be output. In all cases, the **Program language** option (report language = language of the SM4user interface) can be selected. The other languages available depend on the supported languages.
Page selection	Here you can specify what information should be contained in the report.
Preview	Opens a preview window corresponding to the page selection defined above.
Print	Opens the print window with normal setting options.
PDF	Opens the **Save as** window in Windows where you can specify the desired file name and storage location.

4.1.7 Import swk file

Purpose	Import a project file that was created using Shadow Manager 1
Path	*File > Import .swk file*
Type of use	Interactive

To import a project created with Shadow Manager 1, select the path specified above, select the desired sky file, and then follow the on-screen instructions.

The import process automatically creates a new project in which the data to be imported are saved. Once created, the window for the settings of a new project opens automatically (see section New Project 59).

It is recommended to check the SWK project file for formal and content errors in Shadow Manager 1 before importing it to SM4.

The following data areas are included in the import:

- Project Data 89
- Wind Turbine Generators 92 (WTGs)
- Places of Immission 122 (POI)
- Combination Matrix 101 (from several WTGs and POIs)
- Shutdown Calendar 229

The following data areas are **not** included in the import:

- Sensors
- Special Shutdowns
- Night Slice Shutdowns

These data areas may have to be edited/completed manually after the import has been carried out.

In SM4 there are some changes to the imported data areas, which are described in the following tables:

Project Data

Name in SM1	Name in SM4	Notes
	Time zone	Must be set after import in order to display the local time correctly.
Coordinate format	Coordinate format	The implementation of the coordinate systems in SM4 differs from that in SM1. To display a map, an existing coordinate system must be selected by EPSG-No. – it must correspond to the one from the forecast or surveying.

Wind turbine generators

Name in SM1	Name in SM4	Notes
Follow-up time	Release delay	
Generator type	WTG type	Is specified by selecting a WTG type in the **WTG Types** window. Since WTG types did not exist in this form in SM1, a formal placeholder type for imported WTGs is assumed (WTG ID 4210000000, Miscellaneous), which enables buffering. This placeholder type must be newly selected and replaced by a valid WTG type. **IMPORTANT NOTE!** Before selecting a new WTG type, select **Don't use presets** under **Action following WTG type selection** (*File > Application Settings > Wind Turbine Generators > WTG editor*) to make sure the imported data will not be overwritten.
Generator type ID		This parameter does not exist in SM4 in this form; the contained information is determined by selecting the WTG type.
Switch output	Digital output for stop	There is no automatic transfer. If a WTG type was selected whose communication type is **via relay**, the WTG must be assigned a digital output under *Hardware > Hardware Assignments* (see section Hardware Assignments window 189).
Ref. sensor	Reference sensor	In SM1, the lowest number (number of the first sensor) is "0", however, in SM4 the lowest number is "1". Therefore, the number of the reference (light) sensor is automatically increased by one when importing the new data.

Name in SM1	Name in SM4	Notes
		If “all” has been selected as the reference sensor in SM1, the setting must be made manually, since the selection "all" is not available in SM4. In principle, the light sensor data are not imported automatically and must be entered manually.
Switchable		The parameter **Switchable** with the options **yes** and **no** is no longer available. This information is defined in SM4 by the WTG type.

Places of Immission

Name in SM1	Name in SM4	Notes
No. of place of immission	No. of place of immission	In SM1, the numbering of the POIs starts with "0", in SM4 with "1". When a 0 is imported, it is converted to the number 300 and a pop-up window will display the respective information.
	Name of place of immission	This unique identification is generated automatically. The identification consists of the imported **No.of plc. of immission** and the preceding letters “POI".
Weekday selection	Periods with shadow impact monitoring	You will find the equivalent of the **Weekday selection** parameter in SM4 in the **Shadow Impact Monitoring Periods** window. There you can, e.g., exclude individual weekdays from monitoring. The weekdays are imported and automatically created with a period from 12:00 AM to 11:59 PM. For more information on setting parameters in SM4, please refer to the Shadow Impact Monitoring Periods sub window 131 section.

Combinations

Name in SM1	Name in SM4	Notes
Combinations	WTG Combinations POI Combinations	The data from the **Combinations** window will be adopted in SM4, however, they are displayed somewhat differently: Whether a combination is active or not is indicated in SM4 by a checkmark in the **Combination Active** column. Since it is not possible to activate or deactivate a power threshold (Max.Power in SM1) in SM1, it is pre-set to the high value of 99999 kW, which never applies in practice. In SM4 on the other hand, the power threshold is set to 0 kW by default, as it can be activated and deactivated here. Therefore, a power threshold value of 99999 kW from previous versions is displayed in SM4 in the **Power Threshold [kW]** column with a value of 0.

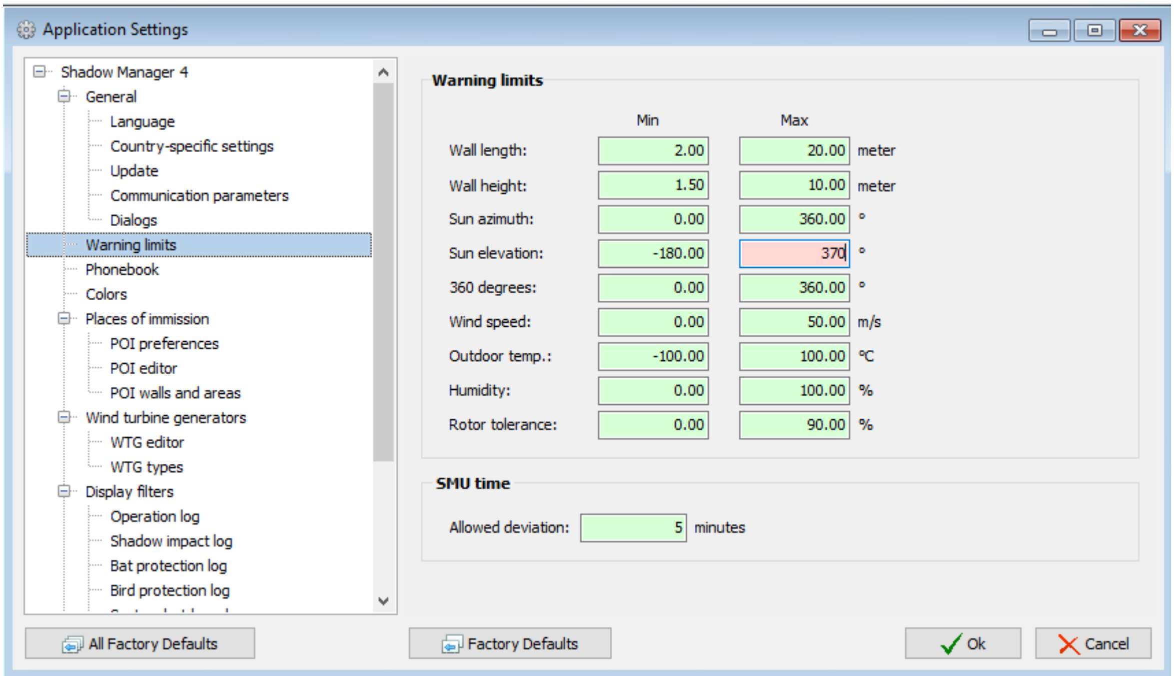
Shutdown Calendar

Name in SM1	Name in SM4	Notes
Shutdown calendars	Shutdown calendar	The **State** column from previous versions was replaced in SM4 by the **Light Sensor** column: • Entries whose state = **inactive** in the previous version will not be transferred to SM4. • Entries whose state = **active** are assigned the value **Ignore all light sensors** in SM4. • Entries whose state = **active (light sensor = 1**) are assigned the value **Evaluate WTG's light sensors** in SM4.

4.1.8 Applications Settings window

Purpose	Specify basic SM4 settings
Symbol	
Path	*File > Application Settings*
Window type	Menu tree window
Type of use	Interactive
Reference	SM4 software

You can specify basic SM4 settings in this window; for example, input formats, warning limits, display filters for logs etc.



Application Settings window, **Warning limits** (example)

Notes on the **Application Settings** window

- The setting ranges available in the **Application Settings** window can be selected in the left-hand half of the window via a menu tree and can be shown/hidden (**+** or **-**).
- Press the Enter key or the Tab key to complete the current entry and jump to the next input field.

- It can be changed there at any time.Fields in which an invalid value was entered (value is outside the permitted range, wrong input format) are highlighted in red:

You will find an explanation of the individual parameters and setting options in the following tables.

In the explanation for the parameters, you will find information on the default highlighted in green, where applicable and appropriate.

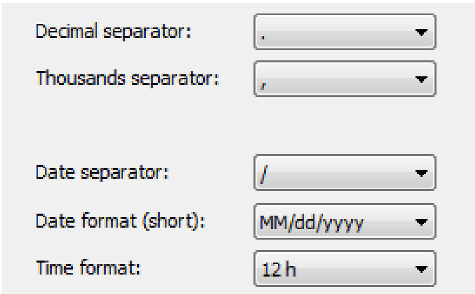
4.1.8.1 Application Settings, General, Language

Input area	Explanation/function
Language	Select between German and English user interface.

4.1.8.2 Application Settings, General, Country-specific settings

<table>
<tr><th>Input area</th><th>Explanation/function</th></tr>
<tr><td>Country-specific settings</td><td>The standard settings for the decimal separator, thousands separator etc. correspond to the selected language and are not changed as a rule.

In the following figure you can see the standard settings to which the parameters can be reset by clicking on the Factory Defaults button below:



For the date format, you can select between dd/MM/yyyy (day first) and MM/dd/yyyy. This setting also affects the entry of a date without defining a year, such as that in the Shutdown Calendar window, for example.</td></tr>
</table>

4.1.8.3 Application Settings, General, Update

Input area	Explanation/function
Update	**Check for updates at application start-up** When this option is activated, a search for an update for SM4 is automatically carried out through your internet connection when starting the application. If the search is successful, you will be asked in a dialog window whether you want to install the new version.

4.1.8.4 Application Settings, General, Communication parameters

The parameters in this input area relate to the connection that is established between SM4 and the SMU.

In the explanation for the parameters, you will find information on the factory defaults, input format, range, etc. in a green field, if applicable and appropriate.

Parameter	Explanation
Connect timeout	This timeout is used to monitor the initial setup of a connection to a SMU. If you click on **Connect** in the **Connect** window, SM4 will try to connect to the defined SMU via the network, however, it will continue do so only as long as specified under **Connect timeout**. If a connection cannot be established during this time and the number of connect retries has been "used up", the attempt will be aborted. Factory default: 4000 ms Changing this value will have the following effects: **INCREASE VALUE** • SM4 will try to connect to the SMU over a longer period. **DECREASE VALUE** • SM4 will abort the attempt to establish a connection earlier.
Connect retries	If you click on **Connect** in the **Connect** window, the number of connect retries specified here will be carried out until a connection has been established. After a command to configure the SMU has been sent in SM4, the SMU will be unavailable for some time. To cause SM4 to try to connect to a (non-responsive) SMU several times, you can increase the number of connection attempts here.

Parameter	Explanation
	However, you can also check in the Connectivity window (*Tools > SMU Connectivity*) whether the SMU is available and ready for a connection before you try to establish a connection. Factory default: 1 Changing this value will have the following effects: **INCREASE VALUE** • If a connection attempt fails, SM4 automatically carries out the number of further attempts specified here.
Time between 2 attempts	After an attempt to connect has failed, SM4 will wait as long as specified here, before a new attempt is made (provided that more than 1 attempt has been specified under **Connect retries**). Factory default: 4000 ms Changing this value will have the following effects: **INCREASE VALUE** • SM4, after an attempt to connect to the SMU has failed, will wait longer before a new attempt is started; this may reduce the number of unsuccessful attempts, however, it may take longer to re-establish a connection. **DECREASE VALUE** • After a connection attempt has failed, SM4 will start a new attempt sooner; thus, the number of unsuccessful attempts may increase, but the connection may be restored faster.
Read command timeout	This parameter is identical to the **Connect timeout** parameter in terms of its functionality, however, it applies to all other commands (all commands except for "Establish Connection", which is triggered by clicking on **Connect** in the window with the same name). This timeout monitors the time between sending a command to the SMU and receiving a response. The value must mainly depend on the commands with the longest processing times and on the transmission time of TCP packets from SM4 to the SMU and back. If SM4, after sending a command, does not receive a response for the period specified here, SM4 will assume that the connection to the SMU has been lost. Factory default: 16000 ms Changing this value will have the following effects: **INCREASE VALUE** • SM4 will wait longer, after sending a command, until it assumes that the connection to the SMU has been lost due to the absence of a response. **DECREASE VALUE** • If SM4, after sending a command, does not receive a response, it will be quicker to assume that the connection to the SMU has been lost.

Parameter	Explanation
Delay between 2 commands	This parameter determines how long SM4 waits after an answered command until a new (different) command is sent. This prevents the SMU from getting overloaded. Factory default: 100 ms Changing this value will have the following effects: **INCREASE VALUE** • After sending a command, you will have to wait longer before the next command can be executed. This way, you can avoid overloading the SMU. **DECREASE VALUE** • After sending a command, you can execute the next command sooner. However, this may overload the SMU.
Login refresh interval	The only way for SM4 and the SMU to reliably determine whether the connection between them still exists is based on "life signs" from their connection partner. A possible “life sign” may be traffic between the two, such as when a Live Data window regularly retrieves data from the SMU. However, if nothing was transmitted over a certain period of time, SM4 will start a mechanism that sends a ping command to the SMU at regular intervals and receives the corresponding ping response. This parameter is used to control as to when and how often this mechanism is activated. As long as no data commands are sent from SM4 to the SMU, the sending of ping commands is repeated regularly at the interval specified here. This is also indicated by the regular flashing of the TX and TX LEDs at the bottom left of the SM4 main screen. This prevents the SMU from assuming that it is still involved in an already interrupted connection (e.g. termination due to a malfunction in the VPN tunnel) and therefore not available for a new connection (only one connection can exist at a time). This parameter must match the parameter **Session timeout** (*Project > Project Settings > Server settings*), which controls how long the SMU will wait for a ping command: To ensure that SM4 will start sending before the SMU assumes that the connection was interrupted, the value on the SMU side (**Session timeout**) must be higher than the value on the SM4 side (**Login refresh interval**). Factory default: 3000 ms Changing this value will have the following effects: **INCREASE VALUE** • The monitoring mechanism starts later, and the ping commands are sent at longer intervals. If a connection has been lost, the SMU will take longer to get ready for new connections. **DECREASE VALUE** • The monitoring mechanism starts earlier, and the ping commands are sent at shorter intervals.

Parameter	Explanation
Command repetitions	This parameter determines how often the command is repeated.
Session time	This parameter defines the maximum connection duration in case of inactivity. It is activated as soon as a connection is established between SM4 and a SMU. Every time you press the left mouse button or use the keyboard in SM4, the **Session time** is reset to the value defined here. The status of the **Session time** is displayed in the status bar at the bottom left of the SM4 main screen at **ST**. Click here for further Information 57. Value range: 1–12 h, Factory default: 4 h INCREASE VALUE • If the user does not make an entry in SM4 (inactivity), it will take longer for the connection to the SMU to terminate automatically. DECREASE VALUE • If the user does not make an entry in SM4 (inactivity), the connection to the SMU is automatically terminated sooner.
Read file operation timeout	Commands that affect the SMU file system (e.g. delete file, request directory) trigger actions on the SMU that take some time to complete, which also means that it may take some time until a response is sent back to the SM4. Therefore, with actions like these, SM4 has to wait a relatively long time for a response. The **Read file operation timeout** parameter is used to make sure SM4 waits for a response as long as file operations usually need to be completed. The value should be based on the maximum time the SMU needs for a file operation. The transmission time of the channel is so short that it can be neglected. Factory default: 360000 ms Changing this value will have the following effects: INCREASE VALUE • SM4, after having sent file command, if there is no response from the SMU, will wait longer before it assumes that the connection to the SMU has been lost. DECREASE VALUE • If SM4, after sending a file command, if it does not receive a response, it will be quicker to assume that the connection to the SMU has been lost.
FSP timeout	File Stream Protocol; upload/download of files) there is a separate timeout as these tasks usually take longer to be completed than others. Here, too, the value should depend on how long the SMU needs to carry out the respective action. Delays due to the connection channel are very short – they can be neglected.

Parameter	Explanation
	Factory default: 120000 ms Changing this value will have the following effects: **INCREASE VALUE** • SM4, after having sent an upload/download command, when there is no answer from the SMU, will wait longer before it assumes that the connection to the SMU has been lost. **DECREASE VALUE** • SM4, after having sent an upload/download command, when there is no answer from the SMU, will be quicker to assume that the connection to the SMU has been lost.

4.1.8.5 Application Settings, General, Dialogs

Option box	Explanation/Function
Show integrity check confirmation	If the integrity check detects dependencies when deleting, e.g., a POI, these are displayed in a dialog. There you can have the dependencies cleaned up in order to finally carry out the operation, or cancel the action at the last minute without further consequences. If a check mark is set here, a dialog is displayed even if SM4 does not detect any dependencies. This will present you with the action again and give you the option to cancel it after all. **NOTE** Keep in mind that after deactivating the dialog, for example, when deleting an otherwise unused sensor, it will be removed immediately, and you will have no way to cancel the operation. Factory default: check mark set

4.1.8.6 Application Settings, Warning limits

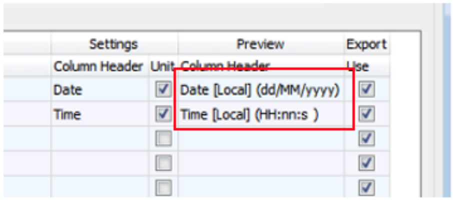
Input area	Explanation/function
Warning limits	Warning limits are an aid to prevent inadvertent entry of incorrect values. **EXAMPLE**

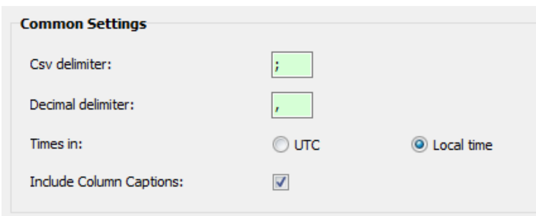
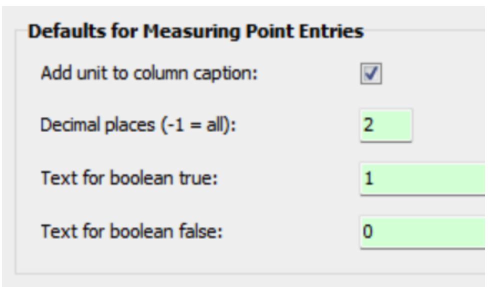
Input area	Explanation/function		
	If the value “20.00 meters” is set under “Max” for “Wall length”, and a wall length of e.g., 50 meters is defined (in the **Edit Walls and Areas** window) due to having entered an incorrect coordinate, the corresponding entry will be highlighted in yellow to indicate to the user that the value needs to be re-checked. This can prevent a WTG being shut down too often or for too long due to a much too large wall area. Click on the **Factory Defaults** button to restore the standard settings.		
Parameter	**Min/Max***	**Factory defaults**	**Reference to window/ function**
Wall length	2.00/20.00 meters	2.00	Places of Immission > Walls and Areas
Wall height	1.50/10.00 meters	1.50	Places of Immission > Walls and Areas
Sun azimuth	0.00/360 °	0.00	Special and Night Slice Shutdowns
Sun elevation	-180.00/180.00 °	-180.00	see above
360 degrees	0.00/360.00 °	0.00	see above
Wind speed	0.00/50.00 m/s	0.00	see above
Outside temp.	–100.00/100.00 °C	-100.00	see above
Humidity	0.00/100.00 %	0.00	see above
Rotor tolerance	0.00/90.00 %	0.00	Project > Project Settings > Shadow impact calculation
Allowed deviation	1 min/1 year (in min)	5	Automatic check of the SMU time when establishing a connection to the SMU

*The entry format (decimal comma or decimal point) is based on the pre-settings (defaults) in the input area **Country-specific settings** (*File > Application Settings > Shadow Manager > General*) and can be changed there at any time.

4.1.8.7 Application Settings,Csv-Export, Cycl. Multi Log

Here you can specify general settings for the .csv files to which CMDRs are exported.

<table>
<tr><th colspan="2">Explanation/function</th></tr>
<tr><td>CSV delimiter</td><td>Separates the columns/data of a row in the csv file.</td></tr>
<tr><td>Decimal delimiter:</td><td>Decimal separator for floating point values.</td></tr>
<tr><td>Times in</td><td>Specifies whether data with time specifications are written to the export file in local time or UCT time.


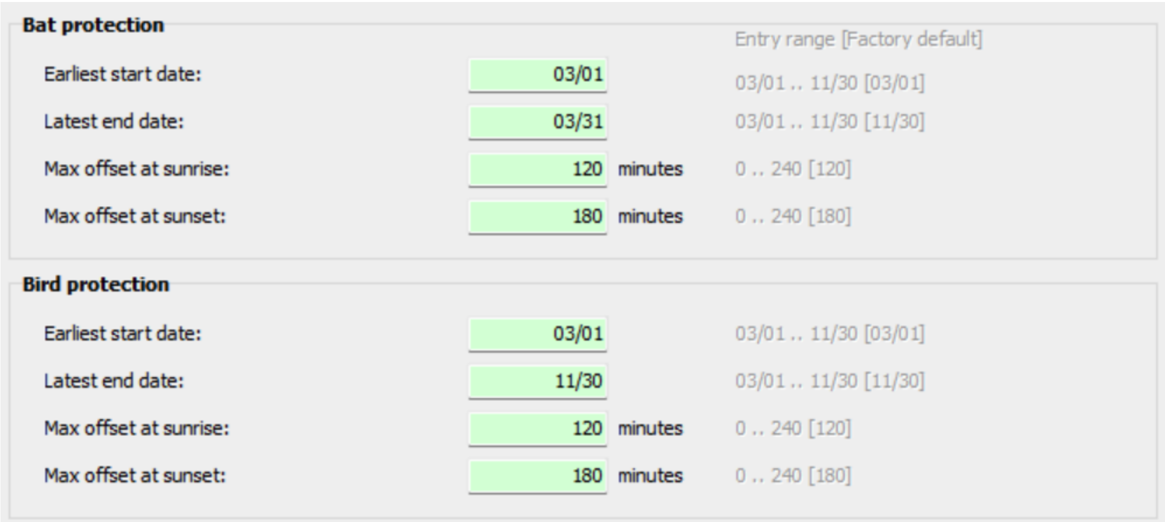
Section from Cyclic Multi Log sub window 331.</td></tr>
<tr><td>Include column captions</td><td>Switch header on/off</td></tr>
<tr><td>Add unit to column caption*</td><td>Displays the unit of the reading point (if applicable) and determines whether it is included in the title row of the export file.</td></tr>
<tr><td>Decimal places*</td><td>Number of decimal places for decimal values</td></tr>
<tr><td>Text for Boolean true/false</td><td>Individual texts for Boolean values</td></tr>
<tr><td colspan="2">*These defaults for the fields of the same name in the Cyclic Multi Log window only affect those reading points that are newly added; reading points that have already been defined retain their csv settings.</td></tr>
<tr><td colspan="2">In the following figure you can see the settings to which the parameters can be reset by clicking on the Factory Defaults button below:</td></tr>
<tr><td>
</td><td>
</td></tr>
</table>

In each of the input areas explained above, you can reset the settings to their **Factory Defaults** at any time by clicking on the button with the same name.

4.1.8.8 Application Settings, Plausibility Limits

The parameters in this input area refer to the plausibility check SM4 carries out for certain inputs in order to detect errors users may make when defining shutdown conditions in the **Special Shutdowns** and **Night Slice Shutdowns** windows. For more information on this functionality, see Plausibility check 202.

The following figure shows a section of the input area for the plausibility limits.



Input area for plausibility limits (detail)

Notes

- In addition to the plausibility limits for bat protection and bird protection, you can also set limits for night slices and for meteorological conditions.
- To the right of each input field, in pale gray, you will find the allowed input range, followed by the default value in square brackets (you can reset all values of this input range to their value preset by NorthTec using the **Factory Defaults** button).
- If you don't change anything in this window, the plausibility check will be performed according to the default values.

4.1.8.9 Application Settings, Phone Book

Here you have the following options:

- Define entries with communication parameters for different projects in order to be able to select them easily in the **Connect** window
- Display, add, edit, remove, import or export existing entries

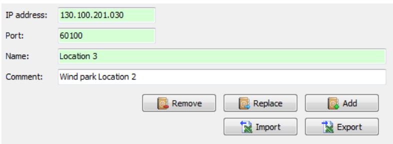
Top:

Existing entries are displayed here in list form, see the following example:

Name	IP Address	Port	Comment
Location 1	130.100.201.010	60100	Wind park Location 1
Location 2	130.100.201.020	60100	Wind park Location 2
Modem	172.027.001.135	60100	Phone option

Bottom:

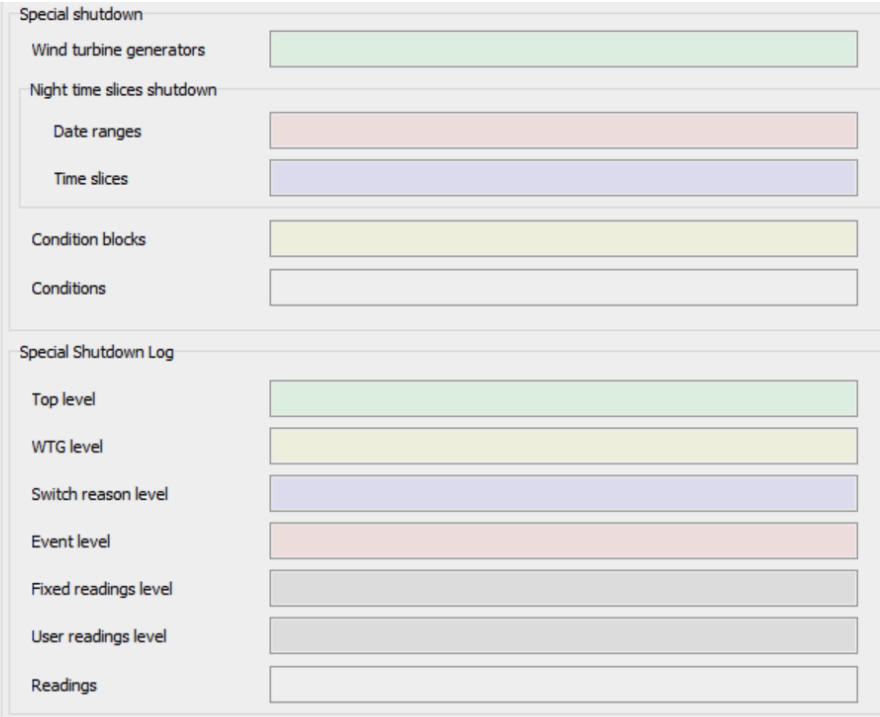
The following input fields and buttons (elements) are available here:



Element	Explanation
IP address	mandatory field: 4 numbers, separated by a period
Port	mandatory field: number from 1 to 65535
Name	mandatory field: Name must be **unique**.
Comment	optional input box
Remove	To remove an entry, select it in the list and click **Remove**.
Replace	To edit an entry, select it in the list, then fill in the three or respectively four input fields and click **Replace**.
Add	To add an entry, fill in the three or respectively four input fields and click **Add**.
Import	When you press **Import**, a standard dialog box opens where you can select the phone book file to be imported. Then a window opens in which all entries of the imported file are displayed. You can select individual or all entries for import. You can also specify whether existing entries should be overwritten. If you do not select the **Overwrite existing names** radio button, imported entries whose name is identical to the name of an existing entry will be ignored.
Export	If you click **Export**, a new window opens in which all current entries in the phone book are displayed. You can select individual or all entries to export them in CSV format. The data of an entry are separated by semicolons in the CSV file.

4.1.8.10 Application Settings, Colors

<table>
<tr><th>Input area</th><th>Explanation/function</th></tr>
<tr><td>Colors</td><td>Here you can change the default colors of specific elements in the Special Shutdowns window and Special Shutdown Log. If you click on the colo-red bar, a corresponding color palette will open, where you can choose a different color.

In the following figure you can see the default colors, to which the colors can be reset by clicking on the Factory Defaults button below:


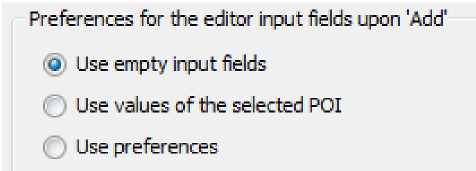
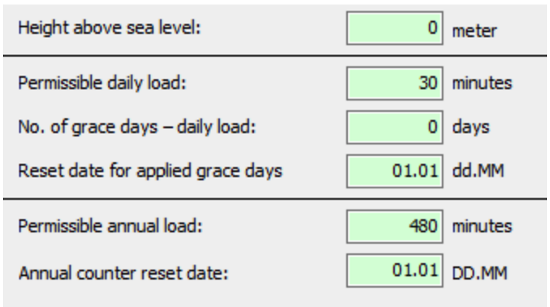
</td></tr>
</table>

4.1.8.11 Application Settings, Places of immission

Here you can influence the behavior of the software when working in the **Places of Immission** and **Add/Edit Place of Immission** window.

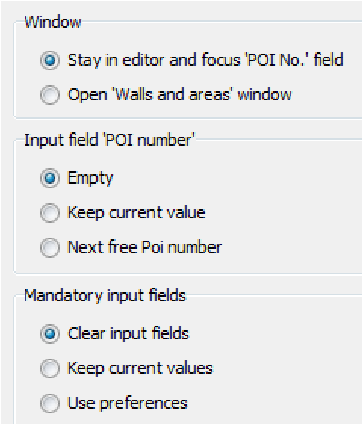
NOTE:

You can also access this settings area directly from the **Add/Edit Place of Immission** window (**Settings** button top right).

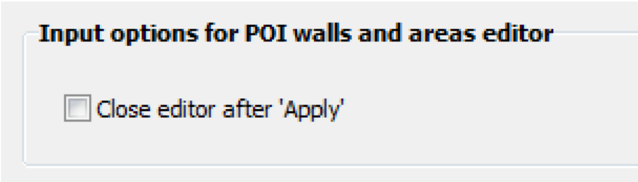
Input area	Explanation/function
Places of Immission	Here you can specify how you would like the **Add/Edit Place of Immission** editing window to behave; the available options have self-explanatory names. It opens when you click on **Add** in the **Places of Immission** window. Select one of the three options, which have self-explanatory names. In the following figure you can see the standard settings to which this parameter can be reset by clicking on the **Defaults** button below:  **NOTE** The **Use preferences** option relates to the **POI preferences** values set in the following input area.
POI preferences	Here you can enter the preferences for the **Add/Edit Place of Immission** window in the fields with self-explanatory names. In the following figure you can see the defaults, to which the parameters can be reset by clicking on the **Factory Defaults** button below, and the input format:  **NOTE** The entered value for the **Permissible daily load** is not permitted to be higher than the **Permissible annual load**.
POI editor	Here you can specify what happens when you click on **Add** in the **Add/Edit Place of Immission** window; the available options have self-ex-

<table>
<tr><th>Input area</th><th>Explanation/function</th></tr>
<tr><td></td><td>
planatory names.

In the following figure you can see the standard settings to which the parameters can be reset by clicking on the **Factory Defaults** button below:



NOTE

“preferences” relate to the settings area
POI preferences.
</td></tr>
<tr><td>POI walls and areas</td><td>


Here you can specify whether the **Edit Walls and Areas** window should remain open or be closed after clicking on **Apply**.
</td></tr>
</table>

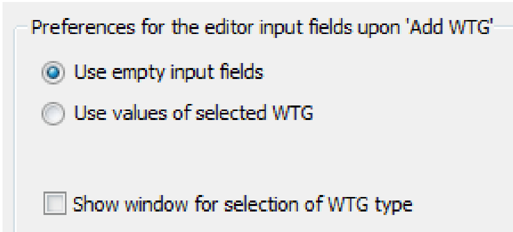
4.1.8.12 Application Settings, Wind turbine generators

Here you can influence the behavior of the software when working in the **Wind Turbine Generators** and **Add/Edit WTG** windows.

<table>
<tr><th>Input area</th><th>Explanation/function</th></tr>
<tr><td>Wind turbine generators</td><td>

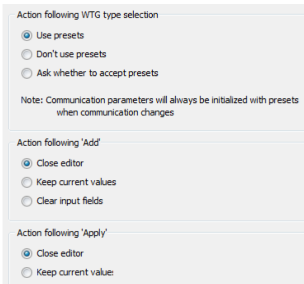
Here you can specify how you would like the **Add/Edit WTG** editing window to behave when you click on **Add WTG** in the **Wind Turbine Generators** window. Select one of the three options, which have self-explanatory names.

In the following figure you can see the standard settings to which this parameter can be reset by clicking on the **Factory Defaults** button below:



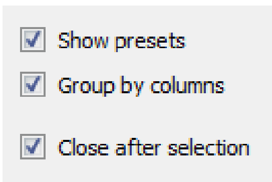
</td></tr>
<tr><td>WTG editor</td><td>

Here you can specify what should happen when you carry out various actions in the **Add/Edit WTG** editor window; the available options have self-explanatory names. In the following figure you can see the standard settings to which the parameters can be reset by clicking on the **Factory Defaults** button below:



</td></tr>
<tr><td>WTG Types</td><td>

Here you can specify how the **WTG Types** window behaves, using options, which have self-explanatory names. In the following figure you can see the standard settings to which the parameters can be reset by clicking on the **Factory Defaults** button below:



</td></tr>
</table>

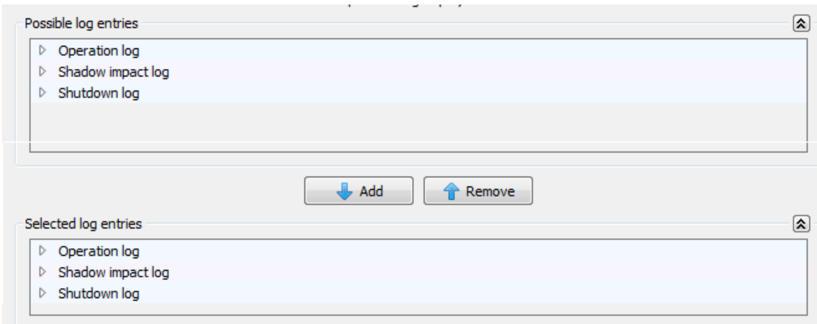
4.1.8.13 Application Settings, Display filters

The SMU generates 4 different logs (**operating log**, **shadow impact log**, **shutdown log** (special shutdown) and **single data recordings**). A very large volume of data can be generated depending on the selection. In order not to overload the PC when processing this data, the entries can be pre-filtered using the Display Filter.

Alongside this function, entries from various different types of logs can also be combined. Log entries from an operating log can, e.g., be presented with entries from the shadow impact log in one view.

The **measurement data logging** logs are the exception. In this case the values set by the user are recorded. No display filters can be used for this log and its entries cannot be combined with entries from other logs.

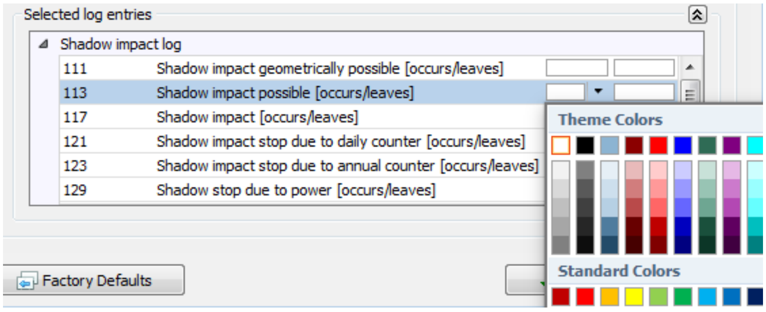
Input area	Explanation
LogPool path	The file path to the folder where you stored the .exe file for running SM4 is displayed here. As soon as you run this .exe file, the **ShadowManager4Data\LogPool** folder structure will be created in the same directory, and, once you download logs from the SMU, these will be automatically stored in the **LogPool** folder.
Default Path	You can use this button to select a different path than the one automatically created by SM4.
...	You can use this button to restore the default path automatically created by SM4.
Maximum number of entries to be shown	Here you can specify the maximum number of entries that should be displayed in the log. Default value: 100000 **NOTE** If the number of entries to be displayed is too high, the system could become instable – the program could crash.
or	This button is located twice at the right-hand side window edge. It serves to show or hide the **Export filter** and **Import filter** fields.
Export	Export filter
	If you show the **Export filter** area by clicking on , the individual log filters will be displayed with checkboxes. Set a checkmark next to the logs you would like to export and click on **Export**.
Open Import	Import filter
	If you show the **Import filter** area by clicking on , the **Open** button will be displayed. If you now click on it, you can select a filter file saved on your computer. The already existing filters and the “new” filter will then be displayed. Now click on **Import** to conclude the import process.

Input area	Explanation
Operation log **Shadow Impact** **Bat protection** **Bird protection** **Sector shutdown** **Noise protection** **Special shutdown**	Not all events that the system for shadow impact monitoring and species conservation records and sends are important or interesting for every log or every user. Display filters are therefore predefined here (see left column). To edit the predefined display filters, select one on the left in the tree menu. The following will then be displayed: 
Possible log entries	The entries shown here are the ones that are not yet contained in the filter selected on the left-hand side of the **Application Settings** window (click on the respective arrow to expand a list). To select an entry to display in a log, mark it here and then click on **Add**.
Selected log entries	The entries shown here are the ones that are already contained in the filter selected on the left-hand side of the **Application Settings** window (click on the respective arrow to expand a list). To remove a display filter, mark it here and then click on **Remove**.

<table>
<tr><th>Input area</th><th>Explanation</th></tr>
<tr><td colspan="2">

Assign colors

You can assign colors to the entries under **Selected log entries** to make the log easier to read. To do this, expand one of the logs (click on the white arrow to the left of it) and then click on the first white field to the right of the desired entry to select the desired color from a color palette, see the following figure:



NOTES

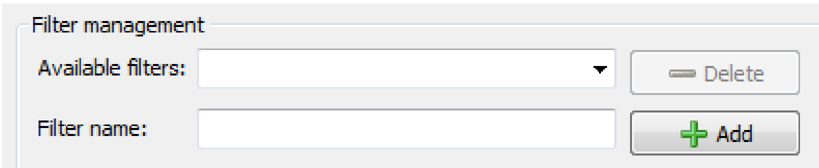
- The second white field is only relevant to entries with the differentiation **[occurs/leaves]**: first field = color for **occurs**, second field = color for **leaves**.
- When you click on **Factory Defaults**, pre-settings will only be restored for the filters marked on the left-hand side.

</td></tr>
<tr><td>

User-defined filter

</td><td>

If you click on **User-defined filter** at the top left, an additional input area will appear at the top right:



Here you can specify a user-defined filter. To do so, enter the desired name under **Filter name** and then click on **Add**.

Then select the desired entries further below in the window as descri-bed above.

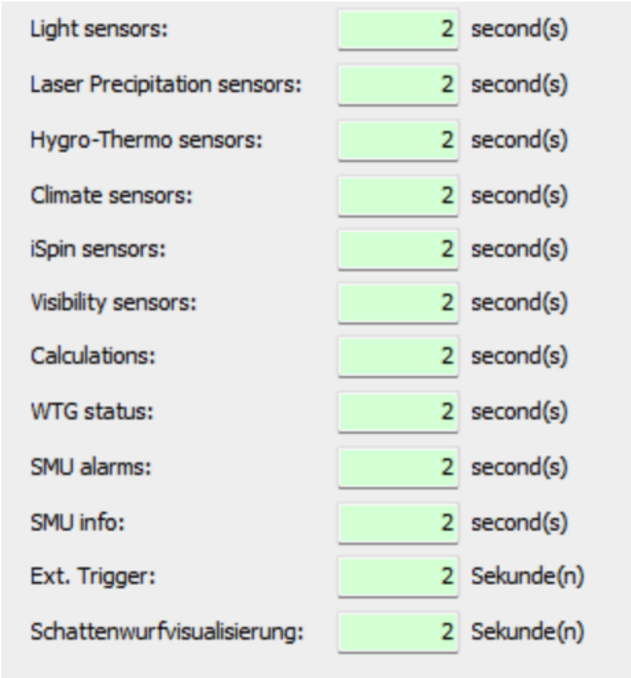
NOTE

In order to use a display filter created here in the **Logs from Local LogPool** window (*Logs > Local log files*), select them in the **Choose a filter** drop-down list (at the bottom of the **Logs from Local LogPool** window).

</td></tr>
</table>

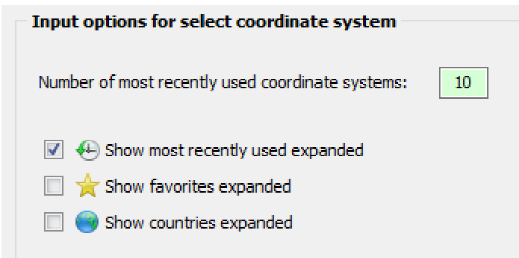
4.1.8.14 Application Settings, Live data

Explanation/function
You specify here the intervals at which the data should be retrieved for display in the **Realtime Data** menu. In the following figure you can see the settings to which the parameters can be reset by clicking on the **Factory Defaults** button below:



4.1.8.15 Application Settings,Select coordinate system

Explanation/function
Here you make defaults for the display of the **Select coordinate system** window (*Project* > *Project Data* > ). In the following figure you can see the settings to which the parameters can be reset by clicking on the **Factory Defaults** button below:



4.1.9 Close

Purpose	Close SM4
Symbol	
Path	*File > Close*
Type of use	Interactive
Reference	Project

If you select *File > Exit* or and have changed project data beforehand without saving it, a dialog box will appear in which you will be asked whether the changes should be saved. You can answer the question with **Yes** or **No** or cancel the process with **Exit**.

NOTES

- If windows in which you have made changes that are not yet saved are still open, you will be given a confirmation prompt (dialog box) for each window that contains changes that have not been saved. Only afterwards will you be asked whether the entire project should be saved.
- If, however, none of the existing changes have been saved yet and you answer Yes to all individual confirmation prompts (Discard changes?) after Exit , the application will close after the last of these prompts. You will not be asked whether the project should be saved as this question has already been answered individually for each of these windows.

  Example: You change data for a WTG and a POI, and DO NOT save either of them, leave both windows open and then select **Exit**. You now receive a confirmation prompt for either window, and you answer **Yes** (discard) to each. The program will then end without any other query.
- If SM4 is connected to the SMU when you exit, the connection will be terminated.

4.2 Project menu

From the settings and information that you make or enter in the **Project** menu, SM4 later derives the configuration data that are transmitted to the SMU together with the project file itself. While the project file will only be stored in the SMU, the configuration data will be used to configure the SMU functions.

The following table provides an overview of the **Project** menu.

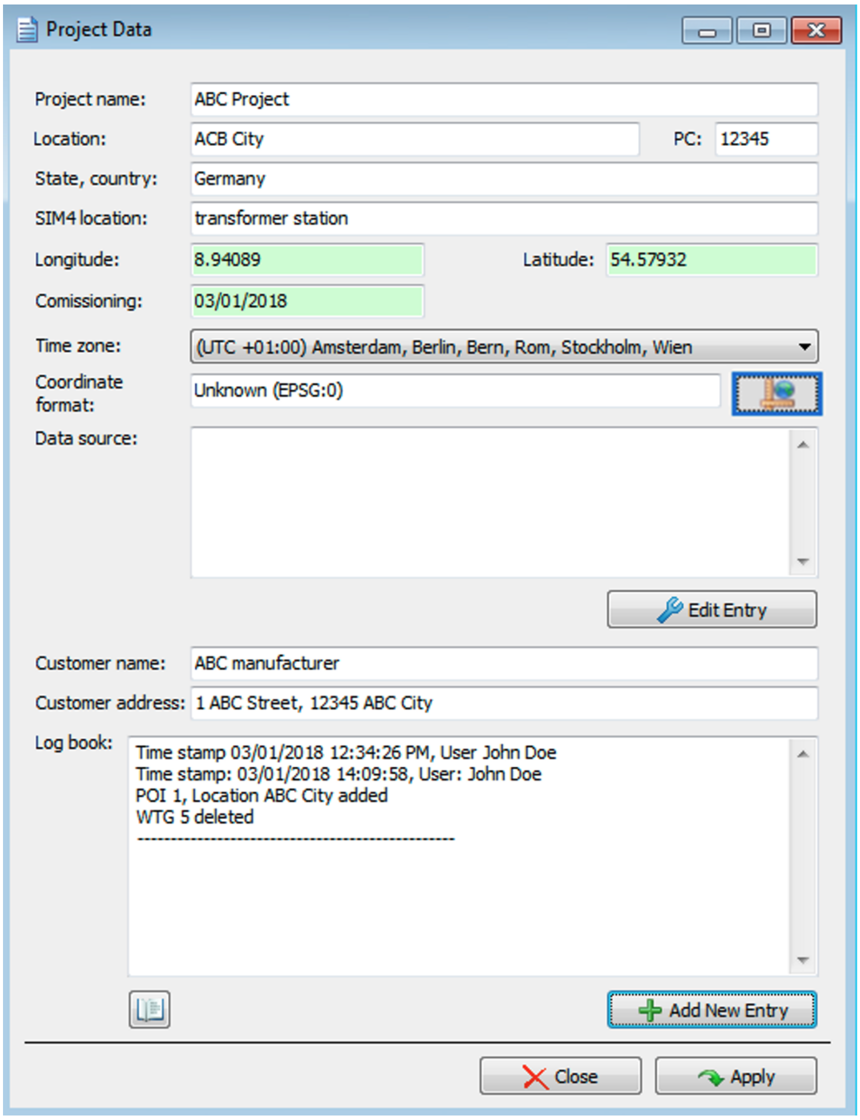
A detailed explanation of the individual settings windows can be found after the overview table.

Symbol	Menu item	Purpose
	**Project Data** 89	Edit and view project-specific information on location, date of commissioning, customer etc.
	**Wind turbine generators** 92	Edit and view the data of a WTG whose shadow impact is to be calculated.
	**Places of Immission** 122	Edit and view the areas/walls that could possibly be affected by shadow impact..
	**Overview Map** 142	Visually check the position of WTGs and POIs.
	**Alarm Settings** 145	Define which alarms are to be triggered for which WTGs/devices.
	**Settings** 148	Basic settings which apply for the entire project can be defined here.
	**Configuration** 159	Send a new or reviewed configuration to the SMU.

Click on a menu item to jump directly to more information.

4.2.1 Prjoject Data window

Purpose	Display and edit project-related information with regard to location, date of commissioning, customer etc.
Symbol	
Path	*Project > Project Data*
Type of use	Display + interactive
Reference	Project



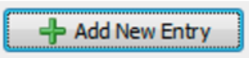
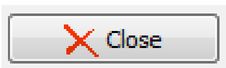
Project Data window

Notes regarding the **Project Data** window

- Press the Enter key or the Tab key to complete the current entry and jump to the next input field.
- The **Apply** button will not be activated until the mandatory fields of the window have been filled out correctly.

The information, options or buttons are described in the following table

Element	Explanation/function
Project name	Enter any characters
Location	Enter any characters
PC	Postal Code, enter any characters
State, country	Enter any characters
SMU location	This entry is for information only.
Longitude	Using the entered coordinates (**Add/Edit WTG** window > **WTG position X/Y**) SM4 determines longitude and latitude, uses these values to calculate the project center (geographic center of the WTGs, see Overview Map window 142 window and displays the respective latitude/longitude here. **NOTE:** If no valid coordinate system was selected, you can also enter the longitude and latitude manually.
Latitude	see above
Date of commissioning	Date of commissioning of the SMU (MM/DD/YYYY)
Time zone	Drop-down list for selecting the time zone in which the wind park is located.
Coordinate format	If you click on , the **Select Coordinate System** window will be opened. Here you can select the system to be used in the project from the list and then click on **OK**. Usually, the expert has decided on a coordinates system in the shadow impact forecast, which will be maintained in most cases. **NOTES** • In the search field in the upper part of the window you can find a specific system by entering free text. • By clicking on the **Info** button in the lower part of the window, you will open a website providing information on the coordinate system

Element	Explanation/function
	you have selected at the top of the window (internet connection required). • In the application settings (*File > Application Settings > Select coordinate system*) you can define defaults for the display of the **Select Coordinate System** window.
Data source 	Information for internal purposes/ authorities (optional, unlimited number of characters). To edit the entry, click on **Edit Entry**.
Customer name	Enter any characters
Customer address	Enter any characters
Log book	Please carry out the following steps whenever you change a project file: ▪ Click on **Add New Entry** and enter your name under **User**. ▪ Describe in the input field below as precisely as possible which changes you have made to the project file, so that you and others can easily understand them later. ▪ Click on **Add**. **NOTES** • If you enter a log book entry as described above, the time and author of the entry are automatically recorded under **Timestamp** and **User**. These manual entries in the log book cannot be changed afterward. • In addition to the manual log entry, the system logs changes automatically. However, this automatic log is difficult to understand - so it serves only for additional security purposes.
	Opens the **Log book** area in a separate window in order to display more information.
	If you click on **Close** without having clicked on **Apply** beforehand, a new dialog window will be opened in which you can see the parameters that have been changed. You will also be asked whether or not the changes should be discarded. If you are sure that the changes should not be applied, click on **Yes**. Otherwise click on **No** in order to apply the changes.
	This button is used to confirm the entered data.

! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

4.2.2 Wind Turbine Generators window

Purpose	Display/remove/edit/add wind turbine generators (WTGs)
Symbol	
Path	*Project > Wind turbine generators*
Window type	List window
Type of use	Display + buttons for sub windows
Reference	Project

This window shows **a list of the WTGs already created in the project that is currently opened. The individual parameters** for a WTG are defined in the **Add/Edit WTG** window, please refer to the next section.

Notes regarding the Wind Turbine Generators window

- Move columns: Columns can be moved by drag & drop.
- Sort by column: You can sort a column according to its heading by clicking on it. If you then click again on the same column heading, the sort sequence will change from ascending to descending or vice versa.
  You can also sort by more than one column heading (criteria). To do this, first press and hold the shift key and then click on the desired column headings. The sorting will be carried out according to the order in which you click on the column headings.
- Column filters: You can also apply filters to columns: Move the mouse cursor to the top right-hand corner of a column heading until a small filter symbol appears. Click on the filter symbol. A list of possible entries will then be shown. Now set a checkmark next to the desired entry. Only the selected entries will be displayed afterwards.

The information, options or buttons are described in the following table

Element	Explanation/function
Number of WTGs (top right)	Indicates how many WTGs have already been created (maximum number: 100).
Wind turbine generators	List of WTGs already created. The column titles (parameters) are described in the Add/Edit WTG window 94.
WTG Types	Opens a like-named window, where you can select a predefined WTG type. This avoids you having to make several entries manually.
Combinations	Opens a like-named window, see WTG Combinations sub window 101.
Remove WTG	Deletes the WTGs selected above.

Element	Explanation/function
	Attention: The WTGs will be deleted immediately, **no** confirmation prompt.
Edit WTG	Opens the **Add/Edit WTG** window, where you can edit the WTG selected above, see next section.
Add WTG	Opens the **Add/Edit WTG** window, where you can add a new WTG, see next section.

Please pay attention to the Information in the following boxes.

Use the data of existing WTGs as a template

- If you want to copy the data of a WTG that has already been created, click on this WTG in the Wind Turbine Generators window to select it (dataset will be highlighted in blue).
- Then click on Edit WTG (or double-click the desired WTG dataset in the list).
- The Add/Edit WTG window will open and the WTG number input field will be highlighted in orange.
- Now enter the next free number here.
- The field will now be highlighted in green and the **Add WTG** button at the bottom of the window is now activated.

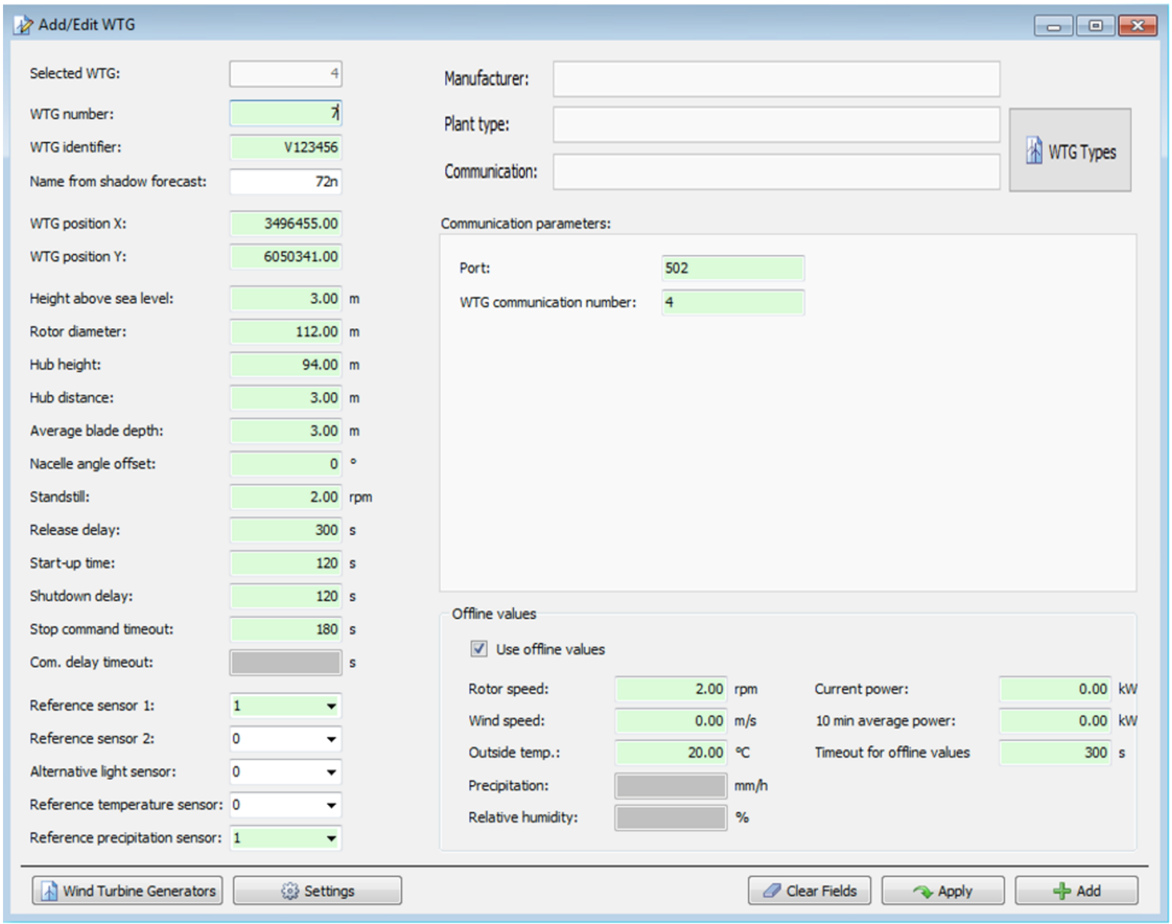
See also Practical example 1: Set up a new WTG with a new POI 29

Note that if you change the WTG type of an already defined WTG, many of its values are set to zero.

4.2.2.1 Add/Edit WTG window

Purpose	Create a wind turbine generator (WTG) in the project
Symbol	
Path	*Project > Wind Turbine Generators > Add WTG/Edit WTG*
Type of use	Interactive
Reference	WTG

You can define the individual parameters for a WTG in this window.



Wind Turbine Generators window

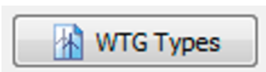
Notes regarding the **Add/Edit WTG** window

- Press the Enter key or the Tab key to complete the current entry and jump to the next input field.
- Input format: For input boxes where decimals are allowed the decimal separator to be used depends on the default in the input area **Country-Specific Settings** (*File > Application Settings > Shadow Manager > General.*)
- Fields in which an invalid value was entered (value is outside the permitted range, wrong input format) are highlighted in red:
- The buttons **Apply** and **Add** will not be activated until the mandatory fields of the window have been filled out correctly.

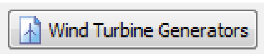
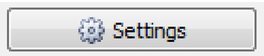
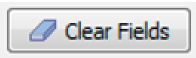
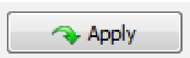
You will find a detailed description of this window in the following table.

Element	Explanation/function
Selected WTG	The WTG selected in the **Wind Turbine Generators** window (reference only)
WTG Number	Up to 100 WTGs can be defined. If you have clicked on **Add WTG** in the **Wind Turbine Generators** window, then the next free number will automatically be provided here. If you have clicked on **Edit WTG** in the **Wind Turbine Generators** window, in order to use the data of another WTG, enter the next free WTG number here, see Wind Turbine Generators window 93. **NOTE:** You can also enter/use the number of an existing WTG. The dataset of this existing WTG will then be overwritten with the "new data". Before that, however, the Dependencies window 347 will open.
WTG Identifier	Unique ID number of the WTG as indicated on the outside of the tower (mandatory field). This number appears in the shadow impact log as WTG name.
Name shadow forecast	Name of the WTG as used in a shadow impact forecast which may have been created (reference only).
WTG position X	Coordinates of the WTG position. **NOTE:** The coordinates of all WTGs and POIs must be defined using the same metric coordinate system. 2 decimals
WTG position Y	see above
Height above sea level	WTG's height above sea level Input in m, value can also be negative, 2 decimals

Element	Explanation/function
Rotor diameter	Input in meters, 2 decimals
Hub height	**NOTE:** If the hub height is less than half the rotor diameter, you will see a warning symbol and the dataset cannot be added. Input in meters, 2 decimals
Hub distance	Distance between the hub and the center of the tower Input in meter
Avg. blade depth	Average blade depth = ½ (max. blade depth + min. blade depth at 0.9*rotor radius) see Glossary 371. Input in meter
Nacelle angle offset	Difference between the nacelle angle reported by the WTG and the actual position (orientation). Input in degrees
Standstill	If the actual rotor speed drops below the value specified here, the SMU will be considered as stopped. Input in rpm, 2 decimals
Release delay	Delay before startup of the WTG after having been shut down due to shadow impact. Serves to reduce wear by avoiding frequent start-up and shutdown processes during rapidly changing weather conditions. Input in seconds, standard setting 300 s **EXAMPLE** A WTG has been stopped due to shadow impact (the light intensity is so high that shadow impact is possible). Later, the light sensor reports that the light intensity is not sufficient to cause shadow impact. Now the WTG will be started up only after the time period specified under **Release delay** has elapsed. However, if the sun has now reached a position in which no POI will be affected by WTG shadow, the release delay will be ignored, i.e., the WTG is started up immediately.
Start-up time	Period between sending the start command to the WTG and the point in time when the rotor actually starts rotating. Input in seconds **EXAMPLE** **Start-up time** has been set to 120 s. If, according to the system's forecast, theoretical shadow impact will not be possible anymore from a specific point in time (because the sun will have reached a position at which no POI can be affected by WTG shadow), the start command will be sent x seconds (Start-up time) earlier (yield optimization).
Shutdown delay	Period between sending the stop command to the WTG and the point in time when the rotor stops rotating (standstill).

Element	Explanation/function
	EXAMPLE According to the system's forecast, theoretical shadow impact will be possible at a POI from a specific point in time (because the sun will have reached a position at which the POI can be affected by WTG shadow). The shadow impact budget for this POI has already been exploited OR 28 of 30 minutes of the budget have already been used. In this case, the stop command will already be sent x seconds (Shutdown delay) before shadow impact actually occurs to ensure that the WTG definitely stands still at this point in time and the regulatory requirements are complied with. Input in seconds
Stop command timeout	Defines the time period after which the SMU reports an alarm to the park server because a WTG fails to respond to a stop command (rotor speed does not drop below the value specified under **Standstill**). Input in seconds, default 180 s
Com. delay timeout	Used to set a break between sending two consecutive queries to two WTGs. Reason: If the break between sending queries is too short, this may cause technical problems with devices. Input in seconds, default depends on the WTG type
Reference sensor 1/2	Here you can set the light sensor to be used to evaluate the light conditions. We recommend selecting the nearest light sensor. With some nacelles it is not possible to install the light sensor in such a way that it can measure the intensity of the sunlight all day (due to shade). In this case, it may be necessary to install a second light sensor. **0** = no sensor is used, **1 to 40** = sensor x is used
Alternative light sensor	Specifies whether an alternative light sensor is available that should be used if reference sensor 1 and/or 2 have failed. **0** = no sensor is used, **1 to 40** = sensor x is used
Reference temperature sensor	Specifies which hygro-thermo sensor should be used to measure the humidity and outside temperature. **0** = no sensor is used, **1 to 5** = sensor x is used
Reference precipitation sensor	Specifies which precipitation sensor should be used to measure the precipitation amount. **0** = no sensor is used, **1 to 5** = sensor x is used
	If you want to add a new WTG, start by clicking on **WTG Types**. A window of the same name will then open in which you can select the respective WTG type in order to use standard values that are identical for every WTG of the same type as default values. When selecting the type, please pay special attention to the information under **Communication** and **Rotor diameter**.

Element	Explanation/function
	For further information on the individual WTG types, please refer to Communication Parameters input area 113. **NOTE:** Note that if you change the WTG type of an already defined WTG, many of its values are set to zero.
Manufacturer	Will be filled in automatically depending on the WTG type.
WTG type	Will be filled in automatically depending on the WTG type.
Communication	Will be filled in automatically depending on the WTG type.
Communication parameters	This input area contains different parameters depending on the selected WTG type, see Communication Parameters input area 113 section.
Offline Values	
Use offline values	Here you can define how the SMU will react if it does not receive data from the WTG anymore due to a communication error. Depending on the type of interface used to communicate with the WTG it is possible that some or all data are missing. However, with most interface types, an error means that all data are missing and that it is no longer possible to send stop and start commands or alarm messages to the WTG. If no checkmark is set here, the SMU continues to operate with the last data received until new data can be received. If a checkmark is set, the SMU will use the pre-sets for the WTG, which can be defined here, after the period set under **Timeout for pre-sets**. In this case, these values will also be reflected in the log.
Rotor speed	If the value defined here is greater than or equal to the value defined under **Standstill** and a WTG communication error occurs, the SMU will assume that the WTGs is always operating. This ensures that any shadow impact that may occur while communication is interrupted is duly reflected in the shadow impact log. Input in rpm, 2 decimals, default: 2
Wind speed	A wind speed pre-set may be relevant if this parameter is part of a special shutdown condition and the interface to the WTG enables sending stop or start commands even during a temporary communication breakdown. Input in m/s, 2 decimals
Outside temp.	An outside temperature pre-set may be relevant if the outside temperature parameter is part of a special shutdown condition and the interface to the WTG enables sending stop or start commands even during a temporary communication breakdown. input in °C, 2 decimals

Element	Explanation/function
Precipitation	A precipitation amount pre-set may be relevant if the precipitation parameter is part of a special shutdown condition and the interface to the WTG enables sending stop or start commands even during a temporary communication breakdown. Input in mm/h, 2 decimals
Relative humidity	A humidity pre-set may be relevant if the humidity parameter is part of a special shutdown condition and the interface to the WTG enables sending stop or start commands even during a temporary communication breakdown. Input in %, 2 decimals
Current power	If a power threshold was defined for a WTG (see WTG Combinations sub window 101) this value must be greater than or equal the power threshold.Otherwise, the SMU would send a stop command to the WTG as soon as shadow impact occurs. **NOTE** A current power pre-set may be relevant if this parameter is part of a special shutdown condition and the interface to the WTG enables sending stop or start commands during a temporary communication breakdown. Input in kW, 2 decimals
10 min Average power	Some WTG types report a 10 minutes average value. In this case, the average value is used instead of the current power value. Otherwise, please refer to the explanation under **Current power** above. Input in kW, 2 decimals
Timeout for offline values	Specifies how long the SMU will wait until it uses the pre-sets after a communication failure has occurred. Input in seconds., 2 decimals, default: 300 s
	Switches to the **Wind Turbine Generator** window (or opens it).
	Opens the **Input options for wind turbine generator editor** where you can define what happens when you click on **Add** or **Apply** in the **Add/Edit WTG** window; the available options are self-explanatory.
	Deletes the data from the input fields of the selected WTG.
	Confirms the entered data.
	Adds a new WTG No. Adds a new WTG No. Up to 100 WTGs can be defined.

i The coordinates used to define WTGs and POIs must be based on the **same metric coordinate system**.

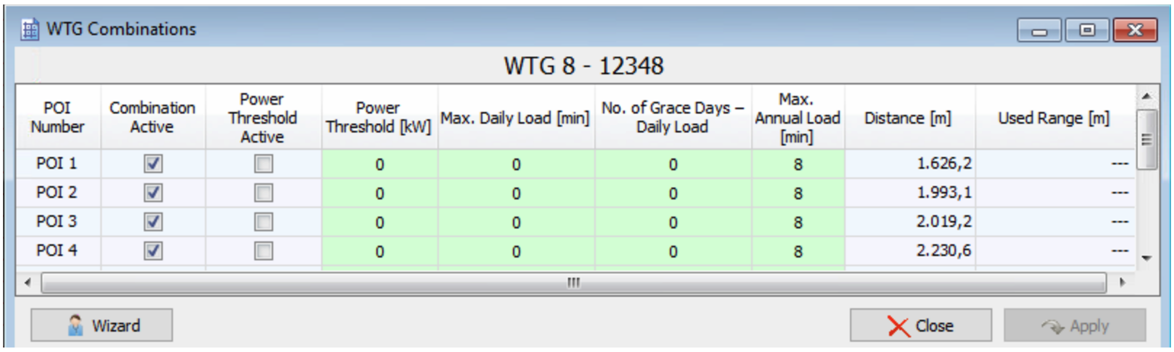
! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

4.2.2.2 WTG Combinations sub window

Purpose	• Activate/deactivate combination(s) of WTG and POI manually (e.g. because a line-of-sight obstacle between WTG and POI precludes shadow impact) • Automatically activate/deactivate combination(s) of WTG and POI depending on shadow range (see Glossary 371) and distance to POI • Change/define direct relations between the WTG selected in the **Wind Turbine Generators** window and each POI for yield optimization
Path	*Project > Wind Turbine Generators > Combinations*
Type of use	Interactive + Wizard
Reference	The WTG selected in the **Wind Turbine Generators** window (reference only).

The tabular arrangement of all combinations of all WTGs and POIs of a project is called combination matrix. If you click on the **Combinations** button at the bottom of the **Wind Turbine Generators** window, the **WTG Combinations** window opens. Only the column of the combination matrix belonging to the currently selected WTG is shown here; however, the view includes sub-elements such as **Combination Active**, **Power Threshold [kW]**, etc. These can be edited directly in this window or in the **Combination Matrix Wizard** sub window (button Assistent). The entire combination matrix can be seen, for example, when configuring the simulation (*Tools > Combination*).

WTG Combinations sub window



Not all setting options are always available for every combination (fields highlighted in gray), e.g., if the daily counter limit and/or annual counter limit of a POI are not being used.

For each relationship between the WTG and a POI, conditions can be defined with regard to the following aspects.

- **Combination Active** column:
  Shadow impact possible or not (deactivate the combination if there is an obstacle between a WTG and a POI)

- **Threshold Power Active** and **Threshold Power [kW]** columns:
  Power threshold for saving shadow impact budget for more profitable times
- Columns **Max. Daily Load [min]**/ **Max. Annual Load [min]**:
  maximum daily/annual load used to save shadow impact budget for more powerful WTGs
- **No. of Grace Days – Daily Load**
  Number of days (per year) on which the **Max. Daily Load** (see above) may be exceeded.
- Columns **Distance [m]** and **Used Range [m]**
  Deactivation of combinations according to fixed or determined shadow range and distance

The information, options or buttons are described in the following table

Element	Explanation/function
POI Number	Number of the place of emission
Combination Active	After the WTGs and POIs of a project have been defined, all combinations are set to **Active** by default. This means that the SMU will assume that each WTG is able to cause shadow impact at each POI. However, if there is an obstruction between a WTG and a POI, the real shadow impact is not possible at this place of immission. Consequently, no calculation has to take place and the corresponding combination can be deactivated (remove checkmark). Default: ☑
Power Threshold Active	Here you can activate or deactivate a power threshold defined in the subsequent column. If the respective WTG is running below this power threshold **while at the same time causing shadow impact** at the respective POI, the WTG is stopped even if the limit value specified by the authorities has not yet been reached. While a WTG is running above the power threshold, the permitted periods of shadow impact will be exploited. With this method, the available shadow budget is saved for "better" (windier) times when the WTG can generate higher power. For more information, please refer to the Glossar 371 as well as Define a power threshold 109. **NOTES** • This column is not displayed if the WTG does not transmit current power values to the shadow impact system (e.g. a preload). • This parameter is automatically disabled under certain conditions, see section Automatic deactivation of the power threshold. 111 Default: ☐
Power Threshold [kW]	Here you define the power threshold in kW. This value will only be applied if **Threshold Power Active** has been activated in the previous column. **NOTES** • This column is not displayed if the WTG does not transmit current power values to the shadow impact system (e.g. a preload).

<table>
<tr><th>Element</th><th colspan="2">Explanation/function</th></tr>
<tr><td></td><td colspan="2">

- This parameter is automatically disabled under certain conditions, see section Automatic deactivation of the power threshold. 111

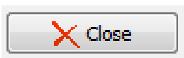
Default: 0</td></tr>
<tr><td>Max. Daily/ Annual Load [min]</td><td colspan="2">Here you can reduce the value set in the Add/Edit Place of Immission window at Maximum permissible daily/annual load to, e.g. to assign a smaller portion of the shadow budget to a low rated WTG than to a high rated WTG.

These parameters are also used to save shadow budget, not for "windier" times, however, but for more powerful WTGs instead.

For further information see Max. daily/annual load 110.

NOTE

These columns are not displayed for WTGs that cannot be switched by the shadow impact system (WTG is only a preload).

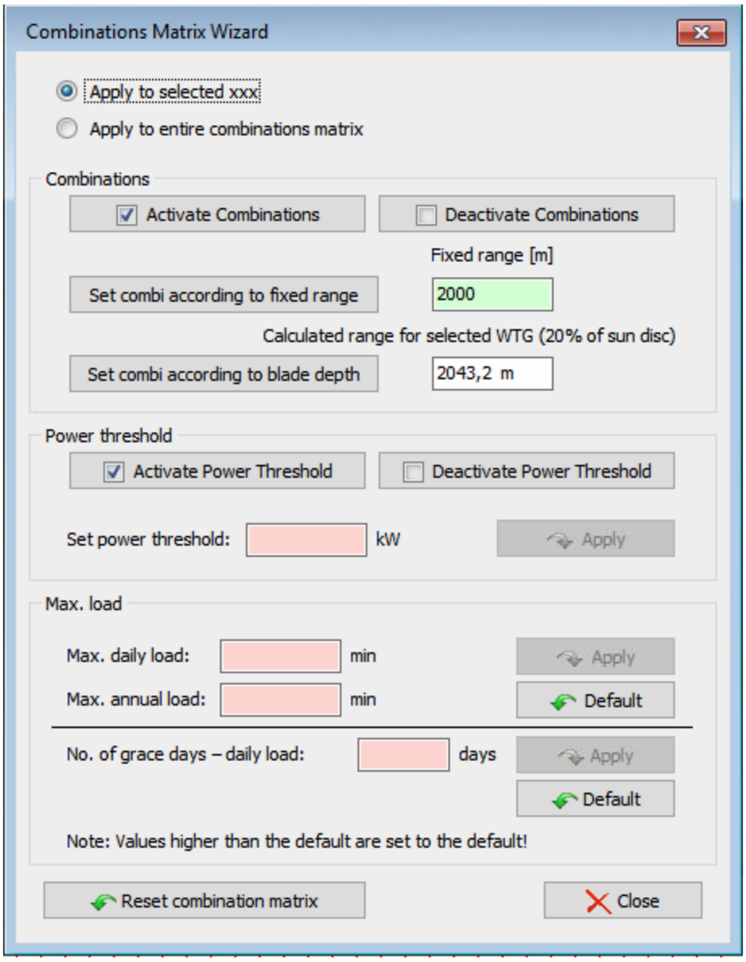
Default = value in the Add/Edit Place of Immission sub window at Max. daily/annual load</td></tr>
<tr><td>No. of Grace Days – Daily Load</td><td colspan="2">In SM4 = number of days (per year) on which the Maximum permissible daily load (see above) may be exceeded.</td></tr>
<tr><td>Distance[m]</td><td colspan="2">Displays the shortest distance (on the map) from the WTG tower center to the nearest wall or area coordinate of the POI.</td></tr>
<tr><td rowspan="6">Used Range [m]</td><td colspan="2">Indicates whether a shadow range is used, and if so, which one. The following options are available:</td></tr>
<tr><td>---</td><td>There is no „used range“.</td></tr>
<tr><td>fixed x</td><td>A fixed range x was set in the wizard.</td></tr>
<tr><td>calc. x</td><td>After the Set combi according to blade depth button has been activated in the wizard, this number is indicated at x.</td></tr>
<tr><td>manually</td><td>Is displayed if inactive single combinations were set and accepted (Apply button) or active single combos were deactivated and accepted in the WTG Combinations window.</td></tr>
<tr><td>Default:</td><td>---</td></tr>
<tr><td></td><td colspan="2">Opens the Combinations Matrix Wizardwindow.</td></tr>
<tr><td></td><td colspan="2">If you click on Close without having clicked on Apply beforehand, the system will ask you whether you want to apply the changes.</td></tr>
<tr><td></td><td colspan="2">Confirms the entered data.</td></tr>
</table>

See also: Combinations Matrix Wizard sub window 105.

4.2.2.3 Combinations Matrix Wizard sub window

Purpose	• You can easily apply the settings of the **WTG Combinations** window to all combinations and then exclude individual ones as necessary. • Have combinations automatically set to active/inactive depending on distance to POI and shadow range (see Glossary 371)
Symbol	
Path	*Project > Wind Turbine Generators > Combinations > Wizard*
Type of use	Interactive
Reference	Selected WTG/entire matrix

Using the wizard, you can easily apply the setting options of the **WTG Combinations** window to all combinations and then exclude only individual ones as necessary. This procedure is particularly suitable for large wind parks to avoid having to edit each combination individually (save time). You can also use this window to configure the SMU in such a way that combinations will be activated/deactivated automatically depending on shadow range and distance.



Combinations Matrix Wizard sub window

Note regarding the **Combinations Matrix Wizard** window:

Press the Enter key or the Tab key to complete the current entry and jump to the next input field.

The information, options or buttons are described in the following table

Element	Explanation/function
Apply to selected WTG	Applies the change(s) made in this window only to the WTG selected in the **Wind Turbine Generators** window.
Apply to entire combinations matrix	Applies the change(s) made in this window to all combinations (the SMU assumes that each WTG can cause shadow impact at each POI because there are no obstructions between them).
Activate/ Deactivate Combinations	Sets the combinations of the selected POIs or respectively of the entire combinations matrix to active/inactive.
Set combi according to fixed range	To use this option, first enter the desired **Fixed range** and then click on the button. Normally, the value determined in the shadow impact report is used; in the UK, it is common to select 10 times the rotor diameter. Now the distance of the POI is automatically compared with this range, and the respective combination is set to active if the distance to the POI is smaller or equal to the range. Meter, decimals allowed
Set combi according to blade depth	If you select this option, the distance is compared with the calculated shadow range according to the German 20% criterion (face of the sun is covered to 20% by a rotor blade). The respective combination is set active if the distance is smaller or equal to the range. **NOTE** If the calculated range with 20% sun coverage is to be used, the average blade depth specified in the manufacturer data must be checked very carefully.
Activate/ Deactivate Power Threshold	Here you can activate or deactivate one or more combinations by clicking the respective button. Furthermore, you can set a new power threshold (in kW). If the power of the respective WTG drops below this value, it will be shut down (provided that the power threshold was activated).

Element	Explanation/function
Set power threshold	Here you can enter the desired power threshold. If a WTG is operated below this power threshold while causing shadow impact in a place of immission, the respective WTG is shut down immediately. kW, no decimals Apply In order to apply the values to one WTG or to the entire combinations matrix, click on **Apply**.
Max. daily/ annual load	You can enter the maximum permissible load per day/year. minutes, no decimals Apply see above Default If you click on **Default**, the settings defined in the **Add/Edit Place of Immission** window under **Maximum permissible daily/annual load** will be applied.
No. of grace days – daily load	Here you enter the number of days (per year) on which the **Max. daily load** may be exceeded. Apply see above Default If you click on **Default**, the settings defined in the window **Add/Edit Place of Immission** under **No. of grace days – daily load** will be applied. If you enter a value that is higher than the value set when defining the place of immission, then the value set there will be applied here.
Reset combination matrix	If you click this button, the values of the entire combination matrix (combinations of **all** WTGs with **all** POIs) will be reset (**Max. daily/annual load** and **No. of grace days – daily load**) to the respective values set in the **Add/Edit Place of Immission** window, all others to **0**).

See also Practical example 4: Editing a POI and WTG combination 34

NOTES

- You can use the **Combination Matrix Wizard** to change **one** selected combination or apply a change to **all** combinations. Please make sure that the combinations whose **Threshold Power Active** parameters were automatically set to inactive are not changed by the assistant. For further information, please refer to section Automatic deactivation of the power threshold 111.

- If you plan to use the activation according to a fixed or calculated range, we recommend you open the combination wizard from the WTG menu, because the shadow range is WTG-related. For the **Set All Combinations** function, it does not matter whether you open the combinations window from the POI list or the WTG list.

In the following subsections you will find further information, examples and step-by-step instructions on the possibilities offered by the **WTG Combinations** window – they will allow you not only to meet the requirements of the authorities but also to optimize the yield of a wind park.

4.2.2.3.1 Activate/deactivate a combination

Is shadow impact possible between the WTG and the POI?

After the WTGs and POIs of a project have been defined, all combinations are set to **Active** by default. This means that the SMU will assume that each WTG is able to cause shadow impact at each POI. However, if there is an obstruction between a WTG and a POI (e.g., a stable or forest), real shadow impact is not possible at this place of immission. Consequently, no calculation must take place and the corresponding combination can be deactivated.

A combination can be activated/deactivated in two ways:

1. **Combinations** window (activate/deactivate the desired combination with the selected WTG/POI by setting/removing a checkmark)

2. Combinations Matrix Wizard 105 sub window

4.2.2.3.2 Define a power threshold

Would it make sense to define a power threshold for the WTG/POI combination?

According to the requirements of the authorities, a specific maximum number of minutes with shadow impact per day/year are acceptable for each POI. This means that the wind park has a so-called shadow impact budget for each POI. Since the wind and consequently the possible yield is different depending on the time of the day or year, it can be interesting to define a power threshold – please refer to the following example.

Shadow impact is caused at a POI; however, the budget has not been exploited; the WTG operates at a power output of 490 kW.

Consequences without power threshold

- WTG will not be shut down since the budget has not been fully exploited
- although operating at a low power output, the WTG consumes budget
- later, when the wind may be stronger, the WTG may have to be shut down immediately
- high loss in yield

☹

Consequences with 500 kW power threshold

- WTG is shut down
- budget saving
- later, when the wind may be stronger, the WTG may not have to be shut down
- yield optimization

☺

There are two ways to define and activate/deactivate the power threshold:

1. **Combinations** window

   - Set the checkmark for the desired combination in the **Power Threshold Active** column.
   - Enter the desired value in the **Power Threshold [kW]** column and click on **Apply** (no decimals possible).

2. Combinations Matrix Wizard sub window 105

4.2.2.3.3 Define a maximum daily/ annual load

Does it make sense to define a maximum daily/annual load for the combination of WTG and POI?

According to the requirements of the authorities, each POI may be exposed to shadow flicker for a certain maximum number of minutes per day/year, so the wind farm has a so-called shadow impact budget available for each POI. However, since shadow impact at an POI can often be caused by more than one WTG, but not every WTG is running at the same power in the process, it may make sense to allocate less budget to lower-power WTGs than to higher-power WTGs. For this purpose, the value set in the **Add/Edit Place of Immission** window at **Maximum permissible daily/ annual load** can be reduced for certain combinations, see the following example.

Example

WTG 1 and WTG 2 can theoretically cause shadow impact at an POI. WTG 1 achieves a rated power of 1,500 kW, while WTG 2 provides a rated power of 3,000 kW.

By reducing the maximum load per day/year on WTG 1, you allocate a larger portion of the budget to the much more powerful WTG 2, optimizing your yield.

There are 2 ways to define and activate/deactivate a maximum daily/annual load:

1. **Combinations** window

   - Specify the maximum number of minutes for the desired combination (no decimals possible) in the Max. Daily/Annual Load [min] column.
   - Click on **Apply**.

> i Since, as described above, you want to reduce the amount permitted by the authorities, the value you enter here must be lower than the value you defined under **Maximum permissible daily/annual load** in the **Add/Edit Place of Immission** window.

2. **Combinations Matrix Wizard sub window** 101

4.2.2.3.4 Automatic deactivation of the power threshold

In the windows **Add/Edit Place of Immission** and **Add/Edit WTG**, conditions can be defined (see table below) which, as soon as they are applied, defeat the purpose of the power threshold functi-on. Therefore, the power threshold is **automatically** deactivated in certain cases in the respective combination matrix. For further explanation, refer to the 2 tables below.

This table shows as to how the definition of such conditions in the **Add/Edit Place of Immission** window affects the associated combination matrix:

Setting in the **Add/Edit Place of Immission** window	Effect on the **IO Combinations** window		Explanation
	Limit active	**Limit [kW [kW]**	
Only log WTG stop (day) = ☐ **Use daily limit** = ☐ **Only log WTG stop (year)** = ☐ **Use annual limit** = ☐	Checkmark is automatically removed, field is deactivated	Value is automatically removed, field is deactivated	Daily and annual counters are not used, the WTG does not stop, and there-fore the power threshold does not need to be con-sidered.
Only log WTG stop (day) = ☑ **Use daily limit** = ☑ **Only log WTG stop (year)** = ☑ **Use annual limit** = ☑	Checkmark is automatically removed, field is deactivated	Value is automatically removed, field will be deacti-vated	Only logging is desired, the WTG must not stop, not even when the power falls below the power threshold.
Only log WTG stop (day) = ☑ **Use daily limit** = ☑ **Only log WTG stop (year)** = ☐ **Use annual limit** = ☐	Checkmark is automatically removed, field is deactivated	Value is automatically removed, field is deactivated	The annual limit is not used, and if the daily limit is exceeded, this should only be logged. The WTG must not stop when the power falls below the threshold.
Only log WTG stop (day) = ☐ **Use daily limit** = ☐ **Only log WTG stop (year)** = ☑ **Use annual limit** = ☑	Checkmark is automatically removed, field is deactivated	Value is automatically removed, field is deactivated	The daily limit is not used, and if the annual limit is exceeded, this should only be logged. The WTG must not stop when the power falls below the threshold

This table shows as to how the definition of such conditions in the **Add/Edit WTG** window affects the associated combination matrix:

Setting in the **Add/edit WEA** window	**Effect on the window WEA Combinations**		**Explanation**
	Limit active	**Limit [kW [kW]**	
Communication = **Preload** **Switch WTG by foreign system** ☐	column is not displayed	column is not displayed	
Communication = **Preload** **Switch WTG by foreign system** ☑	column is not displayed	column is not displayed	
Communication = **via relay** **AI - current WTG power** = ☐	column is not displayed	column is not displayed	
AI - current WTG power = ☑	is not automatically set to inactive	remains active	In this case, it is possible to have the WTG shut down according to the power threshold.

NOTE

Note that combinations whose **Power Threshold Active** parameter was automatically set to **Inactive** cannot be changed by the **Combination Matrix Wizard**.

4.2.2.4 Communication Parameters input area

Purpose	Define settings for the communication between the SMU and the wind turbine generators to be monitored
Path	*Project > Wind Turbine Generators > Edit/Add WTG*
Window type	Input area
Type of use	Interactive
Reference	Selected WTG

This area contains different parameters depending on the selected **WTG type** and the correspon-ding communication type.

For each type of WTG, you will find the respective parameters and their explanation in the following tables.

Communication = Preload	
This is not an actual communication type, but rather of setting of preload caused by a WTG of, e.g., a different wind park.	
Switch WTG by foreign system	If a checkmark is set, it is assumed that in the case of shadow impact the WTG will be switched by an external system.
Use nacelle position from WTG	Allows the value for the nacelle angle of a different WTG to be used for the shadow impact calculation.

Communication “via relay”	
Stop command via	Here you can select whether the stop command should be received by way of a digital output of the master unit or via the digital output of a light sensor. In the latter case, you must define the number of the light sensor.
DO - WTG stop signal	Digital output for sending the stop command to the WTG. This option cannot be deactivated. If the wind turbine generator to be switched stops at LOW, set a checkmark at **Output LOW active** (*Hardware > Interface Cards*).
DO - WTG error alarm contact	Digital output for reporting errors from the SMU to the WTG. If the wind turbine generator to be switched detects LOW as an error, set a check-mark at **Output LOW active** (*Hardware > Interface Cards*).
DI - WTG status	Digital input for retrieving the WTG Status. If the wind turbine generator to be switched reports operation at LOW, set a checkmark at **Input LOW active** (*Hardware > Interface Cards*). If this option is activated, the background of the input field for **Standstill** on the left side of the

Communication “via relay”	
	window changes to red (no input possible) since this parameter cannot be considered anymore.
AI - WTG nacelle angle	Analog input for retrieving the nacelle angle of the WTG to be switched.
AI - current WTG power	Analog input for retrieving the current power of the WTG to be switched.
AI - WTG rotor speed	Analog input for retrieving the rotor speed of the WTG to be switched – if this option is activated, the background of the input field **Standstill** on the left side of the window changes to green and you can define the desired value.
AI - WTG wind speed	Analog input for retrieving the wind speed measured by the WTG to be switched.
Additional DO 1 **Additional DO 2**	Some WTGs have several stop inputs, often, e.g., a separate input for stops due to bat protection. These separate inputs should be operated depending on the reason for shutdown. By setting the checkmarks in these two input areas, you specify the switch reason for which the additional digital outputs (DO1 and DO2) shall be used. Please note the following: • A switch reason selected here will subsequently no longer be sent via the DO - WTG stop signal (above). • With these two additional DOs, a maximum number of 3 DOs are available having a WTG shut down for various reasons. • The two additional DOs are only available once for each SMU, not for each of the maximum 100 WTGs. • If an additional DO is assigned one or more switch reasons, then it must be assigned to an interface card with digital outputs (*Hardware > Hardware Assignments*).

Communication “SWSE Type 01”	
With this type of communication, all 4 analog signals (nacelle angle, current power, rotor speed and wind speed) are not retrieved individually but by way of a Shadow Interface Unit (SIU), which is installed in each WTG and provides signals. These signals are retrieved by the SMU.	
IP address	Enter the IP address of the SIU.
Port	Enter the port of the SIU.
Gear ratio	Some WTGs report the gear speed instead of the rotor speed. In this case, the factor for converting the rotor speed must be entered here.

Communication "Senvion IEC 61400 Type 01"	
So far, data can only be read out via this IEC interface. It is not possible to send stop commands, for example. Therefore, the stop commands are sent via an SIU for now.	
Stop command via	Here you can choose whether the WTG will be switched via a relay of the SMU or via a relay of the Shadow Interface Unit (SIU unit with basic functions).
IP address	Enter the IP address of the WTG to be switched.
Port	Enter the port of the WTG to be switched.
Domain ID	Access data for access to the IEC interface which will be communicated by the manufacturer for each project.
Password	Access data for access to the IEC interface which will be communicated by the manufacturer for each project.
IP address of SWSE unit	Enter the IP address of the SIU.
SWSE unit port	Enter the port of the SIU.

Communication "Senvion IEC 61400 Type 02"	
Via this IEC interface, an IEC61400 server is available both on the WTG side and on the SMU side. The switch signals are provided by the SMU and picked up by the client of the WTG.	
IP address	Enter the IP address of the WTG to be switched.
Port	Enter the port of the WTG to be switched.
WTG identifier	Displays the name of the WTG as it is stored in the SMU-side server.
WTG password	Access data for access to the IEC interface which will be communicated by the manufacturer for each project.
Server port	Port of the SMU-side IEC server.
Server password	A password for the SMU-side IEC server can be entered here. If the string is empty, no password authentication is active.
Domain ID	Access data for access to the IEC interface which will be communicated by the manufacturer for each project.

Communication "Nordex Modbus/TCP Type 01"	
Communication takes place via a network connection: the SMU acts as the client, while the WTG act as the slave.	
IP address	Enter the IP address of the WTG to be switched.
Port	Enter the port of the WTG to be switched. All WTGs use the same port.
Modbus slave address	Enter the slave address
Send collective stop command if another stop command is pending	If a checkmark is set, a collective stop command is sent in addition to the actual stop command due to e.g. shadow impact, bird protection, or bat protection, and the reason for this collective command remains open. Several stop commands are possible – however, for now, it is necessary to send a collective command.

Communication "Nordex Profinet Type 01"	
Communication takes place via an additionally plugged in Profinet interface card. The SMU is a Profinet device and the wind park server acts as a Profinet controller.	
Send collective stop command if another stop command is pending	If a checkmark is set, a collective stop command is sent in addition to the actual stop command due to e.g. shadow impact, bird protection, or bat protection, and the reason for this collective command remains open. Several stop commands are possible – however, for now, it is necessary to send a collective command.

Communication "Vestas OPC-Server Type 01"	
Communication takes place via a network connection to the park server of the WTGs to be switched.	
IP address	Enter the IP address of the park server.
Port	Enter the port of the park server.
WTG Communication Number	This is the number of the respective WTG in the wind park. This number may be different from the "WTG number" in the shadow impact forecast.

Communication “Vestas Modbus/TCP 01”	
Communication takes place via a network connection: the WTG to be switched acts as the client while the SMU acts as the slave. Therefore, since the SMU, instead of establishing the communication, will only respond, entering an IP address is not necessary here.	
Port	Enter the port of the park server.
WTG Communication Number	This is the number of the respective WTG in the wind park. This number may be different from the “WTG number” in the shadow impact forecast.

Communication “Siemens WPS Type 01”	
Communication takes place via a network connection to the park server of the WTGs to be switched.	
IP address	Enter the IP address of the park server.
Port	Enter the port of the park server.
WTG name	Name of the WTG as used in the data telegram sent from a Siemens WTG.
Extended WPS communication	Activates shutdowns for bat protection in the communication.

Communication “Siemens OPC Type 01”	
Communication takes place via a network connection to the park server of the WTG to be switched. OPC UA is used for the communication. The SMU is the client in this case.	
WTG identifier	Displays the name of the WTG as it is stored in the server – serves the exact assignment of the data.
Log server identifier	Here you can enter the name of the log server as it is stored in the server – serves to exchange shadow impact log data.
Alarm server identifier	Here you can enter the name of the alarm server as it is stored in the server – serves for averaging faults.
Port	Enter the port of the WTG to be switched.
User authentication	User name for logging on to the server.
Password authentication	Password used to log on to the server.

Communication "Enercon OPC-Server Type 01"	
Communication takes place via a network connection to the park server of the WTGs to be swit-ched.	
IP address	Enter the IP address of the park server.
Port	Enter the port of the park server.
User ID for control access	Access data needed to write data to the Enercon server so that an addi-tional identification ensures increased security, e.g. when sending stop commands.
WTG name	Name of the WGT specified by Enercon, which is transferred during the communication.
Name of OPC server temperature knot	Name of the WTG control – used to determine the correct temperatu-res.
Use extended stop list	This can be used to define that instead of the standard stop signals (60° and 90°) an extended list defined by Enercon is used, which, e.g., provi-des an individual stop number for shadow impact.
Stop shadow impact	Stop at 60° or 90° in the case of shadow impact. However, if **Use ex-tended stop list** is active, the shadow impact module will stop the WTG.
Stop calendar	Stop at 60° or 90° according to calendar. However, if **Use extended stop list** is active, the shadow impact module will stop the WTG.
Stop bat protection	Stop at 60° or 90° for bat protection. If **Use extended stop list** is acti-ve, stop due to species conservation 60° or species conversation 90° will be carried out.
Stop sector	Stop at 60° or 90° in the case of shadow impact. However, if **Use ex-tended stop list** is active, stop due to shadow impact will be carried out.
Stop noise protection	Stop at 60° or 90° in the case of shadow impact. However, if **Use ex-tended stop list** is active, the shadow impact module will stop the WTG.
Stop external	Stop at 60° or 90° in the case of shadow impact. However, if **Use ex-tended stop list** is active, the shadow impact module will stop the WTG.
Stop bird protection	Stop at 60° or 90° in the case of shadow impact. If **Use extended stop list is active, stop due to species conservation 60° or species con-versation 90° will be carried out.**
Measured ambient temperature	Place where the ambient temperature is to be measured: Ground level, nacelle level or use the mean value of the two.

Communication "Enercon OPC Vleemo Type 01"	
Communication takes place via a network connection to the park server of the WTGs to be switched.	
IP address	Enter the IP address of the park server.
Port	Enter the port of the park server.
WTG name	Name of the WGT specified by Enercon, which is transferred during the communication.
Use extended stop list	This can be used to define that instead of the standard stop signals (60° and 90°) an extended list defined by Enercon is used, which, e.g., provides an individual stop number for shadow impact. If the checkmark is set, the extended stop list is used.
Stop shadow impact	Stop at 60° or 90° in the case of shadow impact. However, if **Use extended stop list** is active, the shadow impact module will stop the WTG.
Stop calendar	Stop at 60° or 90° according to calendar. However, if **Use extended stop list** is active, the shadow impact module will stop the WTG.
Stop bat protection	Stop at 60° or 90° for bat protection. If **Use extended stop list** is active, stop due to species conservation 60° or species conversation 90° will be carried out.
Stop sector	Stop at 60° or 90° in the case of shadow impact. However, if **Use extended stop list** is active, stop due to shadow impact will be carried out.
Stop noise protection	Stop at 60° or 90° in the case of shadow impact. However, if **Use extended stop list** is active, the shadow impact module will stop the WTG.
Stop external	Stop at 60° or 90° in the case of shadow impact. However, if **Use extended stop list** is active, the shadow impact module will stop the WTG.
Stop bird protection	Stop at 60° or 90° in the case of shadow impact. If **Use extended stop list** is active, stop due to species conservation 60° or species conversation 90° will be carried out.

Communication “Eno Energy Modbus/TCP Type 01”	
Communication takes place via a network connection: the SMU acts as the client, while the WTG act as the slave.	
IP address	Enter the IP address of the WTG to be switched.

Communication “Eno Energy Modbus/TCP Type 01”	
Port	Enter the port of the WTG to be switched. All WTGs use the same port.
Modbus slave address	Enter the slave address

Communication “Acciona Modbus/TCP Type 01”	
Communication takes place via a network connection: the SMU acts as the client, while the WTG act as the slave.	
IP address	Enter the IP address of the WTG to be switched.
Port	Enter the port of the WTG to be switched. All WTGs use the same port.
Modbus slave address	Enter the slave address

Communication “GE Modbus/TCP Type 01”	
Communication takes place via a network connection: the SMU acts as the client, while the WTG act as the slave.	
IP address	Enter the IP address of the WTG to be switched.
Port	Enter the port of the WTG to be switched. All WTGs use the same port.
Modbus slave address	Enter the slave address
Wind speed as 10 min. average value	By selecting this option, you specify that the SMU determines a mean value over 10 minutes and uses it instead of the actual value reported by the WTG.

Communication “Vensys Modbus /TCP 01”	
Communication takes place via a network connection: the WTG to be switched acts as the client while the SMU acts as the slave. Therefore, since the SMU, instead of establishing the communication, will merely be addressed, entering an IP address is not necessary here.	
Port	Enter the port of the park server.
WTG communication number	This is the number of the respective WTG in the wind park. This can deviate from the "WTG number" from the shadow impact forecast.

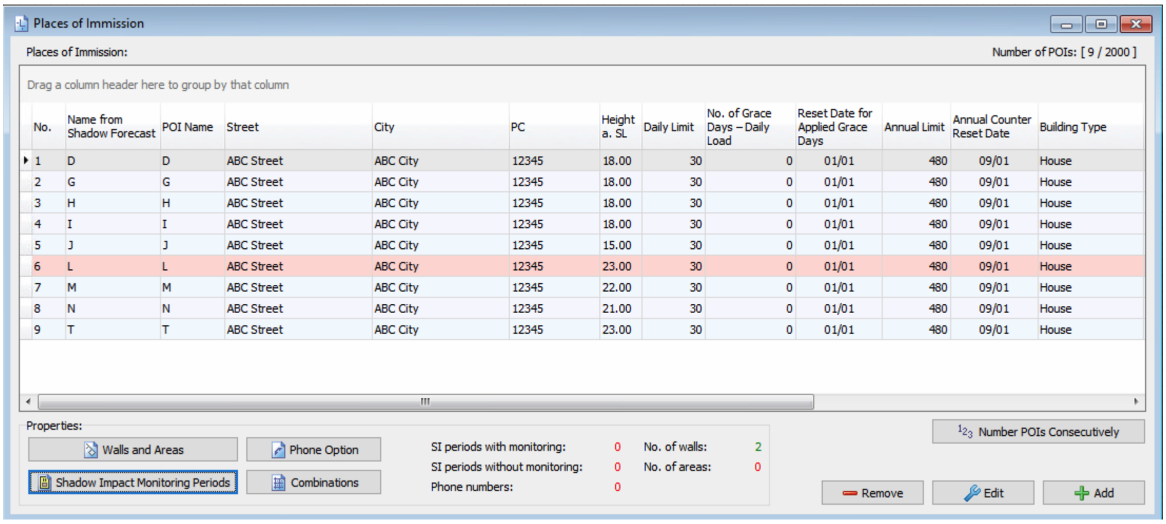
Communication “Lagerwey GE Modbus/TCP Type 01”	
Communication takes place via a network connection: the SMU acts as the client, while the WTG act as the slave.	
IP address	Enter the IP address of the WTG to be switched.
Port	Enter the port of the WTG to be switched. All WTGs use the same port.
Modbus slave address	Enter the slave address
Communication „Amperax Modbus Type 01”	
Communication takes place via a network connection: the SMU acts as the client, while the WTG act as the slave.	
IP address	Enter the IP address of the WTG to be switched.
Port	Enter the port of the WTG to be switched. All WTGs use the same port.
Modbus slave address	Enter the slave address

Communication "General TCP Type 01"	
IP address	Enter the IP address of the server.
Port	Enter the port of the server.
Select names of certificates	Select whether certificate designations different from the standard are to be used.
Name of your own certificate:	Enter the name of the SMUs own certificate.
Name of your own key	Enter the name of the SMU's own key.
Name of your own configuration file	Enter the name of the SMUs own configuration file.
Name of trusted third-party certificate	Enter the name of the trusted third-party certificate.

4.2.3 Places of Immission window

Purpose	Display and edit places of immission (POIs), areas/walls, shadow impact periods, combinations, etc.
Symbol	
Path	*Project > Places of Immission*
Window type	List window
Type of use	Display + buttons to sub windows
Reference	Project

This window shows a list of the POIs already created in the project that is currently opened. The individual parameters for a POI are defined in the **Add/Edit Place of Immission** window, see next paragraph.



Places of immission window

General notes regarding the **Places of Immission** window

- The top part of the window shows a list of the already created POIs, the actual settings are made in the **Add/Edit Place of Immission** sub window. The information "9/2000" in the upper-right corner of the screen means that 9 of 2000 possible POIs have already been created. An explanation of the individual columns (parameters) can be found in the Add/Edit Place of Immission sub window 126 section.
- The currently selected POI is highlighted in **blue**.

- POI 6 is highlighted in red because no walls/areas have yet been defined for this POI.
- If you double-click on a POI in the list, the **Add/Edit Place of Immission** window will be opened.
- The parameters defined in the **Add/Edit Place of Immission** window under **Maximum permissible annual load/Maximum permissible annual load** are displayed in the **Daily Limit/Annual Limit** columns. For more information on these two columns, see the end of this chapter.

Operating instructions regarding the **Places of Immission** window

- Move columns: Columns can be moved by drag & drop.
- Sort by column: You can sort a column according to its heading by clicking on it. If you then click again on the same column heading, the sort sequence will change from ascending to descending or vice versa.
  You can also sort by more than one column heading (criteria). To do this, first press and hold the shift key and then click on the desired column headings. The sorting will be carried out according to the order in which you click on the column headings.

Information and setting options in the **bottom part of the window**

Element	Explanation/function
Shadow Impact Monitoring Periods	According to the default settings, a defined POI will be monitored 24/7 all year round. If you click on this button, you can exclude specific periods of time from monitoring, please see Shadow Impact Monitoring Periods sub window 131.
Walls and Areas	In the **Edit Walls and Areas** window, you can edit or create walls and areas for an existing POI, see Edit Walls and Areas sub window 135.
Phone Option	Used to define phone numbers from which residents can shut down WTGs that currently cause shadow impact by dialing a special phone number, see Phone Option sub window 139.
Combinations	Opens the **POI Combinations** window. This window corresponds to the WTG Combinations sub window 101 (for more information, see the respective section), however, instead of the possible combinations of one WTG with all POIs, the possible combinations of ONE specific POI with all WTGs defined in the project are concerned here. **NOTE:** To reduce the production periods of a small WTG during shadow impact in favor of a larger WTG that has a higher power output, for example, you can reduce the load periods for each combination even further here. In other words: The times during which a WTG with low rated power output is allowed to cause shadow impact should be reduced so that a WTG with a higher output can yield more revenue.

Element	Explanation/function
SI periods with monitoring	Displays the number of shadow impact periods **with** monitoring that have been defined for the POI selected in the list — no input possible. For further information, see Shadow Impact Monitoring Periods sub window 131.
SI periods without monitoring	Displays the number of shadow impact periods **without** monitoring that have been defined for the POI currently selected in the list — no input possible. For further information, see Shadow Impact Monitoring Periods sub window 131.
Phone numbers	Shows how many telephone numbers for the phone option have been defined for the POI currently selected in the list. For further information, see Phone Option sub window 139.
No. of walls	Displays the number of walls that have been defined for the POI currently selected in the list — no input possible. For further information, see Edit Walls and Areas sub window 135.
No. of areas	Displays the number of areas that have been defined for the POI currently selected in the list — no input possible. For further information,see Edit Walls and Areas sub window 135.
Number POIs Consecutively	If you click on this button after you have deleted one or more POIs, a consecutive numbering will be restored (the purpose of this function is simply to provide a better overview).
Remove	Deletes the POI selected in the list. **Attention:** If you click this button, the POI will be deleted immediately, (no confirmation dialog).
Edit	Is used to edit the POI selected in the list.
Add	Adds a new POI. Up to 2000 POIs are possible.

Notes regarding the "Daily Limit" / "Annual Limit" columns

The following table shows how the parameters defined in the **Add/Edit Place of Immission** window affect the display in the **Daily Limit**/**Annual Limit** columns in the **Places of Immission** window.

	Add/Edit Place of Immission window			**Places of Immission** window	
	Maximum permissible daily/annual load parameter	Parameter **Only log WTG stop**	Parameter **Use annual limit/ Use daily limit**	**Day Limit** column	**Annual Limit** column
1	--	☐	☐	--	--
2	30 / 356	☐	☑	30	356
3	30 / 356	☑	☑	(30)	(356)

NOTE: Please note that defined limit values (**Maximum permissible daily/annual load**), for which the corresponding parameter **Only log WTG stop** has been activated, are displayed in brackets in the **Places of Immission** window.

The following table shows the representation of the parameters from the above example in the configuration log and Google Earth export:

POI	Indication in the configuration log / Google Earth export **Max. permissible daily/annual load**
1	not used
2	30 min / 356 min
3	(30) min / (356) min

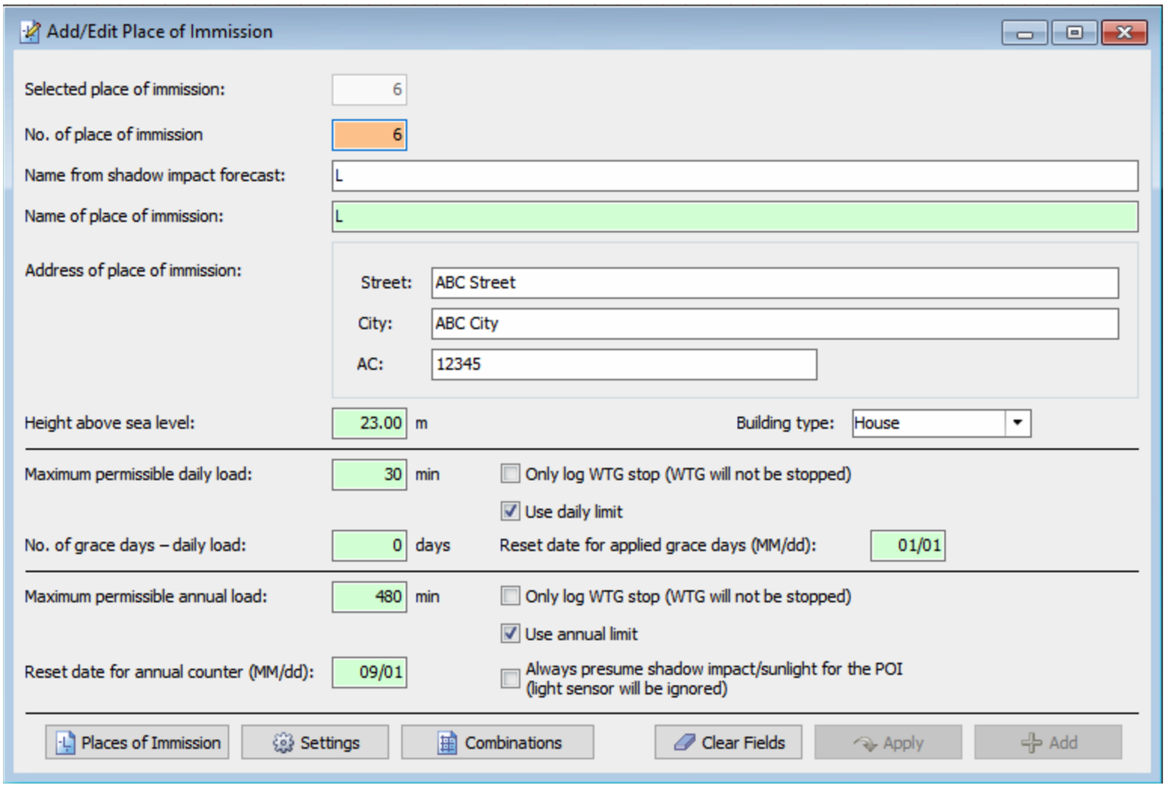
Use the data of an existing place of immission

- If you want to copy the data of a POI that has already been created, click on this POI in the **Places of Immission** window in order to selected (dataset highlighted in blue).
- Then click on **Edit** (or double-click the desired POI dataset in the list).
- The **Add/Edit Place of Immission** window will open and **No. of place of immission** will be highlighted in orange.
- Now enter the next tree number here (in the case of the above window this would be number 4). The box will now be highlighted in green and **Add** at the bottom of the window will be activated.

See also Practical example 1: Set up a new WTG with a new POI 29

4.2.3.1 Add/Edit Place of Immission sub window

Purpose	Add or edit places of immission (POI) including information, such as address, height above sea level, maximum permissible load and building type.
Symbol	
Path	*Project > Places of Immission > Edit* or *Add*
Type of use	Interactive + buttons to sub windows
Reference	POI



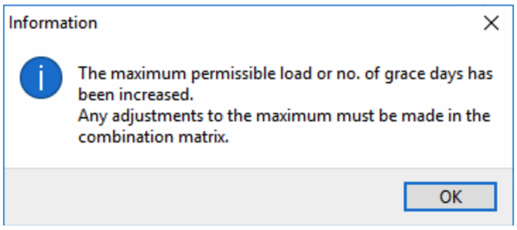
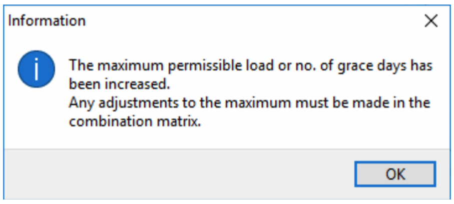
Add/Edit Place of Immission sub window

Notes regarding the Add/Edit Place of Immission window

- Press the Enter key or the Tab key to complete the current entry and jump to the next input field.
- Fields in which an invalid value was entered (value is outside the permitted range, wrong input format) are highlighted in red:
- The buttons **Apply** and **Add** will not be activated until the input fields have been filled out correctly.

The information, options or buttons are described in the following table

Element	Explanation/function
Selected place of immission	Displays the POI that was selected in the **Places of Immission** window and whose data will be used for the new POI.
No. of place of immission	Up to 2000 POIs can be defined. If you have clicked on **Add** in the **Places of Immission** window, the next free number will automatically be provided here. If you have clicked on **Edit** in the **Places of Immission** window, you can enter the next free POI number here in order to use the data of another POI, see the productivity tip in the Places of Immission window 125 section. **NOTE** You can also enter/use the number of an existing POI. The dataset of this existing WTG will then be overwritten with the "new data". Before that, however, the Fenster Abhängigkeiten 347 will open.
Name from shadow impact forecast	Name of the POI as used in a shadow impact forecast which may have been drawn up.
Name of place of immission	This piece of information is useful when there is more than one POI with the same address. Each name can be used only once. This **unique** identification of a POI will also be shown in the log and can thus be allocated in the shadow impact forecast.
Address of place of immission	Exact address of the POI (street name, city, area code)
Height above sea level	Height above sea level of the POI **Meter**
Building type	Drop-down list that offers the following: **House, Commercial, Stable, Church, Open area, Unknown** You can also enter free text.
Maximum permissible daily load	Maximum permissible shadow impact load at the POI per day; after reaching this limit, the responsible WTG is switched off. This parameter can be activated or deactivated in the **Use daily limit** checkbox – this makes it possible, e.g., to only observe the shadow impact for a while without actually switching off. **NOTES** • In the **Place of Immission** window, this parameter is displayed in the **Daily Limit** column. • If you increase this value, click **Apply** and confirm with **OK** in the **Dependencies** window, you will see the following message:

Element	Explanation/function
	 It indicates that the change made here has no effect on the values in the corresponding columns in the **Combinations** window. In other words, this parameter only defines the "maximum value" that cannot be exceeded in the **Combinations** window (otherwise an error message will appear there). The redistribution of the shadow impact budget from low rated to higher rated WTGs can be defined/adjusted in the **Combination** windows, see WTG Combinations sub window 101. **Minutes** (integers only), the value must not exceed the corresponding value for the year
Only log WTG stop	This checkbox is only available (active) if the subsequent box has been checked. In this case, if a checkmark is also set here, exceeding the daily limit only causes an entry in the log, but **no** shutdown of the responsible WTG.
Use daily limit	This checkbox is marked by default. If the checkmark is removed, this has the following effects: • no WTG will be shut down due to a daily limit having been exceeded • the previously displayed limit value is replaced by a double line, and the input field is highlighted in gray • the **Only log WTG stop** checkbox belonging to the counter is deactivated.
No. of grace days – daily load	In SM4 = number of days (per year) on which the M**aximum permissible daily load** (see above) may be exceeded. **NOTE** If you increase this value, then click **Apply** and confirm with **OK** in the **Dependencies** window, you will see the following message:  It indicates that the change made here has no effect on the parameter values in the corresponding columns in the **Combinations** window. In

Element	Explanation/function
	other words, this parameter only defines the "maximum value" that cannot be exceeded in the **Combinations** window (otherwise an error message will appear there). **0 Tage**
Reset date for applied grace days (MM/dd)	The grace days counter will be reset on the date set here. **01/01**
Maximum permissible annual load	Maximum permissible shadow impact load at the POI per year; after reaching this limit, the responsible WTG is switched off. This parameter can be activated or deactivated in the **Use annual limit** checkbox – this makes it possible, e.g., to only observe the shadow impact for a while without actually switching off. **NOTE 1** In the **Place of Immission** window, this parameter is displayed in the **Annual Limit** column. **NOTE 2** If you increase this value, a system message informs you that a change you make here will have no effect on the value in the **Max. Annual Load [min]** in the **Combinations** window. In other words, this parameter only defines the "maximum value", which cannot be exceeded in the **Combinations** window (error message). The redistribution of the shadow impact budget from low rated to higher rated WTGs can be defined/adjusted in the Combination windows, see WTG Combinations sub window 101. **Minutes** (only integers)
Only log WTG stop	This checkbox is only available (active) if the subsequent box has been checked. In this case, if a checkmark is also set here, exceeding the annual limit only causes an entry in the log, but **no** shutdown of the responsible WTG.
Use daily limit	This checkbox is marked by default. If the checkmark is removed, this has the following effects: • no WTG will be shut down due to an annual limit having been exceeded • the previously displayed limit value is replaced by a double line, and the input field is highlighted in gray • the **Only log WTG stop** checkbox belonging to the counter is deactivated.
Reset date for annual counter (MM:dd)	Since the “shadow impact year” does not necessarily correspond to the calendar year, you can set another date here.
Always presume shadow impact/sun-	If you set a checkmark here, shadow impact will be logged as soon as the conditions for theoretical shadow impact are met, and the WTG re-

Element	Explanation/function
light for the POI (light sensor will be ignored)	sponsible for the theoretical shadow impact will be shut down, no matter if the sky is cloudy or not. Otherwise, when weather conditions changes from cloudy to sunny, a WTG will not come to a stop until 1 to 2 minutes after the shutdown command is sent.
Places of Immission	Switches to the **Places of Immission** window (if this window is not open already, it will be opened now). Here you can specify what happens if you click on **Add** in the **Add/Edit Place of Immission** window.
Settings	Opens the **Action following 'Add'** input area in the **Application Settings** window where you can define what happens when you click on **Add** in the **Add/Edit Place of Immission** window; the available options are self-explanatory.
Combinations	Opens a window of the **POI Combinations** sub window.
Clear Fields	Clears the freely definable input fields of the current POI.
Apply	Accepts the entered data.
Add	Add a new POI number. Up to 2.000 POIs are possible.

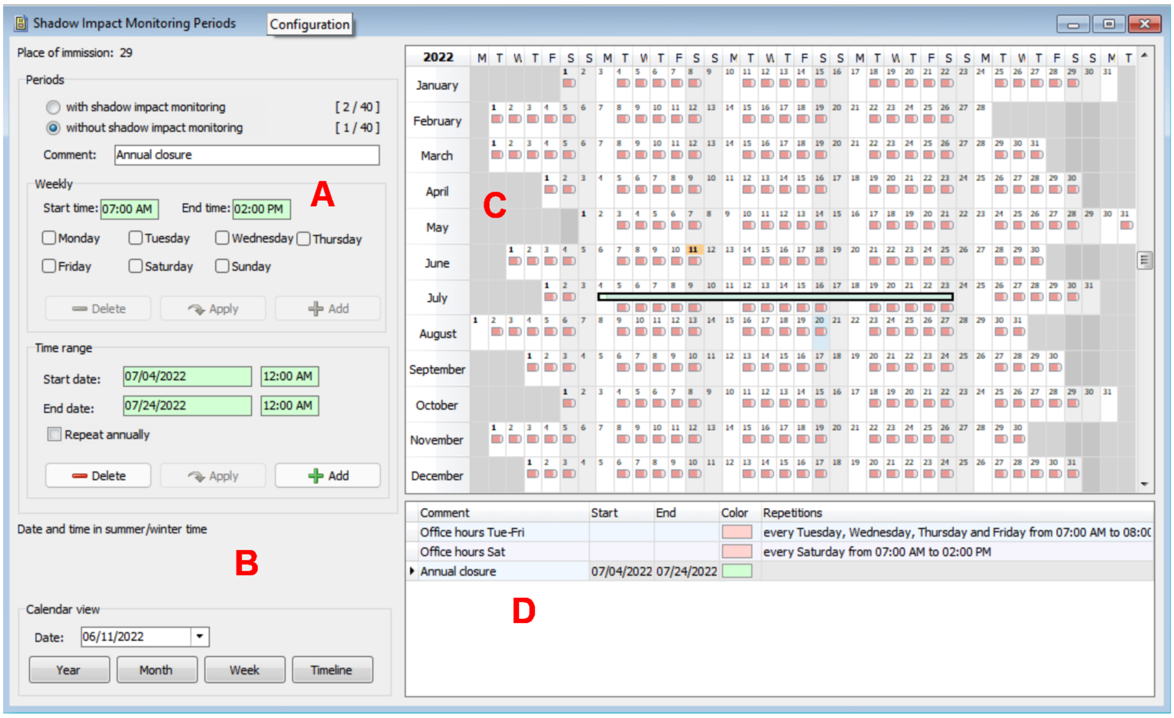
See also Practical example 1: Set up a new WTG with a new POI 29

See also Practical example 3: Changed load times & utilization times of a POI 32

4.2.3.2 Shadow Impact Monitoring Periods sub window

Purpose	Here you can define time periods in which the shadow impact at a POI is to be monitored or not monitored.
Icon	
Path	*Project > Places of Immission > Shadow Impact Monitoring Periods*
Usage type	Display + Dialog
Reference	POI

According to the default settings, all places of immission defined in SM4 will be monitored 24/7 all year round. In the **Shadow Impact Monitoring Periods** sub window, you can define up to 40 periods in which shadow impact at a place of immission will be monitored and another 40 during which shadow impact will **not** be monitored, for example, in order to reduce monitoring of commercially used POIs to the working hours or to deactivate monitoring during annual closures.



Shadow Impact Monitoring Periods window

Overview of the individual areas of the **Shadow Impact Monitoring Periods** window

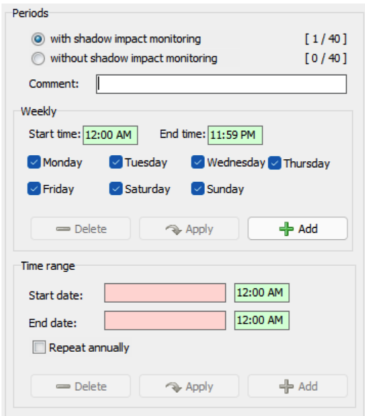
- **A** Area for defining a new dataset or edit or delete an existing dataset.
- **B** Area for changing the time resolution of display area C
- **C** Calendar view of existing data records (display only)
- **D** List of existing records (display only)

Notes on the example window **Shadow cast monitoring times**

- In the above example window, as can be seen on the bottom right, 2 weekly recurring monitoring periods are defined to ensure that the building is exposed to limited shadow impact during office hours, marked red.
- Below this you can see the **company vacations** in July, which are excluded from shadow impact monitoring, marked green. Whenever "green" periods (**without** monitoring) overlap with "red" periods (**with** monitoring), green periods are given priority.
- If you do not make any changes in the Shadow Impact Monitoring Periods times window, then only the following default dataset is created here, which ensures that monitoring takes place 24/7 all year round:

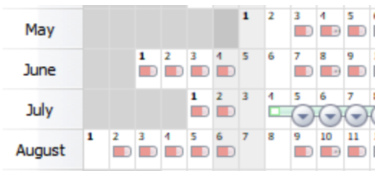
Comment	Start	End	Color	Repetitions
Standard				every Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday from 12:00 AM to 11:59 PM

An explanation of the information, options or buttons can be found in the following table

<table>
<tr><th>Input field/area</th><th>Explanation/ function</th></tr>
<tr><td>Place of immission</td><td>Displays the number of the place of immission point selected in the Places of Immission window.</td></tr>
<tr><td>[x/40]</td><td>Shows how many of 40+40 possible periods have already been defined.</td></tr>
<tr><td>
</td><td>In this area you can add, edit or delete a dataset.
Add a dataset - procedure
1. First you decide for one of two options:
- with shadow impact monitoring
- without shadow impact monitoring
2. Then you can enter a descriptive free text at Comment (e.g. commercial property, usage MO-FR).
3. If a day segment (start time to end time) is to be defined and repeated on certain or all weekdays, then make the further entries in the Weekly area and click on Add there.

However, if you want to define a yearly period (start date to end date), then make the further entries in the Time range area and click Add there. A period defined here will be excluded from monitoring in the following years as well only if you activate Repeat annually.
NOTE RE 3.
Please note that it makes a difference whether you use the buttons in the Weekly area or in the Time range area.

Delete a record
• Select the record to be deleted in the calendar view (click on a red box of the respective period) or select it in the list at the bottom right, then click on Delete in the Weekly area or in the Time range area, depending on the dataset type concerned.</td></tr>
</table>

Input field/area	Explanation/ function
	Modify a record • Select the record to be changed in the calendar view (click on a red box of the respective period) or select it in the list at the bottom right. • Make the desired change and then click on **Apply** (again, under **Weekly** OR under **Time range**, depending on the dataset type). **GENERAL NOTES** • Entry formats for time and date depend on the settings under *File > Application Settings > Shadow Manager 4 > General > Country-specific settings*. • According to the default setting, monitoring takes place 24/7 all year round ("Default" data set: every Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday from 00:00 to 23:59*). • If time ranges **without** and **with** shadow impact monitoring overlap, then the time range **without** monitoring has priority.
	Defined periods are displayed in a calendar view in the top right of the window. You can change the temporal resolution (**Year**, **Month**, **Week**, **Timeline**) using the buttons at the bottom left of the window under **Calendar view**), description see below. Periods with shadow monitoring Periods without shadow monitoring
Calendar view	Here you define the view in which periods with/without shadow impact monitoring are to be displayed in the top right of the window. In the **Date** drop-down list, you can switch directly to a specific day. Use the **Year**, **Month** and **Week** buttons to call up the corresponding time frames and then scroll back and forth as you wish. If you click on **Timeline**, the current day is displayed and you can scroll one day forward and one day back at the bottom scroll bar.
List at bottom right	All currently defined datasets are listed here. In the **Color** column, periods with shadow impact monitoring are marked red, while times without shadow impact monitoring are marked green. If you wish to edit or delete a dataset, you can select it here.

*The entry format (date and time format) is based on the pre-settings (defaults) in the input area **Country-specific settings** (*File > Application Settings > Shadow Manager 4 > General*) and can be changed there at any time.

Defining periods with/without shadow impact monitoring can be useful in cases such as the followi-ng:

- It is not necessary to monitor a POI on Saturdays and Sundays because it is not used on these days.
  Measure: Remove the checkmarks for **Saturday** and **Sunday** of the “default” dataset under **Periods with shadow impact monitoring**.

- It is not necessary to monitor or a POI doing a specific period of the year due to annual clos-ures.
  Measure: Add a dataset that specifies the corresponding period under **Periods without shadow impact monitoring**.

See also Practical example 3: Changed load times & utilization times of a POI 32

Practical tip for zero shadow impact

Requirement

At POI X, shadow impact should be = 0 (zero) on weekends and holidays, regardless of how much of the shadow impact budget has been used at the time.

Solution

Set up POI X twice as follows:

POI X.1

Add/Edit Place of Immission window > **Maximum permissible daily/annual load:**

daily = 30 min, annual = 480 min

Shadow Impact Monitoring Periods subwindow:

Periods with shadow impact monitoring, Monday to Sunday, 00:00–23:59 (00:00 AM–12:00 PM)

POI X.2 (copy POI X1, i.e., use X1 as template)

Add/Edit Place of Immission window > **Maximum permissible daily/annual load:**

daily = 0 min, annual = 0 min

Shadow Impact Monitoring Periods subwindow:

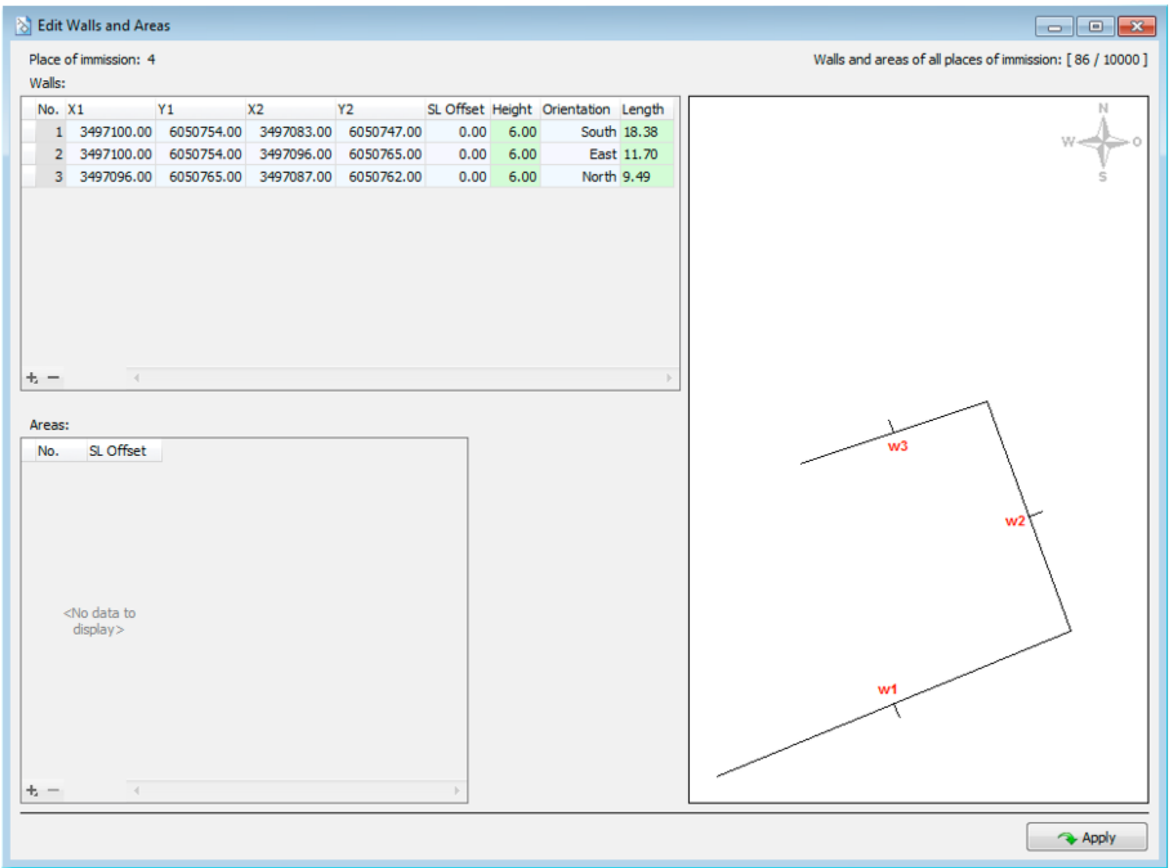
Periods with shadow impact monitoring > Saturday and Sunday, 00:00–23:59 (00:00 AM–12:00 PM)

Periods without shadow impact monitoring > public holidays

4.2.3.3 Edit Walls and Areas sub window

Purpose	Specify the coordinates of the walls and areas to be monitored
Symbol	
Path	*Project > Places of Immission > Edit Walls and Areas*
Type of use	Display + interactive
Reference	POI

In order to enable the SMU to monitor a defined place of immission (POI), you have to define the actual walls and/or areas of the POI that need to be protected from shadow impact. No monitoring will take place until you have defined the corresponding coordinates in the **Edit Walls and Areas** sub window.



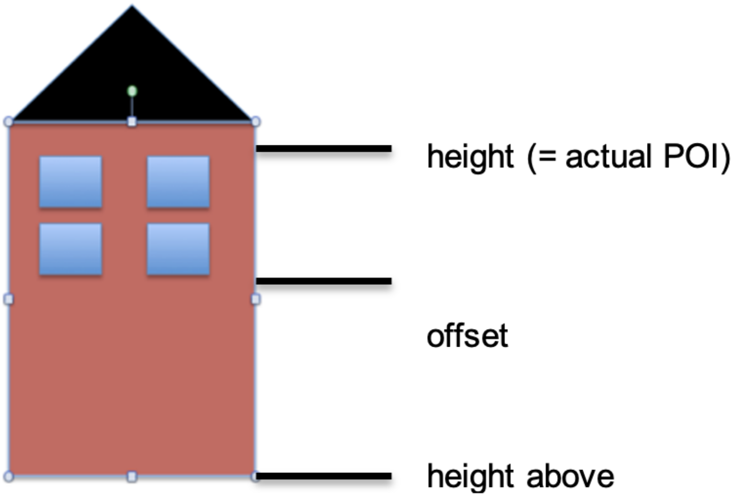
Edit Walls and Areas window

Notes regarding the **Edit Walls and Areas** window

- To add a wall or area, click on the **+** character (bottom left) in the corresponding screen area; to remove a wall or area, select the wall/area to be removed and then click on the **-** character (also bottom left).
- Press the enter key to confirm your input and jump to the next field.
- Input format: For input fields in which decimals are allowed, the decimal separator to be used depends on the default selected in the input area Country-specific settings (*File > Application Settings > Shadow Manager 4 > General.*). It can be changed there at any time.
- Upon confirming the last input field of a line by pressing the Enter key, you automatically add a new empty dataset.
- In the top view on the right you can visualls check your entries

You will find a detailed description of this window in the following table.

Element	Explanation/function
Place of immission	Number of the POI selected in the **Places of Immission** window (reference only).
Walls and areas of all places of immission	Indicates how many walls and areas have already been defined for all POIs and how many can be defined in total. In the exemplary window above, you can see that 86 of 10.000 possible walls and areas have been defined so far.
Walls/No.	Consecutive number of the respective wall
Walls/X1, Y1, X2, Y2	A wall is defined here by specifying 4 metric values based on the coordinate system selected in the **Project data** window (*Project > Project Data*). 2 decimals

Element	Explanation/function
Walls/ Offset NN	Enter the distance between **Meters above sea level** specified when defining the POI and the first window of the building. **EXAMPLE** The bottom edge of the lowest window in a wall is located 5 m above the ground, and from a height of 8 m above the ground, there are no more windows in this wall. In the above example you would have two enter “5 m” as **Offset**.  You can also enter a negative value, e.g. for buildings situated on a slope whose windows may be located below sea level. meter, 2 decimals
Wall/ Height	**Actual place of immission:** Enter the height of the wall area to be considered as POI. In the above example you would have two enter “3 m” meter, 2 decimals
Walls/ Orientation	Defines the orientation of the respective wall.
Wall/ Length	This field will be filled out automatically – here you can verify the entered coordinates are correct.
Area/No.	Consecutive number of the area
Areas/ Offset NN	Enter the distance between **Meters above sea level** as specified when defining the POI and the elevation of the respective area. Example: rooftop garden. meter, 2 decimals
Areas/X, Y (1, 2, 3 …)	The sides of an area are defined here by specifying 2 metric values based on the coordinate system selected in the **Project data** window (*Project > Project Data*). 2 decimals

Element	Explanation/function
Areas/ Length	This field will be filled out automatically – here you can verify the entered coordinates are correct.

Important notes for defining walls and areas

- The points defining area must be entered clockwise or counterclockwise; it is important not to enter them in a criss-cross manner.
- Walls and areas, you have already edited or created will only be saved and applied if you click the **Apply** button.
- The coordinates of all WTGs and POIs must be defined using the same metric coordinate system.
- You can define an unlimited number of walls and areas for each POI. However, the number of walls and areas is limited to 10,000 for each project.
- Once you have entered or edited a parameter of a wall/area, you can press Enter to jump to the next parameter (to reduce mouse operation).
- An area must have at least 3 sides (defined by points) and can have a max. number of 9 sides (i.e., 10 points); the last point connects to the first point.

Please also pay attention to the following note.

Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

If the field **Length** to a wall or area in meters (last field of the line) is highlighted in yellow (instead of green), the entered values are not plausible or the maximum length of a wall or side of an area according to the warning limit (*File> Application Settings > Warning Limits*) has been exceeded. Check that you have entered the coordinates correctly. For further information, please refer to section Application Settings window, Warning limits 74.

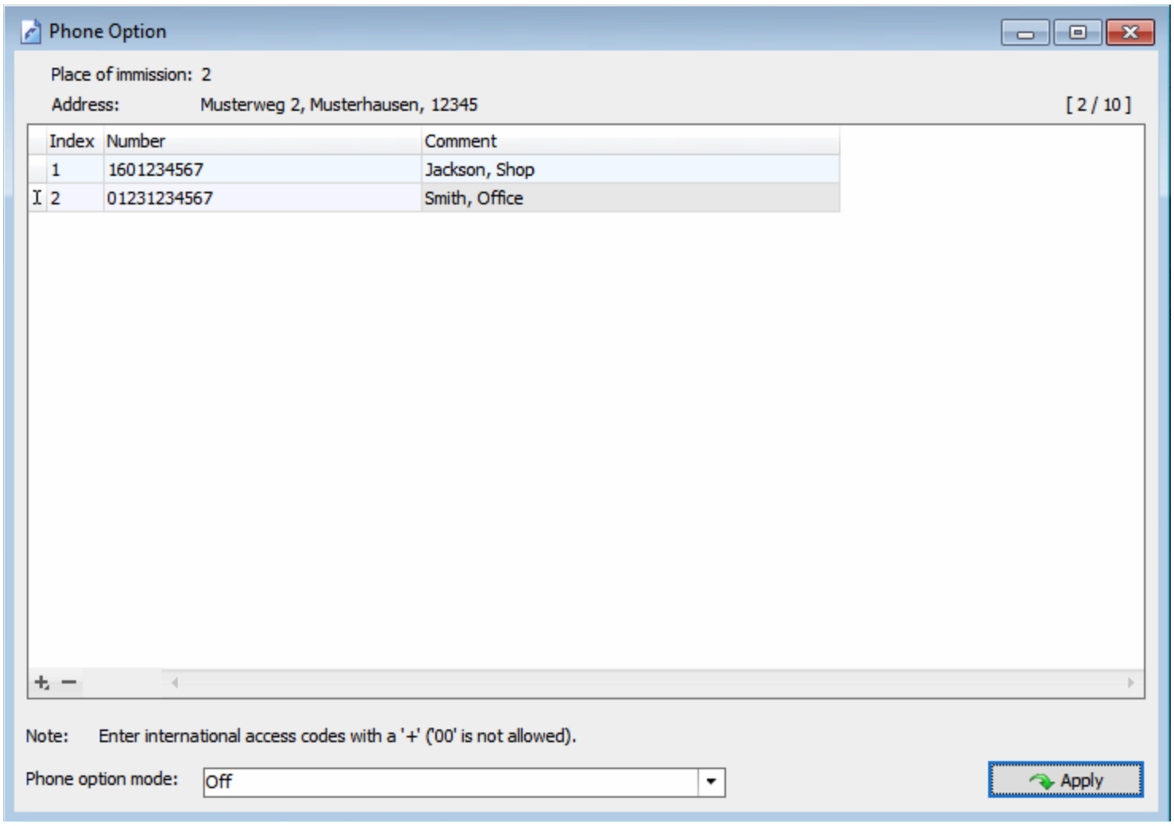
See also Practical example 1: Set up a new WTG with a new POI 29

4.2.3.4 Phone Option sub window

Purpose	Define phone numbers from which residents can shut down WTGs that currently cause shadow impact by dialing a special phone number.
Symbol	
Path	*Project > Places of Immission > Phone Option*
Window type	Divided horizontally
Type of use	Display + interactive
Reference	Project

For each place of immission, you can define up to 10 phone numbers from which residents can call to stop shadow impact at their place of immission. A connected modem will then forward the identified caller number to the SMU without answering the call.

A will immediately stop a WTG that causes shadows at this POI, even if no limit has yet been exceeded. On the following day this function is switched off again and must be reactivated by a new call if necessary. Several WTGs in the vicinity of the place of mission may be shut down immediately after a call has been made.



Phone Option window

You will find a detailed description of this window in the following table.

Element	Explanation/function
Place of immission	Displays the number of the place of immission selected in the **Places of Immission** window.
Address	Displays the number of the address selected in the **Places of Immission** window. The number of telephone numbers already added (up to 10 are possible) is displayed in square brackets on the right-hand side.
+ –	To add a phone number, click on the **+** character (bottom left); to remove a phone number, select the phone number to be removed and then click on the **-** character (also bottom left).
Index	Sequential number
Number	Enter the phone number. **NOTE:** Enter international area codes with a “+” (00 is not allowed).
Comment	Free text field in which you may enter the name of the subscriber, for example.
Phone option mode	The following 5 options are provided here: **Off** The Phone option is switched off for this POI, none of the subscribers can prevent shadow impact via telephone. **Phone call, consider light sensor, ignore counter** A WTG that causes shadow impact will only be stopped if a subscriber has called. The entered limit values do not apply in this mode. **Phone call, consider light sensor, consider counter** A WTG causing shadow impact is stopped if (a) one of the defined limit values is exceeded and/or (b) a subscriber has called. **Phone call, ignore light sensor, ignore counter** If a subscriber calls, the WTG is switched off, provided that shadow impact is mathematically possible. Whether or not the sun actually shines is not taken into account if you select this option. **Phone call, ignore light sensor, consider counter** A WTG causing shadow impact is stopped if (a) one of the defined limit values is exceeded and/or (b) a subscriber has called. Whether or not the sun actually shines is not taken into account if you select this option.

4.2.3.5 POI Combinations sub window

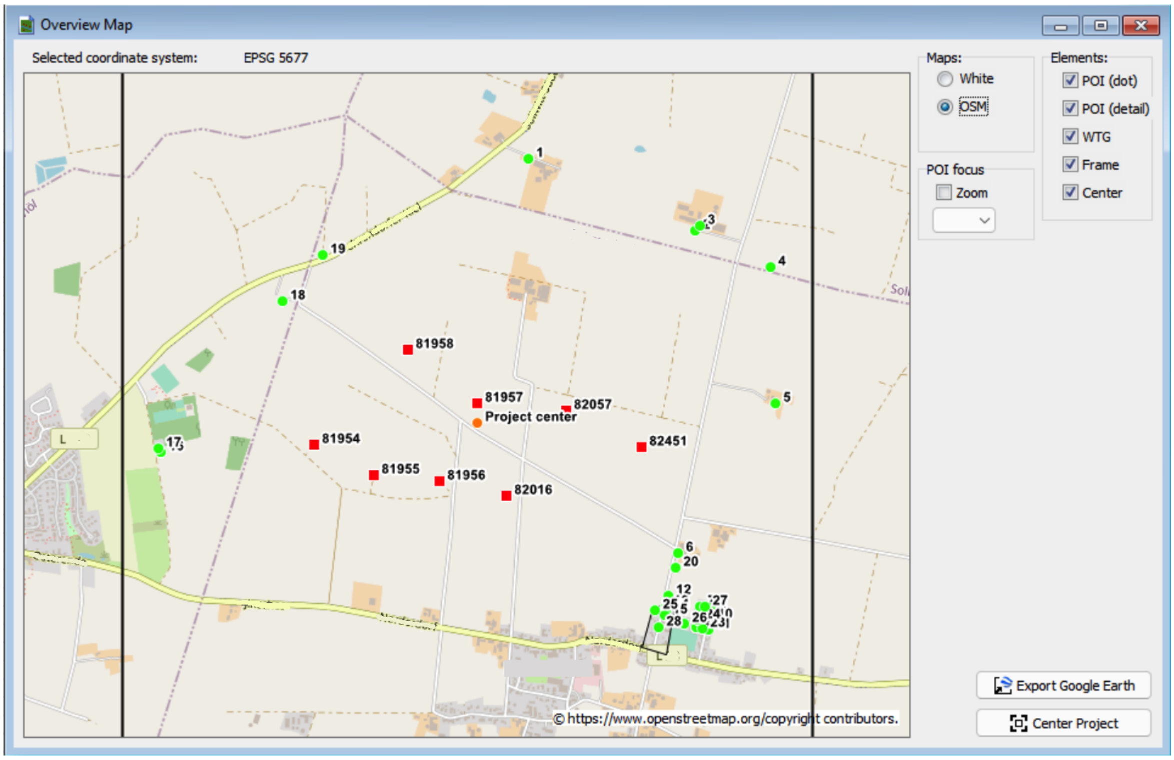
Purpose	Define/change direct relationships between the POI selected in the **Places of Immission** window and each WTG for the purpose of yield optimization
Symbol	
Path	*Project > Places of immission > Combinations*
Type of use	Interactive + Wizard
Reference	POI

Just like the **Wind Turbine Generators** window, the **Places of Immission** window also provides a **Combinations** button. When you click on this button, the **POI Combinations** window opens; the operation of this window basically corresponds to the **WTG Combinations** window except that here you are dealing with relationships from the 'viewpoint' of a place of immission instead of a WTG. Therefore, you can find more information on this window under **WTG Combinations sub window** 101.

4.2.4 Overview Map window

Purpose	Visually check whether WTGs, POIs as well as walls and areas have been defined correctly
Symbol	
Path	*Project > Overview Map*
Type of use	Display + interactive
Reference	Entire project

You can open an overview map to visually check the defined locations of WTGs, POIs as well as the defined walls and areas. It is also possible to export the data to Google Earth.



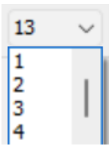
Overview map window several POIs (green dots) and WTGs (red squares)

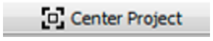
Notes regarding the Overview Map window

- Click on the map and use the mouse wheel/touchpad or press the plus (+) or minus (-) key to zoom in or out.
- To move the map, hold down the left mouse button and drag the map in the desired direction or use the arrow keys on the keyboard.

- If you zoom in strongly on the map and have selected the POI (detail) option, you can also see the defined walls and areas. The small rectangular line on walls indicates their orientation.

The information, options or buttons are described in the following table

Element	Explanation
Selected Coordinate System	Displays the coordinate system selected in the **Project Data** window for **Coordinate format**.
Cards	
White	Background is white.
OSM	Open Street Map will appear in the background. **NOTE** The computer must be connected to the internet to use the OSM.
POI focus	
Zoom 	If the **Zoom** option field has been activated, you can use the dropdown list underneath to select a POI number which will then become the center of the map.
Elements	
POI (dot)	Used to show/hide defined places of immission. Defined POIs are displayed as green dots.
POIs (detail)	Used to show/hide defined walls and areas. Defined walls and areas are displayed as black lines. The view needs to be greatly enlarged to be able to detect them. The small rectangular line on walls indicates their orientation.
WTG	Used to show/hide defined wind turbine generators. Defined WTGs are displayed as red squares.
Frame	Used to show/hide a black frame.
Center	If you click on this button, the map section is moved so that the project center is displayed in the middle of the map. The project center, i.e. the center of the WTGs according to the longitude and latitude specified in the **Project data** window, is displayed as an orange circle. It is calculated automatically.
	Exports the data as a kml file that can be opened in Google Earth. When you open the kml file with Google Earth, the WTGs and the POIs are also represented there by red squares or green dots.

Element	Explanation
	If you click on a WTG in Google Earth, a window with data relating to the respective WTG (type, meters above sea level, hub height, etc.) will be displayed. If you click on a POI in Google Earth, a window with data relating to the respective POI (address, building type, max. load, etc.) will be displayed. Using the Google Earth functions, you can also zoom in so far that you can identify e.g. the walls and areas defined for a POI.
	Moves the map view so that the center of the WTGs is displayed in the center of the window.

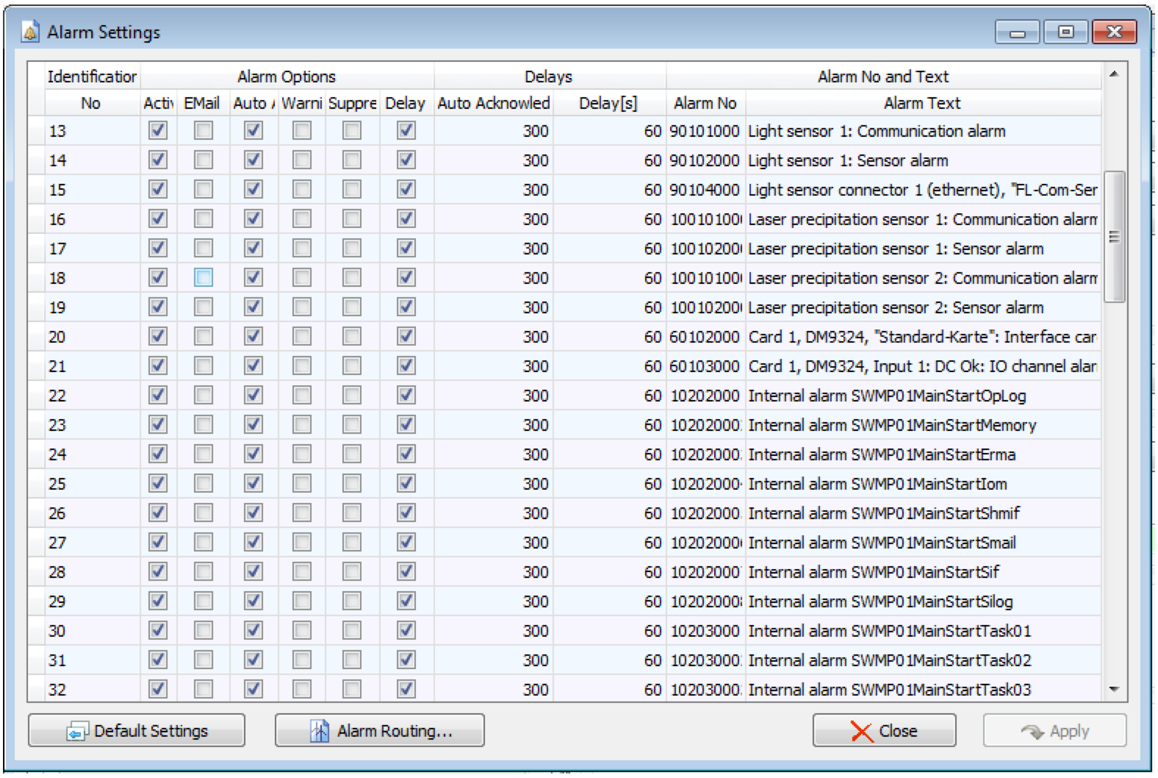
See also Practical example 2: Visually check the position of POIs and WTGs 31

4.2.5 Alarm Settings window

Purpose	Specify when alarms are initiated for what components
Symbol	
Path	*Project > Alarm Settings*
Type of use	Display + interactive
Reference	Entire project

In this window you specify the way in which alarms are initiated for which components. All possible alarms have been pre-defined: you may edit these, but you cannot add alarms.

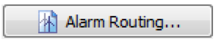
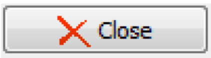
Perform edits directly in the list of alarms (there is no editor here). After changing an alarm, click on **Apply** to apply the changes.



Alarm Settings window (section)

The information, options or buttons are described in the following table

Element	Explanation
Identification	
No.	Consecutive number for the alarm
Alarm options	
Active	All alarms are active by default. It is possible to deactivate each alarm individually by removing the checkmark in this column. **EXAMPLE** If it is known in advance that a WTG does not react to a stop command, it may be helpful to deactivate this alarm until the respective error has been remedied. **NOTE** If this option is not checked, the alarm will continue to be displayed and logged as soon as it occurs. However, **no** notification will be sent via email and it will not be transferred to the WTG.
EMail	If this option is checked, a corresponding message will be sent to the person specified in **Project Settings** (*Project > Project Settings > Email recipient settings*) for each alarm.
Auto acknowledge	If this option is checked, the respective alarm will be automatically reset after the error has been remedied.
Warning	By activating this box, you can classify a specific event that requires no immediate action as a warning (the watchdog will continue to be controlled, however, there will be no transmission to the WTG). Whether and to whom an email warning notification will be sent can be specified in the **Project Settings** (*Project > Project Settings > Email recipient settings*).
Suppress	If this option is checked, the alarm will be ignored. This means that it will not be displayed or logged, and no message will be sent to an external destination – it will be completely ignored.
Delay	The values of the two subsequent columns (Reset Autom.[s], Delay[s]) are activated/deactivated in this column, provided values have been entered there.
Delays	
Auto Acknowledge [s]	If a check mark has been placed in the **Auto Acknowledge** column, you can specify a period in seconds by which the automatic reset is delayed.
Delay[s]	If an alarm should not be triggered as soon as it occurs but only after a certain period has elapsed, you can enter the desired delay (in seconds) here.
Alarm number and text	

Element	Explanation
Alarm No	Automatically generated number that is also displayed in the log.
Alarm Text	Automatically generated text that is also displayed in the log.
	The default settings of the **Alarm Settings** window can be found in Appendix I.
	Use this button to open the **Alarm routing to WTG** settings window for the alarm marked in the **Alarm Settings** Window. This is not relevant for all WTG types. This is only relevant for WTG types the SMU communicates with directly. In this case, you can set which alarms are to be forwarded to which WTGs. This is particularly useful if an alarm is received by the SMU that triggers an action of the WTG (e.g., stop during night time because the bat shut-down feature is active then). During this time, non-relevant alarms, such as the fault of a sensor not assigned to this WTG or errors in the communication with another WTG, should not be forwarded. Relevant WTG types: 200xx, 300xx, 400xx, 2200xx, 6200xx, 19100xx To route the selected alarm (displayed above the list of WTGs in the **Alarm routing to WTG** setting window) to all WTGs, click on **... to all WTGs** (unless all WTGs are already selected in the **Alarm routing** column). To route the selected alarm only to specific WTGs, click on **... to no WTG** and select only certain WTGs individually in the **Alarm routing** column.
	If you click on **Close** without having clicked on **Apply** beforehand, the system will ask you whether you want to apply the changes.
	Confirms the entered/selected values.

4.2.6 Project Settings window

Purpose	Perform basic settings that apply to the entire project
Symbol	
Path	*Project > Settings*
Window type	Menu tree window
Type of use	Interactive
Reference	Project

You can perform basic settings that apply to the entire project in this window.

From the settings and information, SM4 later derives the data used to configure the SMU. It is therefore imperative that you observe the following warning notice:

! Pay particular attention when entering the following information in the Project Settings window:

- Port number(Server settings 151)
- Ethernet IP address, Ethernet net mask, Gateway, DNS server (Ethernet settings 152)

If incorrect information is entered here and transmitted to the SMU, the SMU will no longer be available, and a service technician will have to determine the IP address of the SMU on site.

You will find an explanation of the individual parameters and setting options in the following tables.

In the explanation for the parameters, you will find information on the default highlighted in green, where applicable and appropriate.

4.2.6.1 Project Settings window, SMU, Time settings

Summer winter time handling, summer winter time application

Parameter	Explanation
Global switchover	explained in detail in the software
Fixed usage	explained in detail in the software

NOTE

If you change this setting, the times defined in the project are **not** automatically adjusted..

Time synchronization, Time sync settings

NTP Settings (NTP = Network Time Protocol)

In this input area, you specify whether and how the internal system time of the SMU is synchronized. If synchronization is not performed, this will result in the internal system being imprecise and quickly lead to inaccurate shutdown times. In the previous version, synchronization was only possible via a request to the light sensor (with GPS). In the current version, synchronization can also take place via a request to an NTP server.

If an NTP server is used, the SMU must be available via an internet connection and the server data must be entered. If the system is only used for species conservation, using an NTP server means that it is not necessary to install a light sensor.

Parameter	Explanation
Synchronize system time	You specify here whether the system time should be synchronized.
Use NTP	You specify here whether synchronization should take place via NTP. If NTP is used, the SMU must be available via an internet connection. If a system is only used for bat shutdowns, for example, this makes the light sensor superfluous; whereas in the previous versions, synchronization was only possible via a request to the light sensor (with GPS).
NTP server 1–10	If NTP is used, you need to enter at least one NTP server address here.
Repetitions NTP request	The SMU sends a request to the registered NTP servers, one after the other. If all requests are unsuccessful, it starts, after the **Delay until next NTP request**, again with the first NTP server, etc. After X (here set number) unsuccessful “request rounds”, the request process will be aborted, and a new attempt will only take place the next day. Default: 3

Parameter	Explanation
Delay until next NTP request	see above Default: 300 s
Error after X day(s) without synchronization	Specifies after how many days without synchronization an alarm is generated. Default: 7 days
Use time of synchronization	If a checkmark is set here, synchronization always takes place at 00:00 hours (midnight, local time)
Time of synchronization	If a checkmark is set here, synchronization only takes place at the time set here (local time). Default: 00:00:00
Use light sensor	If a checkmark is set here, synchronization always takes place via the GPS module of the light sensor.
Use climate sensor	If a checkmark is set here, synchronization always takes place via the GPS module of a climate sensor.
Use daylight savings time/ winter time	This is deactivated for countries that do not have daylight savings time.

4.2.6.2 Fenster Projekt-Einstellungen, SMU, Server-Einstellungen

Settings for the connection between SM4 and the SMU are defined here.

! Pay particular attention when entering the **Port No.**: If incorrect information is entered here and transmitted to the SMU, the SMU will no longer be available, and a service technician will have to find out the port number of the SMU on site.

Parameter	Explanation
Server settings	
Timeout	The only way for SM4 and the SMU to reliably determine whether the connection between them still exists is based on "life signs" from their connection partner. A possible "life sign" may be traffic between the two, such as when a Live Data window regularly retrieves data from the SMU. If the SMU receives neither a data command nor a ping command from SM4 for the period specified here, the SMU will recognize that its connection to SM4 has been lost. Now it will change its connectivity from **Busy** to **Ready for connection**. Default: 30000 ms **NOTE:** This parameter must match the **Login refresh interval** (*File> Settings> General > Communication parameters*) that controls the interval at which **SM4** sends a ping command. The value on the SMU side (**Session timeout**) must be higher than the value on the SM4 side (**Login refresh interval**) to ensure that SM4 sends before the SMU assumes that the connection has been interrupted.
Port No	You specify the port number of the SMU server here. Default: 60200 **NOTE:** The port number and the IP address need to be entered into the **Connect** window to establish a connection to the SMU.
Special Shutdown Interface	
Timeout	The special shutdown interface is used, among other things, to set the external triggers (see Glossary 371) on the SMU. If the interface receives neither a data command nor a ping command from SM4, the connection will be closed. Default: 30000 ms
Port No	Here you define the port number of the SMU behind which the functionalities of the special shutdown interface are located. Default: 60300
Interface active	Place a check mark here to activate the interface.

4.2.6.3 Project Settings window, SMU, Server settings

Settings for the connection between SM4 and the SMU are defined here. The control unit has 2 physical network connections, with only one being used as a rule.

To be able to establish an online connection to the SMU, the following settings must match that of the SMU: **Ethernet IP address**, **Ethernet net mask**, **Gateway**, **DNS server and Port number (see above).**

> ! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

Input for all addresses: 4 integers from 0 to 255 separated by periods

Example: 192168044201

Parameter	Explanation
Ethernet IP address	You specify the IP address of the SMU server here. **NOTE** The port number and the IP address need to be entered into the **Connect** window to establish a connection to the SMU.
Ethernet net mask	You specify the network mask of the SMU server here.
PowerLink IP address **PowerLink net mask**	The **PowerLink IP address** and **PowerLink net mask** fields relate to the second physical network connection of the SMU. There are two options: 1. Use it to retrieve data from POI modules (analog/digital inputs and outputs) **EXAMPLE** The cabinet is located at the base of the tower, some POI modules are not installed on a DIN rail in the cabinet but, instead, installed in the nacelle. These are fitted with a network module, which can be queried via the Powerlink port. 2. Use it as a second network port In this case, the **PowerLink interface in Ethernet mode** checkmark must be checked below. This makes it possible to set up a second network with its own IP address. It is important that both networks are separate from one another physically.
Gateway	The term gateway (GW) refers to hardware and software used to connect non-compliant networks, that work with different network protocols, to each other. As a rule, the address corresponds to the IP address of the router.

Parameter	Explanation
DNS server	The Domain Name System (DNS) primarily responds to name resolution requests. As a rule, the address is identical with that of the gateway.
Host name	Freely selectable host name (of the SMU) for the own computer component that will be displayed instead of the IP address.
PowerLink interface in Ethernet mode	Set a checkmark here if the Powerlink port should be used as a second network port, see above.

4.2.6.4 Project Settings window, SMU, Email settings

The access data of an email provider must be entered here and stored in the SMU to automatically send emails (e.g., in the case of alarms and/or other warnings) through the SMU.

NOTES

- The transmission of emails only works if a provider is entered here that still supports unencrypted transmission.
- E-mails are only sent if this has been activated in the Alarm Settings window 145.

Parameter	Explanation
Server name	Provider's outgoing email server
Email user	User name as stored with the provider
Email password	Password as stored with the provider
Sender nameFreely selectable (example:	SMU_serial_number_project_name)
Domain name	e.g. gmx.de
Timeout	The SMU attempts to make contact to the email server for x seconds. Default: 30 s
Port No	Port number of the outgoing email server (as made available by the provider)
Delay after sending	The SMU summarizes several alarms and/or notifications that belong to a fault in one email. After sending such an email, the SMU waits for the number of seconds specified here before it sends the next one. What notifications should be sent is specified under **Email recipient settings**; see the next table. Default: 60 s
Use SMTPS	Specifies whether the SMTPS (Simple Mail Transfer Protocol Secure) is used to secure e-mail communication via SMTP using SSL/TLS.

4.2.6.5 Project Settings window, SMU, Email recipient settings

Error messages (alarms), Warnings, and Other emails can be automatically sent by the SMU as an email. You can define 10 recipient email addresses for this and specify whether they should be sent either **Alarms** and/or **Warnings** and/or **Other Emails**.

Parameter	Explanation
Receiver	Enter a valid email address here.
Alarms	Set a checkmark here if Alarms should be sent to the recipient address. **NOTE** E-mails are only sent if this has been activated in the Alarm Settings window 145.
Warnings	Set a checkmark here if **Warnings** should be sent to the recipient address. Warnings are a kind of alarms (seeAlarm Settings window) 145.
Other	If you set a check mark at **Other** for a recipient, this recipient will receive all e-mail messages defined in the **Other Emails** window (*Switching & Measurement > Email*) (provided that the respective conditions are met).
Subject for alarm/ warn/ other mails	If you enter $**PN** or $**SN** here, these strings will be replaced by the respective project name or serial number in the subject line of a sent e-mail.
After x minutes send email again	If you set a checkmark here, emails that were not sent successfully will be sent again after the number of minutes specified.

4.2.6.6 Project Settings window, SMU, Shadow impact calculation

You can specify the various basic settings for the shadow impact calculation here.

Parameter	Explanation
Rotor radius tolerance	If you are not sure whether the POIs of the project have been measured accurately, you can decrease/increase the WTG rotor to be on the safe side. **EXAMPLE** If this parameter is set to 5 % for an actual rotor diameter of 100 m, this will result in a calculated diameter of 105 m. Default: 0 %
Min. sun elevation	As soon as the sun sinks to the elevation set here, all shadow impact calculations will be stopped. Default: 3°
Min box to rotor angle	If the angle between the rotor and POI is zero degrees, disruptive flickering could still be perceived at the POI. This value ensures that the ellipse always has a minimum width to ensure that shutdown occurs in the case where the SMU assumes that shadow impact is not possible. Default: 5°
Add missed shadow impact periods to POIs after SMU start (assumption: worst-case scenario)	Checking this box has the following effects: If a system including the SMU has the power switched off for a specific period of time (e.g., due to a fault, deliberate shutdown etc.) and it is then started up again, the shadow impact that may have been caused by other WTGs monitored by this SMU will be recalculated and added to the budget. The calculation is carried out based on a worst-case scenario (sun shines, rotor is in a 90 °position with respect to the sun)

4.2.6.7 Project Settings window, SMU, Monitoring

You perform settings for the SMU hardware here.

Parameter	Explanation
Standard inputs and outputs	
Use "DC present"	You set a checkmark here if the SMU does **not** have a puffer module installed for the power supply. The CPU of the SMU monitors its own power supply. If there is a power cut, the system is shut down in safe mode, without saving the last events. Log entries may be lost, meaning that, for example, there is no longer a log entry regarding the power cut.
Use "DC OK"	You set a checkmark here if the SMU is provided with a puffer module (normal case). The CPU of the SMU monitors its own power supply. In the case of a power cut, the CPU can draw power from a puffer module for 2 to 3 seconds in order to complete saving processes and shut down in safe mode to ensure that no data or data structures are destroyed. Moreover, all log entries can be carried out.
Use "Watchdog output"	This option is activated if the WTG type has a watchdog (see Glossary 371).
Use "Watchdog input"	This option is activated if the watchdog function should be monitored by the SMU.
Use "Modem reset"	If you check this box, you enable the use of an additional digital output signal, see Phone Option window 274. Prerequisites for using the signal: • assignment to an output of a DO card • wiring of the DO to the reset input of the modem
Watchdog	
Monitor watchdog	It only makes sense to activate this option if the **Use "Watchdog input"** above is also activated. If this is the case, a test is performed to ensure the watchdog relay is operating for additional security.
On duration **Off duration**	Set here how often the watchdog is controlled. At a value of 10000 ms (pre-setting), the output of the control switches to high for a corresponding period and then to low for exactly the same length of time. If the change between high/low is not carried out, the voltage to the watchdog relay drops and it is apparent that the control is faulty. Default: 10000 ms

4.2.6.8 Project Settings window, SMU, Additional hardware

Select here which component should be used by the Phone option.

NOTE

The Phone option is supported from SMU version 4.2.15 and higher.

Parameter	Explanation
Use GSM modem (RS232)	Only the GSM modem can be selected at this time.
Use Profinet card	The Profinet card is only used in connection with the WTG type “Nordex Profinet Type01”.

4.2.6.9 Project Settings window SMU, Customer Interface

The SMU customer interface is a read-only interface that is used to read out the status of the SMU, the cause of shutdowns, and measured values. The interface is designed as a switchable ModBus TCP interface. The port can be set here.

If you are interested in the customer interface, please contact NorthTec.

Parameter	Explanation
Use interface	Default: not activated
Port	Here you set the port number of the SMU server.

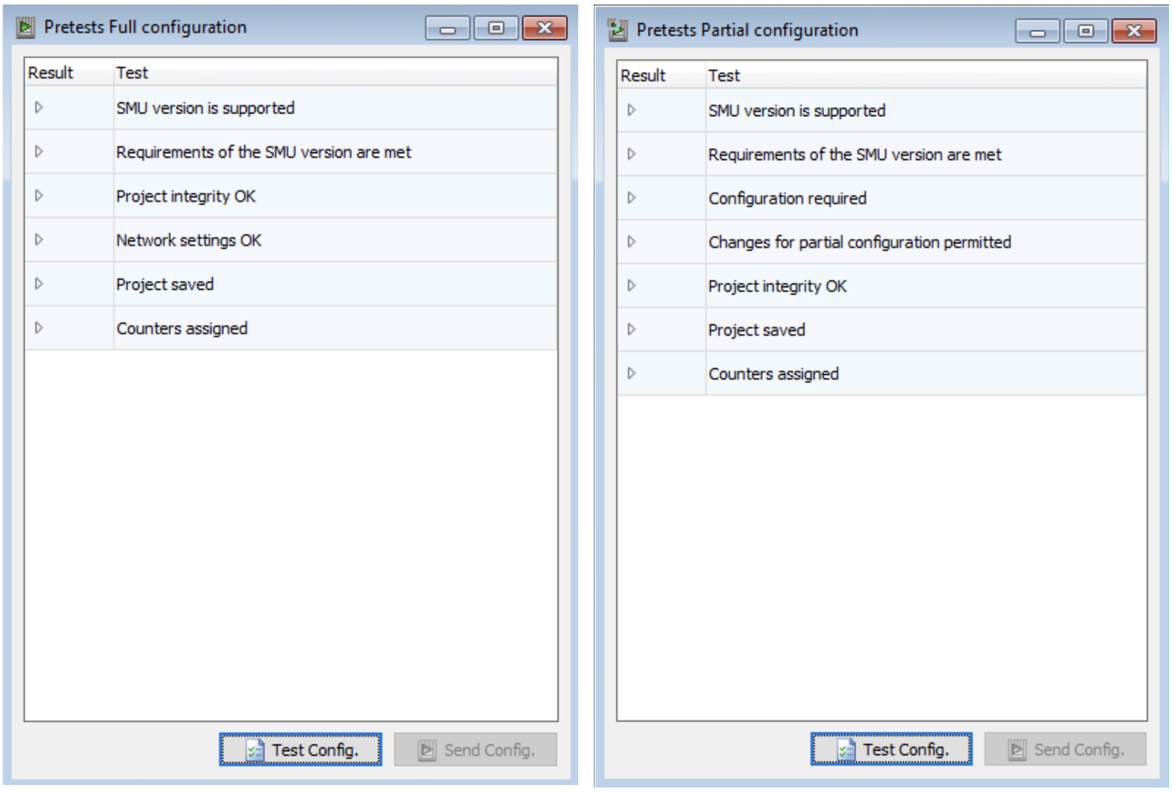
4.2.7 Configuration / Partial configuration

Purpose	• Check the configuration of pending tasks • Send the configuration to the SMU • Verify the configuration of the SMU
Symbol	
Path	*Project > Configuration / Partial Configuration*
Right group	Project configuration
Prerequisites	Online connection to the SMU; Partial configuration requires SMU 4.2.50 or later
Type of use	Display + interactive
Reference	Project

1. **Configuration**
   All data of the project is sent to the SMU; then the SMU is restarted. This process can take a long time, and especially the restart of the SMU can cause some wind parks to switch to emergency mode and stop all WTGs.

2. **Partial configuration**
   Only the differences between the configuration running on the SMU and the project currently opened in SM4 will be transferred to the SMU if you choose this option. This method is faster and also often doesn't require a SMU restart; SM4 remains connected to the SMU, and you can continue to edit the project in the current session. See also the info boxes on Storing the project file on the SMU 165 and Live data windows 165 at the end of this chapter.

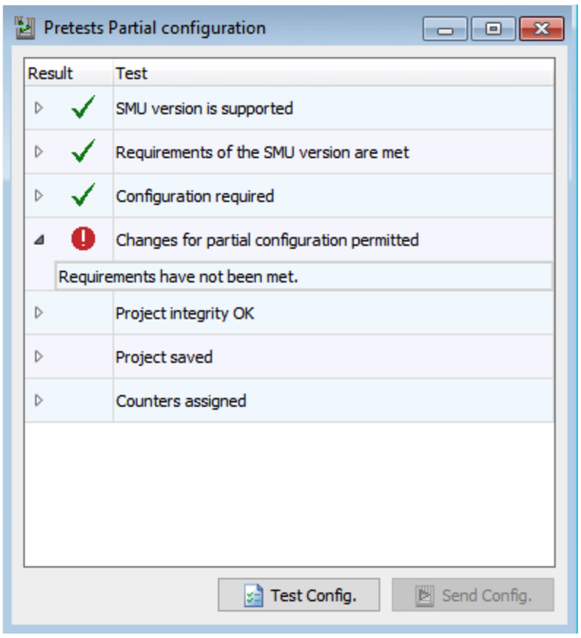
Once you select *Project > Configuration / Partial configuration*, one of the windows shown below will open – a preliminary stage of the actual configuration. This window lists a number of conditions that must be met before the configuration can be started. See the following example windows:

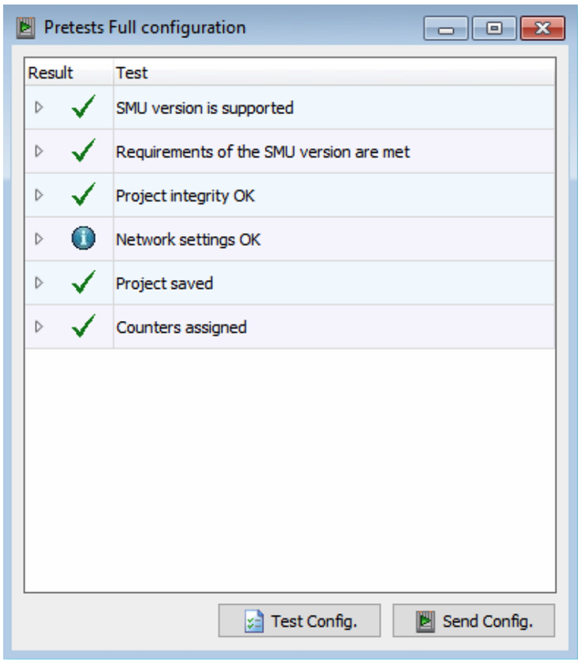


Pretests Full / Partial Configuration windows

Procedure

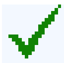
To check the current project, click on **Test Config.** in the respective pre-test window. The system will now check whether the conditions listed in each case are met for the project. If not all conditions are met, the window may then look like one of the following screenshots:





Pretests windows (after clicking on **Test Config.**)

Explanation of the symbols in the examples above



A green check mark always means that the respective conditions are already met – no need for action.

An exclamation mark means that an essential condition is not met: you must make a change in the project, or, in some cases, you must carry out a full configuration instead of a partial configuration.

The screenshot on the **left** above shows that a partial configuration is not allowed; one or more of the following reasons may be the cause:

- SMU version is older than 4.2.50.
- Hardware changes have been made, e.g., IO boards have been added to the SMU or you have defined digital inputs or outputs.
- The IP address of the Shadow Manager Interface has changed.

In all 3 cases, you must perform a **full** configuration instead of a partial configuration.

An info icon means that a detected difference has already been confirmed. In the screenshot on the **right** above, you can see that different network settings have been detected and the user has already answered **Yes** to the corresponding query.

An explanation of all elements in the pre-test window (full / partial configuration) can be found in the following table

Element	Explanation
SMU version is supported	Checks whether the SMU version to which a connection has been made is higher than the lowest supported version.
Requirements of the SMU version are met	There are SMU versions that do not yet support specific functions and features in the project. The Phone option, for example, or specific WTG types are not supported in older SMU versions. If these functions or features are not used in the current project, the configuration can be transferred to SMU. Otherwise the transfer will be rejected.
Configuration required	This is a check to determine whether or not there are differences between the configuration running on the SMU and the project loaded in SM4.
Changes for partial configuration permitted	This is a check that a partial configuration is allowed. The following conditions must be met • No hardware changes have been made (e.g. equipping the SMU with IO cards or defining digital inputs or outputs). • The IP address of the Shadow Manager Interface has **not** changed. • In addition, a SMU 4.2.50 or a later version must be used. If one of these conditions is not met, you must carry out a full configuration.
Network settings OK	The network settings required to establish a connection to the SMU are part of the project. Before starting a configuration, the system ensures that the relevant network settings (**Port No**, **Ethernet IP address**, **Ethernet net mask**, **PowerLink IP address**, **PowerLink-IP netmask**, **Gateway**) match the settings of the SMU to which a connection has been established. If differences are found, you will be asked if you want to apply the changes to the network settings. If you answer **No** to this dialog, you can click on the small arrow to the left of the condition to expand a record that shows the set data one below the other, as shown in the following **Ethernet address** example: Ethernet IP address Project: 172.027.002.021 SMU : 172.027.001.150 You now have two options: 1. You can click on **Test config.** again, only this time you accept the settings. During the configuration process, the Ethernet address entered in the project is now transferred to the SMU and stored there. After the configuration, the SMU will no longer be accessible under the current Ethernet address of the current connection (172.027.002.021), but will receive the new address (172.027.002.150). Select this option if you want to **change the Ethernet address of the SMU**. 2. You open the area in the **Application Settings** window where you can change the Ethernet settings of the project. The reason why

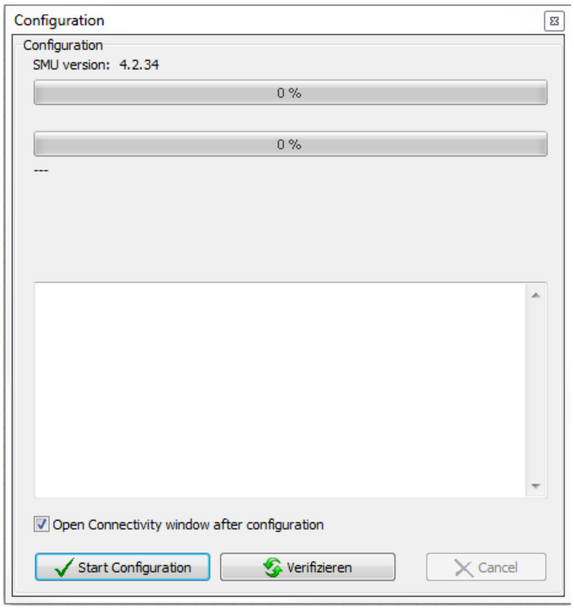
Element	Explanation
	the Ethernet address in the project is different from that used on the SMU can be, for example, that you copied a project from another user and you only changed the shadow impact scenario (you forgot to change the Ethernet address). This option allows you to correct (at the last minute) the Ethernet address of the SMU stored in the project while you are already connected to it for configuration purposes. Choose this option if you want to **change the Ethernet address of the project**. If the info icon is displayed here, then different IP addresses have been identified, and the new IP address has already been confirmed with **Yes** in the dialog.
Project integrity OK	In Shadow Manager 4 (SM4), you can create a project or a project component (e.g. light sensor) even if not all the required parameters are known in order to prepare the project as far as possible. The following situations are conceivable: • creating a new project without an IP address being assigned for the SMU • adding a light sensor that is not yet connected to the hardware • defining a WTG that refers to sensors that do not yet exist However, an incomplete project may not be transferred to the SMU (configured). In order to check the project for integrity, go to *Project > Configuration / Partial Configuration* and then click on **Test Config.** All incomplete references will be detected and clearly displayed to the user. Starting the configuration is only possible if there are no longer any unresolved items.
Project saved	If the project from which the SMU configuration is derived was changed but has not yet been saved, this must be remedied here at the latest.
Counters assigned	For a description of this condition, please refer to the Assign Counter sub window 166 section.
Test Config.	Click on this button to test or retest the configuration. The results of the individual items will then be displayed on the left-hand edge of the window.
Send Config.	When all items are OK, click on this button to open the **Configuration** window.

Send the configuration

As soon as a green checkmark is displayed for all points in the **Pretest** window, the **Send Config** button is active, and you can send the configuration to the SMU as follows and then verify the process.

- Click on **Send Config.** in the **Pretests Full / Partial Configuration** window to open the **Configuration** window.
- Set a checkmark, if applicable, at **Open connectivity window after configuration** in the **Configuration** window.
- Click on **Start Configuration**.

The bar at the top of the **Configuration** window will display the progress of the readout of the current counter readings (if the assignment of the counter readings takes a long time, further shadow impact may have increased the counter readings). The second bar displays the progress of the configuration transfer, see following figure.



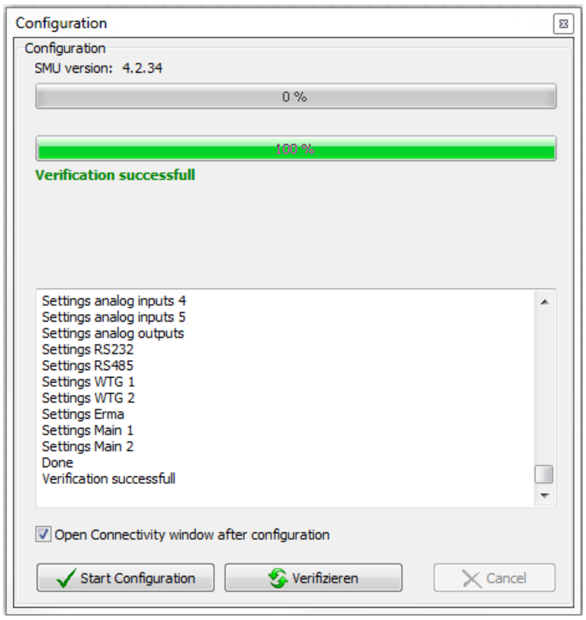
Configuration window

Verify the configuration

To make sure all data have been accepted by the SMU, you can compare the data on the SMU with the data in SM4:

- Click on **Verify** in the **Configuration** window.

If the configuration was sent successfully, this is indicated in the **Configuration** window as shown in the figure on the next page (or similar).



Configuration window (following verification)

Storing the project file on the SMU

At the end of a configuration, the project file must be stored on the SMU. In a full configuration, this is one of the last steps before logging out and restarting the SMU. In the case of a partial configuration, this time-consuming step may postponed, among other things because further partial configurations may follow. However, before logging off, the project file must be stored on the SMU; therefore this step will be carried out automatically at that point. Since the process is rather time-consuming, there is a progress indicator.

The fact that the transfer of the project file is still pending is indicated by an icon in the bar at the top of the SM4 main window:

 ... 

The icon changes from **inactive-gray** to **colored** after a partial configuration. You can click on it at any time to start the transfer manually and thus avoid the waiting time later when logging out. However, after another partial configuration you would have to upload the project again.

Live data windows (Realtime Data menu)

For the duration of a configuration process, the values displayed in the real-time data windows will not be updated.

4.2.7.1 Assign Counter sub window

Purpose	Manually assign counters that cannot be automatically assigned
Path	*Project > Configuration / Partial Configuration > Test Config.*
Right group	Project configuration
Prerequisites	Dongle, online connection to the SMU
Type of use	Display + interactive

In correspondence with the maximum number of configurable POIs, there are an identical number of counter registers on the SMU, which take on the role of daily and annual counters. These registers only exist on the SMU and are not a part of a dataset that belongs to a POI in the project because the content changes according to the shadow impact that occurs at the POI. The POI and the counter register are linked via the POI number – for example, the load times from POI 20 are registered in counter register 20.

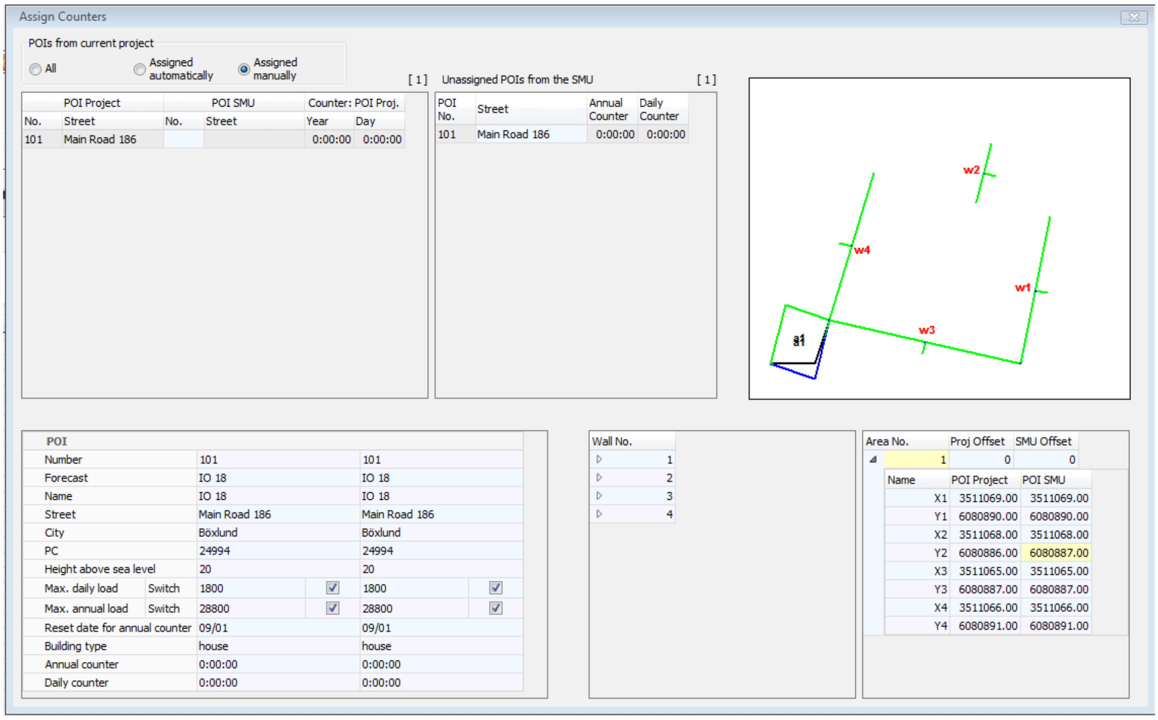
If the number of a POI is changed in a project, this would mean a correspondingly different counter would be addressed. This would also mean that the previous counter readings of the POI would be lost or, respectively, would be recorded to a different counter register. Due to the renumbering of the POIs, it is important to ensure that the counter readings are correspondingly ‘moved’ so that counting continues correctly and without any loss after the configuration.

It is only possible to determine if one or several POIs have been renumbered by comparing the project to be configured with the configuration currently running on the SMU. In the process, the SMU will attempt to “recognize” the corresponding POI on the SMU based on all the parameters of a POI in the project (name, designation, and also all walls and areas). If this is successful, the content of the associated counter can be automatically copied to the new counter position.

If an area, for example, is also changed in a project in addition to the number of a POI, the POI can no longer be identified on the SMU in this way, or at least not a 100 % correctly. In this case, the user must manually determine which (changed) POI in the project corresponds to the (previous) POI on the SMU. This manual assignment thus allows counter readings to be correctly transferred. The operation of this window will be described on the following, based on examples.

Example

You have clicked on **Test config**. in the **Pre-tests Full Configuration** or **Pre-tests Partial Configuration** window. A green checkmark is displayed in front of all conditions, only the last condition named **Counters assigned** is preceded by the info icon and the following window opens:



Assign Counters window (example)

While a green bar indicates the progress of the readout you can move the POIs, but the window cannot be closed.

Legend for the **Assign Counters** window

1 Depending on the option selected (**All**, **Assigned automatically**, etc.), the corresponding POIs of the opened project will be displayed here.

2 The POIs that could not be automatically assigned to the SMU will be displayed here. If nothing is displayed here, you can be sure that all POIs and/or counters have been correctly assigned. If you want to confirm the changes to the POI displayed here, move this POI to the POI with the same number in area **1** per drag & drop. **Note:** The drag & drop function only works here if you have selected the **Assigned manually** option above.

3 If a wall or an area has been changed for the POI selected under **1**, the changes will be represented graphically here. An area has been changed in the example above.
The **green-black** shape represents the “old” area, a square. The **green-blue** shape represents the “new” area, an irregular four-sided rectangle.

4 Comparison: The most important data of the POI selected under **1** is displayed in this table. The second column shows the data of the project currently opened in SM4, the third column the data of the project in the SMU.

5 If a wall of a POI selected under **1** is changed, the old and new offset values and coordinates are displayed here (as specified in the **Edit Walls and Areas** window). Changed coordinates are highlighted in yellow.

6 If an area of a POI selected under **1** is changed, the old and new offset values and coordinates are displayed here (as specified in the **Edit Walls and Areas** window). Changed values are highlighted in yellow.

7 If there are no coordinates displayed in **5** or **6** despite changed walls/areas, click on the small arrow to display them.

4.3 Hardware

The following table provides you with an overview of the **Hardware** menu.

Symbol	Menu item	Purpose
	Sensors and IO Signals 170	Define light sensors, hygro-thermo sensors, laser precipitation sensors and digital inputs and outputs (if deployed)
	Interface Cards 183	Define digital input properties
	Sensor Node Units 184	Define Sensor Node Units (SNU) - enhance the cyber security of wind farms
	Interface Connectors 187	Assign the individual sensors to the interface connectors
	Hardware Assignments 189	Assign required hardware to the various components

Click on a menu item to jump directly to more information.

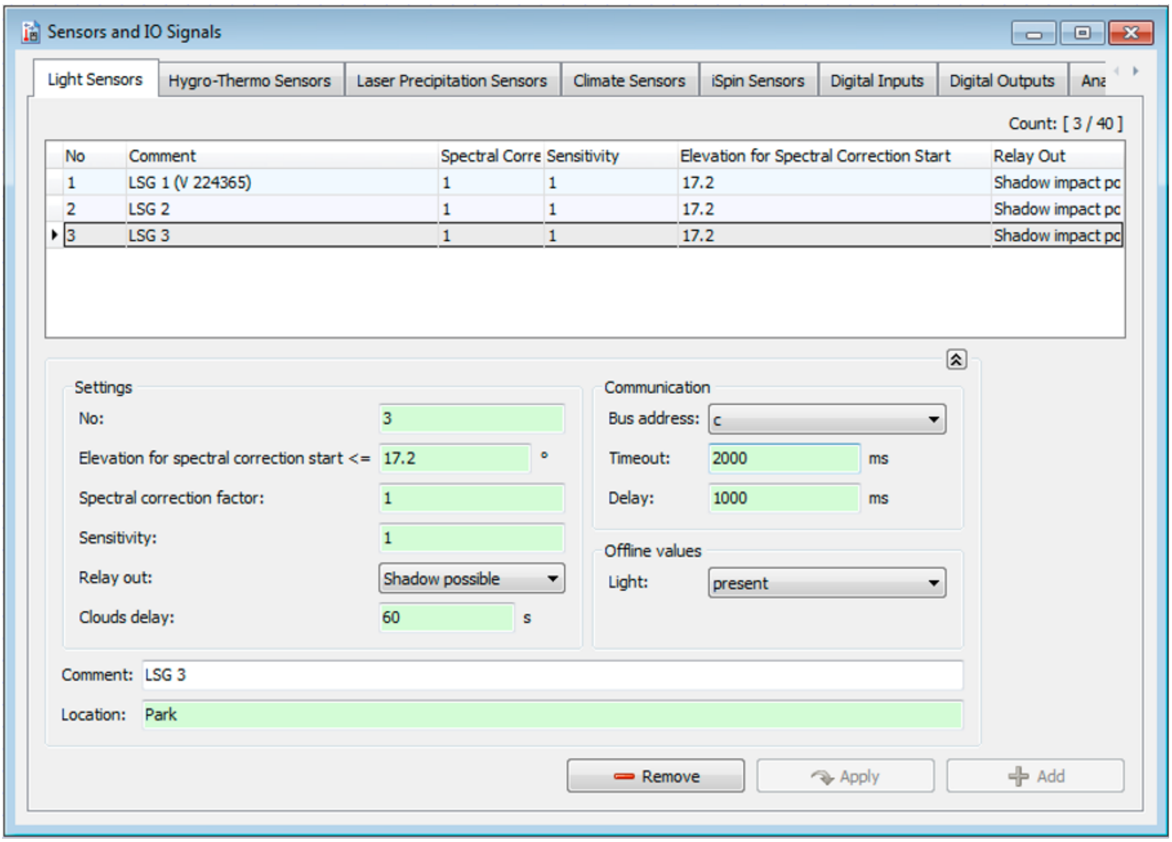
4.3.1 Sensors and IO Signals window

Purpose	Define light sensors, hygro-thermo sensors, laser precipitation sensors and digital inputs and outputs (if deployed)
Symbol	
Path	*Hardware > Sensors and IO Signals*
Window type	List window (with tabs)
Prerequisites	Can only be edited with a dongle
Type of use	Display + interactive
Reference	Project

The various sensors that can be integrated into the system for shadow impact monitoring and species conservation serve the following functions:

Sensor	Function
Light Sensor	Light Sensor This sensor measures whether or not shadow impact is possible and provides the SMU with a time signal (GPS).
Hygro-thermo sensor	This sensor measures the relative humidity and outside temperature. It is only used for species protection.
Laser precipitation sensor	This sensor measures the precipitation amount and optionally the outside temperature. It is also only used for species protection.
Climate sensor	This sensor can measure both humidity and precipitation amount, providing more flexibility when requirements change. In addition, the sensor collects climate data and provides the SMU with a time signal (GPS).
iSpin sensor	This sensor enables, for example, the monitoring and optimization of the performance of WTGs.
Visibility sensor	The main task of this sensor is to determine the visibility in the atmosphere.

The reading points of sensors can be used to formulate special and night slice shutdowns as well as for Single Data Recordings. They can also be entered as elements to be logged as events in the extended Special Shutdown Log. They report the alarms “Sensor error” and “Communication error”. If you have established an online connection to an SMU (*File > Connect*), you can display live data for each connected sensor.



Sensors and IO Signals window, displaying the **Light Sensors** tab (section)

NOTE

All fields of all tabs except for the **Comment** field the mandatory fields.

In the following sections, you will find a description of the tabs of the different sensors. In some cases, you will find helpful examples..

4.3.1.1 Light Sensors tab

The information, options or buttons are described in the following table

Parameter	Explanation
Settings	
No.	No. of the light sensor, 40 are possible
Elevation for spectral correction start	The percentage of red light in the color spectrum of sunlight increases when the sun is low. This thus also shifts the threshold level for direct intensity of illumination from when shadow impact effects can occur. Enter here from which sun elevation the spectral correction begins. Degrees (default: 17.2)
Spectral correction factor	Spectral correction can be reduced here (value less than 1) or, respectively, increased (value greater than 1) here. Value range: 0.8 to 2, default: 1
Sensitivity	The higher the set value here, the more sensitive the light sensor reacts. Value range: 0.8 to 2, default: 1
Relay out	• **Shadow possible** means that the relay output will switch as soon as the threshold limit of the light intensity (direct percentage of sunlight > 12,000 lux) is exceeded. • **Universal** means that the output can be switched to the light sensor by command (targeted control through the master unit). Default: Shadow Possible
Clouds delay	A time period is defined here that has to elapse before a change in condition from “shadow impact” to “no shadow impact” is taken into account. Hysteresis should not be set too low to ensure that the WTG does not restart too early if the weather is changeable (or in the case of small clouds). **NOTE:** When switching in the opposite direction (no shadow impact -> shadow impact) switching takes place immediately to fulfill the requirements of the authorities/residents. Input in seconds, default: 60 s
Communication	
Bus address	Address of the sensors on the RS485 bus a = master unit, remaining sensors = b, c, etc.

Parameter	Explanation
Timeout	Specifies the length of time that the master unit waits for a response from the sensor before it sends a request to the next sensor. This prevents a situation where if one sensor fails none of the other sensors are sent a request as only one sensor request can be executed at a time. Input in milliseconds, default 2000 ms
Delay	Set here how often the master should send requests. Input in milliseconds, default 250 ms
Offline Values The parameters of the **Offline values** area are used to define the values to be assumed by the SMU in cases when a sensor does not respond.	
Light	Set here the base values that the SMU should assume if the sensors do not respond. Select **available** here to prevent shadow impact periods being exceeded. If more than one light sensor is used in a wind park, it may make sense to select **not available** for one of the light sensors as it can “stand in for” the second in the case of a fault. available, not available
Comment	Enter any characters
Location	For the sake of clarity, enter the location of the light sensor (the WTG on which it is installed). Enter any characters

4.3.1.2 Hygro Thermo Sensors tab

The information, options or buttons are described in the following table

Parameter	Explanation
Settings	
No.	Hygro-thermo sensor No., 5 are possible
Offline Values The parameters of the **Offline values** area are used to define the values to be assumed by the SMU in cases when a sensor does not respond.	
Temperature	Set here the base values that the SMU should assume if the sensors do not respond. Input in °C, default 20 °C
Humidity	Set here the base values that the SMU should assume if the sensors do not respond. Input area 0 to 100 %, default 0 %
Communication	
Bus address	Address of the sensors on the RS485 bus 0, 1, 2 etc.
Timeout	Specifies the length of time that the master unit waits for a response from the sensor before it sends a request to the next sensor. This prevents a situation where if one sensor fails none of the other sensors are sent a request as only one sensor request can be executed at a time. Input in milliseconds, default 2000 ms
Delay	Set here how often the master should send requests. Input in milliseconds, default 250 ms
Comment	Enter any characters
Location	For the sake of clarity, enter here the location of the hygro-thermo sensor (the WTG on which it is installed). Enter any characters

4.3.1.3 Laser Precipitation Sensors tab

The information, options or buttons are described in the following table

Parameter	Explanation
Settings	
No.	Sequential No. of the laser precipitation sensor, 5 are possible
Threshold value	This is a general setting that can be used later when setting up special shutdowns for the “Precipitation yes/no” condition. **EXAMPLE** If the precipitation value entered here has been reached, the precipitation condition is considered to be fulfilled. Input in mm/h, default 0 mm/h
Offline Values The parameters of the **Offline values** area are used to define the values to be assumed by the SMU in cases when a sensor does not respond.	
Precipitation	Set here the base values that the SMU should assume if the sensors do not respond. available, not available
Temperature	Set here the base values that the SMU should assume if the sensors do not respond. Input in °C, default 20 °C
Communication	
Bus address	Address of the sensors on the RS485 bus 0, 1, 2 etc.
Timeout	Specifies the length of time that the master unit waits for a response from the sensor before it sends a request to the next sensor. This prevents a situation where if one sensor fails none of the other sensors are sent a request as only one sensor request can be executed at a time. Input in milliseconds, pre-setting 5000 ms
Delay	Set here how often the master should send requests. Input in milliseconds, pre-setting 900 ms
Comment	Enter any characters
Location	For the sake of clarity, enter the location of the laser precipitation sensor (the system in which it is installed). Enter any characters

4.3.1.4 Climate Sensors tab

The information, options or buttons are described in the following table

Parameter	Explanation
	Settings
No.	No. of the climate sensor, 5 are possible
Communication	
Bus address	Address of the sensors on the RS485 bus 0, 1, 2 etc.
Timeout	Specifies the length of time that the master unit waits for a response from the sensor before it sends a request to the next sensor. This prevents a situation where if one sensor fails none of the other sensors are sent a request as only one sensor request can be executed at a time. Default: 5000 ms
Delay	Set here how often the master should send requests. Default: 900 ms
Offline Values The parameters of the **Offline values** area are used to define the values to be assumed by the SMU in cases when a sensor does not respond.	
Temperature	Default: 20 °C
Rel. Humidity	Default: 0 %
Air pressure	Default: 1013.25 hPa
Dew point	Default: -10 °C
Synop 4680	Identifier for precipitation type (synoptically encoded); light drizzle, for example, has the Synop key 51. Default: 0
Precipitation	Default: Checkmark not set
Intensity	Default: 0 mm/h
Wind speed	Default: 0 m/s
Wind Direction	Default: 0 °

Parameter	Explanation
Comment	Enter any characters
Location	For the sake of clarity, enter the location of the climate sensor here (the WTG on which it is installed). Enter any characters
	Opens the **Multisensor parameters** window. There you can adjust the parameters of the sensor. A description of this window can be found in the following table.

Multisensor parameters sub window

In this sub window you can adjust the parameters of the climate sensor.

> ! Do not change the pre-set parameters of the climate sensor unless you have fully understood the functioning of the climate sensor. In case of doubt, be sure to consult the climate sensor's manual beforehand.

Parameter	Explanation
Averaging method	The averaging procedure for wind direction and wind speed can be selected here. With the scalar averaging method (default setting), the wind direction and wind speed are averaged independently of each other. However, in the vectorial averaging method, wind direction and wind speed depend on each other. This procedure should only be selected for specific applications. Default: Scalar
Averaging time	The averaging period for all measured values is set here. The averaging period is calculated from the set value multiplied by 100 ms. Moving averages are formed. Value range: 0 to 6000, default: 600
Brightness option	The total brightness can be determined by two methods. The **Brightest sensor** option used the highest measured value of an individual sensor. The **Vectorial sum** option determines the total brightness from the measured values of the adjacent brightness sensors with the highest brightness. Default: Brightest sensor
Bus termination	Here, a 120-ohm termination resistor can be switched on or off on the RS485 bus. Default: No (without termination resistor)
Timeout error	Here you can set the period of time after which a measured value is marked as invalid if there is an error in the reading. Value range: 10 to 60 s, default: 30 s

Response delay	After the climate sensor receives a request, the response is delayed by the time set here. An increased delay of the response is useful e.g. when using interface converters. Value range: 5 … 1000 ms, default: 5 ms
Time sync	Here, you can set whether and how time and date are to be synchronized using GPS information. Instead of the complete daily synchronization of time and date, it is possible to only have the second value or the second and minute values synchronized. Default: Complete
Min. heater voltage	If the supply voltage falls below the set value, the heating no longer switches on. Only when the voltage exceeds the set value by 2 volts does the heating become active again. Value range: 5 to 48, default: 10 V
Min. heater pwr.	Here the power with which the heating starts its operation is set in %. The heat output will then be controlled automatically depending on the current wind speed and temperature. Value range: 0 to 100 %, default: 10 %
Heater	This is where the operating mode of the heating is set. Switching off the heating is not recommended. Default: On at below 5 °C
Height measurement	The station height can be determined from the GPS information. This function can be activated and set here. The station height can be extracted from the GPS information as an instantaneous value or as a 14-day average value. A determined 14-day average value can be stored permanently or determined anew after each restart of the climate sensor. Default: 14 days GPS-Ø, sets default
Station height	If the determination of the station height by the GPS information is not active, the station height can be specified here. Value range: 0 to 9000 m, default: 0 m
Measurement delay	This parameter sets the delay between two readings of the ultrasonic wind measurement. The value is calculated from the set value multiplied by 10 ms. Value range: 2 to 25, default: 2 10ms
Wind dir. correction	This parameter can be used to compensate for a misalignment of the climate sensor. If, for example, the climate sensor has not been aligned to the north (0°) but to the north-east (45°), the value 45 must be entered for correction. The input of a correction value is only necessary if the wind direction or the direction of the brightness is to be measured. If the value 1000° is set, the north correction is carried out via the compass correction. Value range: 0 to 359° /1000°, default: 1000 °
Wind speed units	Here you can set the desired unit of wind speed.

	Default: m/s
No of drops for rain	This is where the minimum number of drops is determined, which is used to detect the beginning of precipitation. Value range: 2 to 30, default: 16
Volume threshold per part	This parameter sets the threshold for the volume of a single precipitation particle. Precipitation particles with a smaller volume will be ignored. Value range: 100 to 600 µm, default: 260 µm
No of parts precip.	Here the minimum number of precipitation particles to detect precipitation is determined; only those particles are counted which are above the thres-hold value defined above (see **Volume threshold per partl.** above) AND which were detected within the last set period (see **Precip. time window** below). Value range: 1 to 15, default: 2
Precip. threshold	Here the threshold of the precipitation intensity for reporting precipitation is defined. If this threshold is exceeded, precipitation is reported. Value range: 1 to 200 µm/h, default: 10 µm/h
Precip. time window	Here you define the time window in which the set number of precipitation particles must be recorded before precipitation is reported. Value range: 10 to 60 s, default: 60 s
Compass correction	The magnetic compass correction adds a constant angle to the measured direction of the magnetic compass. Thus, a magnetic declination can be compensated. Value range: 0 to 359°, default: 0 °
Synop threshold	The lower precipitation intensity threshold from which a Synop key is output is defined here. Value range: 0 to 1000 µm/h, default: 0 µm/h
Default settings	Resets all parameters in this window to their default values, see above

4.3.1.5 iSpin Sensors tab

The information, options or buttons are described in the following table

Parameter	Explanation
Settings	
No.	No. of the iSpin sensor, 100 are possible
Offline Values The parameters of the **Offline values** area are used to define the values to be assumed by the SMU in cases when a sensor does not respond.	
Temperature	Input in °C, default 20 °C
Wind speed	Input in m/s, default 0 m/s
Rotor speed	Input in 1/min, default 3 1/min
Yaw angle	Angle between rotor axis and wind direction Input in °, default 0°
Communication	
IP address	In contrast to the other sensors, which are equipped with RS485 interfaces, the iSpin sensors only have an Ethernet interface. Instead of the connection via interface connectors, the IP address and port are specified directly at the iSpin sensor. 4 numbers, separated by a period, example: 192.0.2.42
Port	see above number from 1 to 65535
Bus address	Address of the sensors on the RS485 bus 0, 1, 2 etc.
Timeout	Specifies the length of time that the master unit waits for a response from the sensor before it sends a request to the next sensor. This prevents a situation where if one sensor fails none of the other sensors are sent a request as only one sensor request can be executed at a time. Input in milliseconds, default 1000 ms
Delay	Set here how often the master should send requests. Input in milliseconds, default 1000 ms
Comment	Enter any characters

Parameter	Explanation
Location	For the sake of clarity, enter here the location of the hygro-thermo sensor (the WTG on which it is installed). Enter any characters

4.3.1.6 Visibility Sensors tab

The information, options or buttons are described in the following table

Parameter	Explanation
Settings	
No.	No. of the visibility sensor, 5 are possible
Offline Values The parameters of the **Offline values** area are used to define the values to be assumed by the SMU in cases when a sensor does not respond.	
Visibility	Set here the base values that the SMU should assume if the sensors do not respond. Input in meter
Communication	
Bus address	Address of the sensors on the RS485 bus 0, 1, 2 etc.
Timeout	Specifies the length of time that the master unit waits for a response from the sensor before it sends a request to the next sensor. This prevents a situation where if one sensor fails none of the other sensors are sent a request as only one sensor request can be executed at a time. Input in milliseconds, pre-setting 5000 ms
Delay	Set here how often the master should send requests. Input in milliseconds, pre-setting 900 ms
Comment	Enter any characters
Location	For the sake of clarity, enter the location of the laser precipitation sensor (the system in which it is installed). Enter any characters

4.3.1.7 External Trigger tab

External triggers are, in simple terms, software versions of digital inputs. They were introduced in SM4 as a way of allowing users to control shutdowns or other processes externally in a convenient yet IT-safe manner (see **Glossary** 371).

Parameter	Explanation
No.	No. of the external trigger, max. 2500 are possible
Name	Enter any characters
Comment	Enter any characters

4.3.1.8 Tabs for Digital/Analog Inputs/Outputs

These tabs are not currently in use.

4.3.2 Interface Cards window

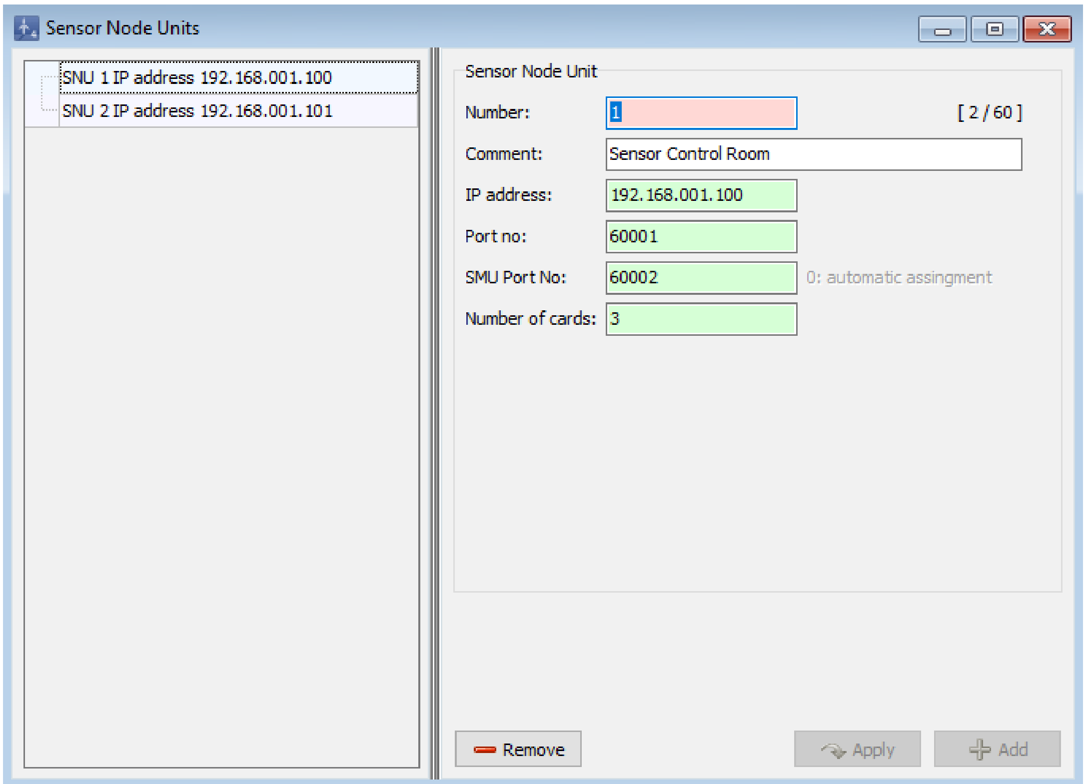
Purpose	Define digital input properties
Path	*Hardware > Interface Cards*
Window type	Divided vertically, see Vertically divided windows 21
Prerequisites	Can only be edited with a dongle
Type of use	Display + interactive
Reference	Project

Only the manufacturer is authorized to set up more interface cards and therefore this is not described here in more detail.

4.3.3 Sensor Node Unit window

Purpose	Define Sensor Node Units (SNU) - enhance the cyber security of wind farms
Path	*Hardware > Sensor Node Units*
Window type	Vertically split, see Vertically split windows 21
Requirements	Editing requires a dongle
Usage type	Display + dialog
Reference	Project

Sensor Node Units are stand-alone devices that are used to connect sensors. They can transmit the data from up to five RS485 buses via an IP network; several sensors can be connected to each bus. Communication between Sensor Node Units and an SMU is **encrypted**. Commands and responses from sensors, which are transmitted as "plain text", are tamper-proof thanks to Sensor Node Units and unreadable by unauthorized third parties or hacker attacks from the outside. This increases the cyber security of wind farms.



Fenster **Sensor Node Units**

Notes on the **Sensor Node Units** window

- For general instructions on working in vertically split windows, please refer to Vertically Split Windows 21.
- Each Sensor Node Unit can transmit data from up to 5 RS585 buses over an IP network.
- In the example window above, two of a possible 60 Sensor Node Units have been set up.

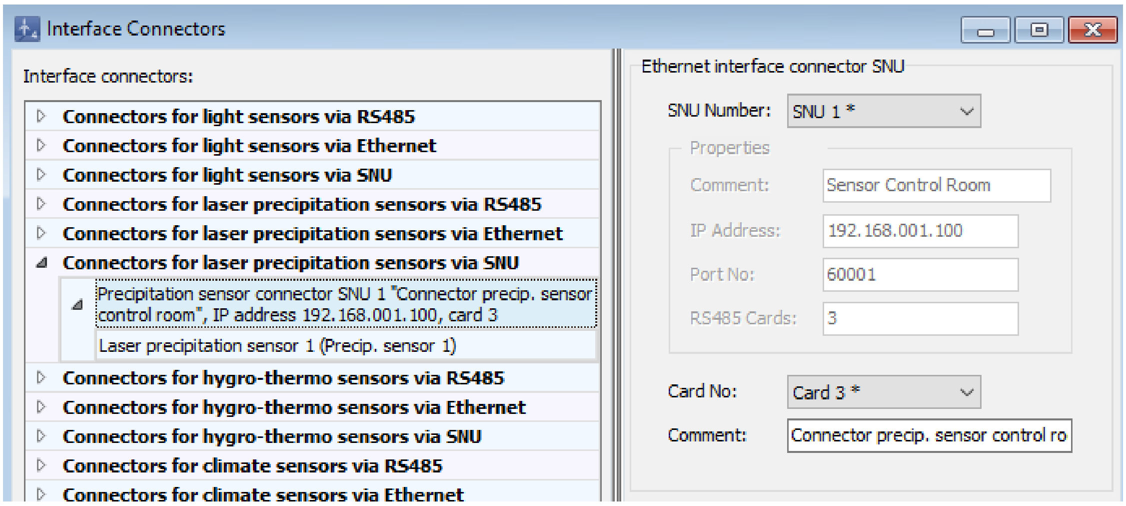
An explanation of the input fields (right half of the window) can be found in the following table

Field	Explanation/Function
Number	The number of the connection can be freely assigned in the range from 1 to 60 (only once) and is used later as a reference.
Comment	Free text input
IP address	Here you enter the value of the Sensor Node Unit that is addressed.
Port no.	Here you enter the value of the sensor node unit that is addressed.
SMU Port No	Enter the port number for responses to the SMU here.
Number of cards	Here you enter how many RS-485 cards are inserted in the respective Sensor Node Unit.

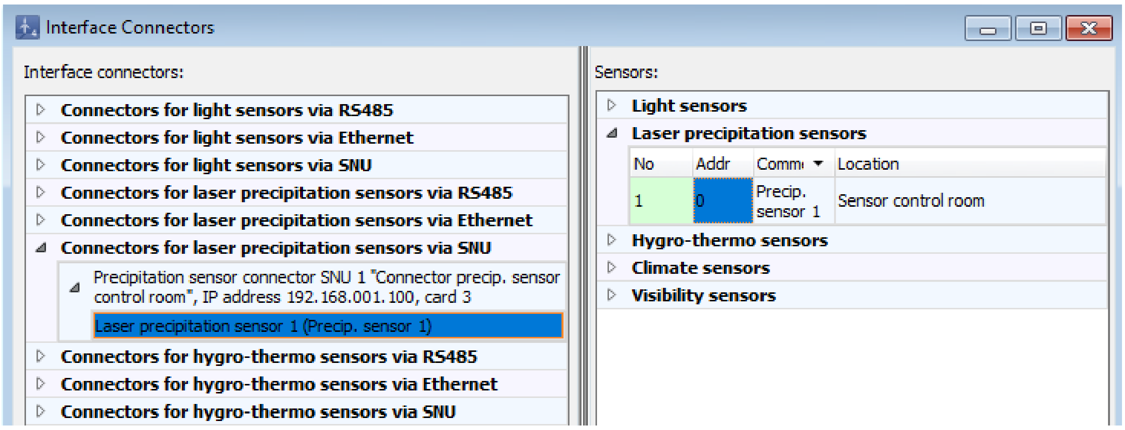
If you want to work with Sensor Node Units, perform the following tasks:

1. Set up a sensor note unit in the **Sensor Node Units** window: define the connection and the number of RS485 cards, see the table above.

2. In the **Interface Connector** window create a connector of the "via SNU" type for the desired sensor type (parameters: **SNU number** and **card No.**), see the following screenshot:



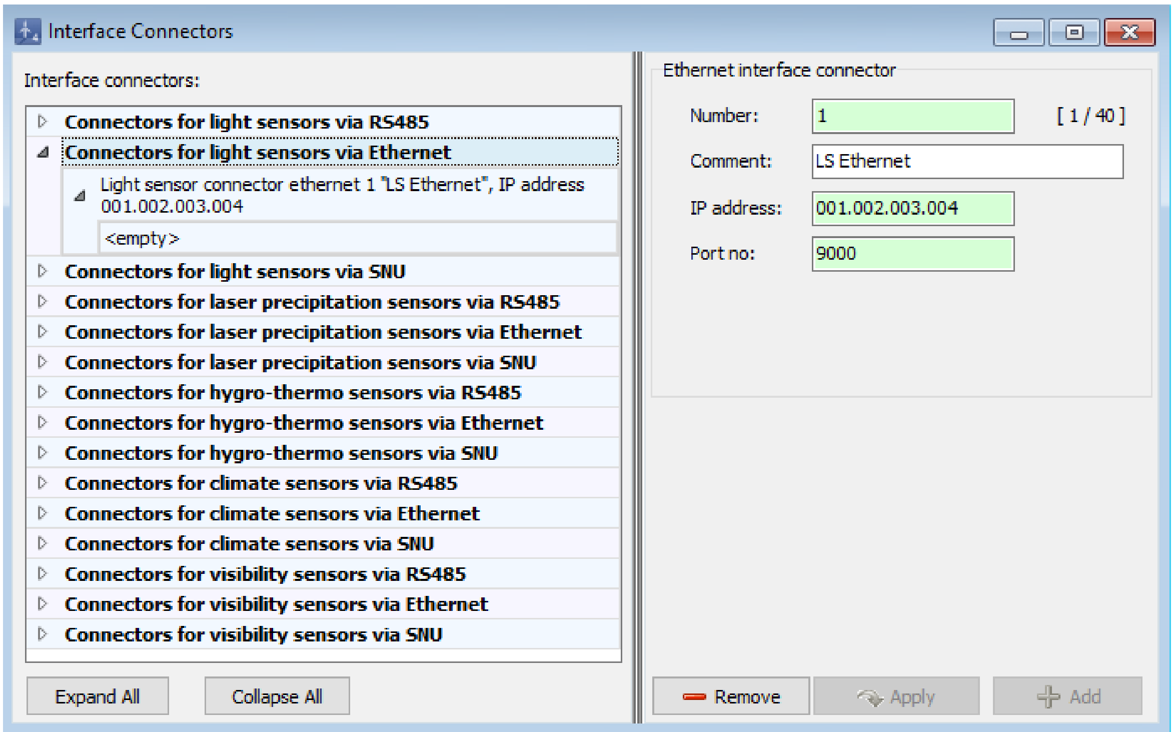
3. Add the appropriate sensors to the previously created interface connector, see also [Interface connector window] 187 and the following screenshot:



4.3.4 Interface Connectors window

Purpose	Assign the individual sensors to the interface connectors
Path	*Hardware > Interface Connectors*
Window type	Divided vertically, see Vertically divided windows 21
Prerequisites	Can only be edited with a dongle
Type of use	Display + interactive
Reference	Project

Here you can assign the sensors defined in the **Sensors and IO Signals** window (light sensors, hygro-thermo sensors, precipitation sensors) to the interface connectors to ensure that the SMU knows which sensors are connected.

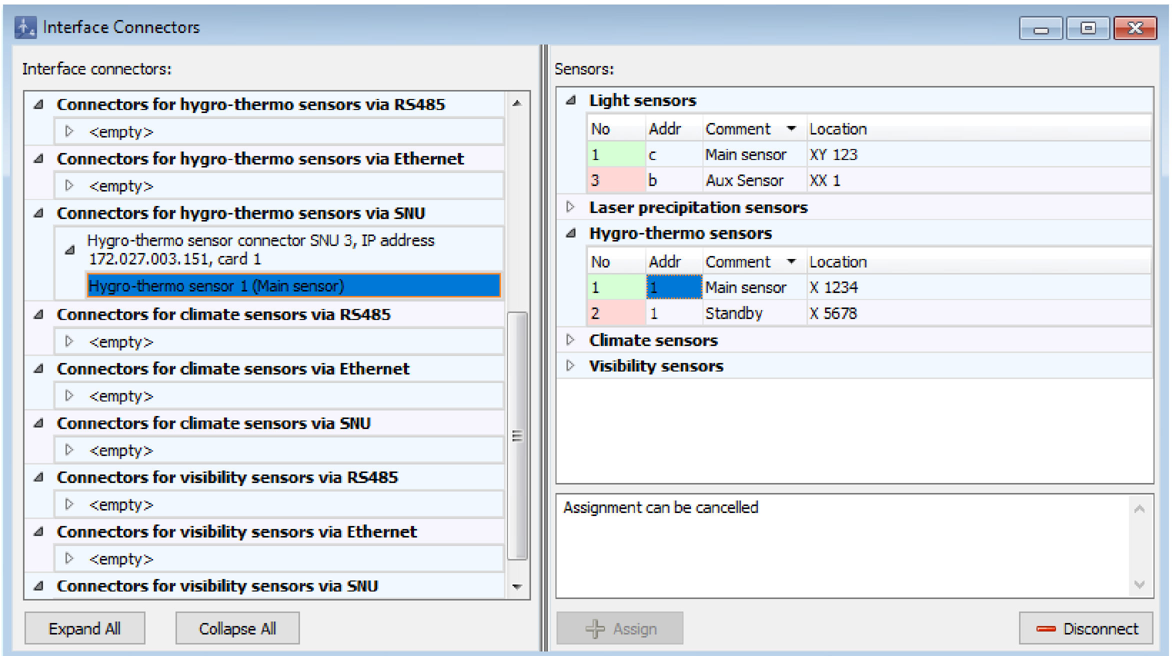


Interface Connectors window

Notes on the **Interface Connector** window

- General instructions on vertically divided windows can be found in the Vertically divided windows 21 section.
- Only the connector for light sensors via Ethernet is assigned in the above example.

- There are 5 types of connectors corresponding to the 5 types of sensors (light sensor, precipitation sensor, hygro-thermo sensor, climate sensor connectors and visibility sensors).
- Connectors for precipitation sensors can only be assigned precipitation sensors; connectors for hygro-thermo sensors can only be assigned hygro-thermo sensors, etc.
- Each sensor can only be assigned once.
- Light sensor connectors can also be assigned hygro-thermo or precipitation sensors, provided that a light sensor has already been assigned.
- If you select a sensor on the left, a list of all sensors defined in the **Sensors and IO Signals** window will appear on the right. It is possible to identify here whether a sensor is assigned (sensor No. highlighted in green) or not assigned (sensor No. highlighted in red), see the following figure:



Interface Connectors window

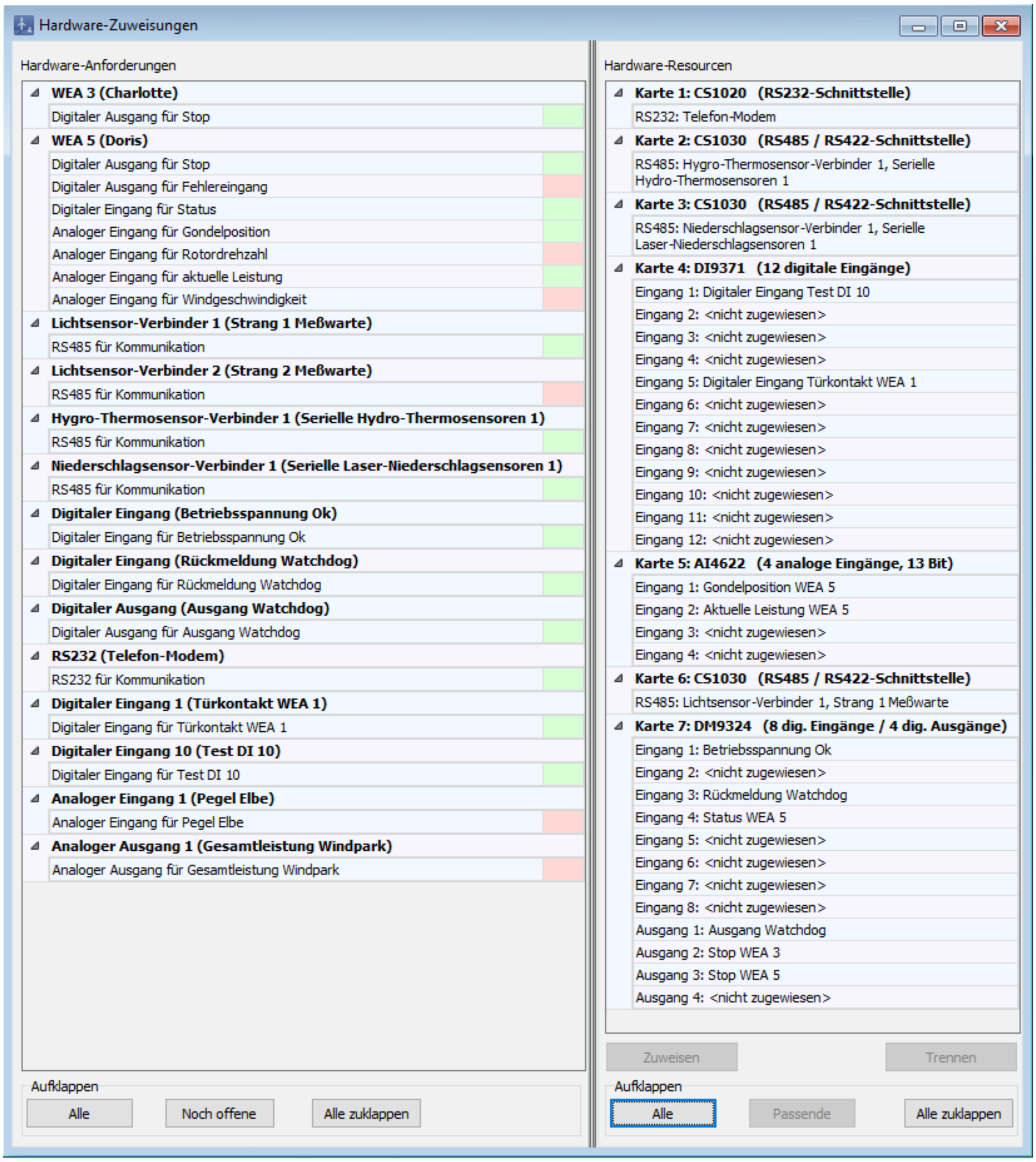
4.3.5 Hardware Assignments window

Purpose	Assign required hardware to the various components
Path	*Hardware > Hardware Assignments*
Window type	Divided vertically, see Vertically divided windows 21
Prerequisites	Can only be edited with a dongle
Type of use	Display + interactive
Reference	Project

Here you can assign, for example, connectors for sensors (defined in the **Interface Connector** window) that are queried via a RS485 bus to the respective RS485 card. Furthermore, the following can be assigned:

- connectors for sensors queried via a RS485 bus to the respective RS485 card
- watchdog inputs/outputs
- inputs/outputs for operating voltage
- inputs/outputs (digital and analog) of relay-controlled WTGs
- digital/analog inputs/outputs created by the user (**Sensors and IO Signals** window)
- GSM modem for the Phone option

See the following window for illustration.



Hardware Assignments example window

Notes on the **Hardware Assignments** window

- General instructions on working in vertically divided windows can be found in the Vertically divided windows 21 section.
- Hardware highlighted in green on the left is already assigned to an input/output.
- Hardware highlighted in red on the left has not yet been assigned to an input/output.

- If you click on **Unassigned** at the left in the window, only the hardware that is not yet assigned will be displayed.
- If you click on **Matching** at the right in the window, only the cards that are suited to be assigned will be expanded. If an analog input is selected on the left, for example, all analog input cards will be expanded on the right.
- More information on watchdogs can be found in the Glossary 371.

4.4 Switching & Measurement menu

The following table provides you with an overview of the **Switching & Measurement** menu.

Symbol	Menu item	Purpose
Special Shutdowns		
	Special Shutdowns 193	Define shutdown conditions – used for example to fulfill official requirements regarding bat protection.
	Night Slice Shutdowns 226	Complex shutdown conditions for bat protection (divide the night into slices with different conditions).
	Shutdown Calendar 229	Calendar for scheduling fixed shutdown periods
	On-Demand Shadow Shutdowns window 232	OSS can be used to allow residents of places of immission to switch off WTGs that cause shadow impact using an app on their smartphone.
	Digital Out Switching 235	Set conditions for switching digital outputs
Data Recording		
	Single Data Recording 236	To record individually selectable measurement data and link/compare them to one another.
	Cyclic Multi Data Recording 239	Automatically record one or more readings for one or more WTGs at regular intervals and define the output of the results as a file
	Interval Timer 243	Define intervals, e.g., for the **Cyclical Multi Data** window.
Accessories		
	Condition Flags 244	Define condition flags for special or night slice shutdowns that can be activated (set) by one set of conditions and cleared (reset) by another
	Reading Point Switches 248	Set up automatic switching between two reading points (e.g. to increase the reliability of sensors)
	Calculations 252	Define automatic calculation of certain values to use them in shutdown conditions of Special Shutdowns and Night Slice Shutdowns, Single Data Recordings or as user-defined reading points in the Special Shutdown Log, etc.
	Events 258	Read out which reading points (measured values) are automatically logged for a special shutdown event und Add your own (user-defined) reading points

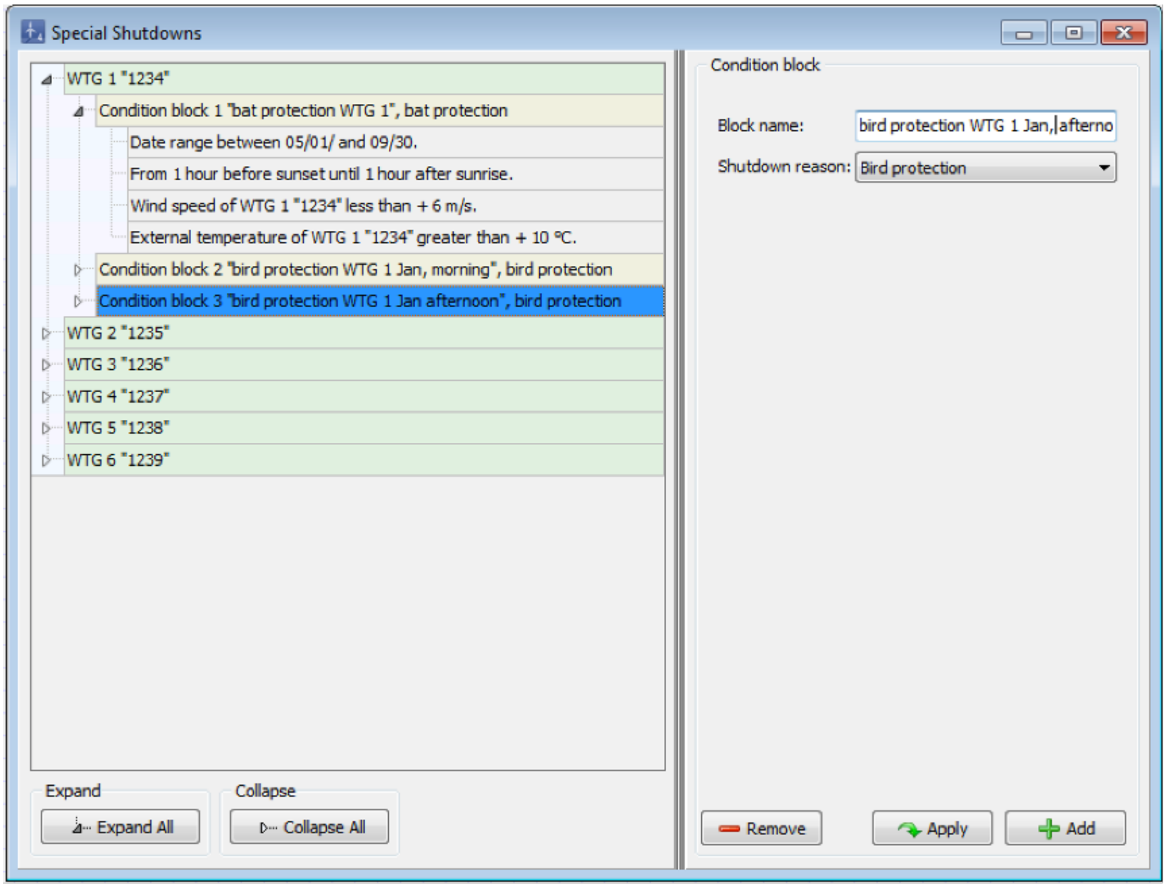
Symbol	Menu item	Purpose
	Email 267	Define emails to be triggered by conditions

Click on a menu item to jump directly to more information.

4.4.1 Special Shutdowns window

Purpose	Define shutdown conditions other than shadow impact and link them using logical operators (e.g., for the protection of bats or birds) while taking into account criteria, such as sunset/sunrise, temperature, wind speed, precipitation, and humidity
Symbol	
Path	*Switching & Measurement > Special Shutdowns*
Window type	divided vertically, see Vertically divided windows 21
Type of use	Read-only (left-hand side)/ selection/ drag & drop, dialog (right-hand inside)
Reference	Project

The **Specials Shutdowns** window provides (almost) unlimited possibilities for creating shutdown conditions other than those related to shadow impact, e.g. protection of bats protection of birds etc. Once shutdown conditions have been defined, the SMU will continuously check whether or not these are met by comparing actual values with the corresponding thresholds defined here. As soon and as long as the conditions are met, the corresponding WTG will be shut down. While it is true that the possibilities in the **Special Shutdowns** window are enormous, its operation is not as complex as it may seem at first glance – the structure, operation as well as all options available will be explained in an easily understandable manner in this chapter.



Special Shutdowns window

Since the **Special Shutdowns** window may look very differently depending on the operations carried out thus far, you will find a schematic representation of the basic window structure in the following.

Special shutdowns

<table>
<tr><td>

display area (levels)

Special shutdowns that have already been defined are displayed here (in different colors according to the level) and can be easily selected or copied using drag & drop.

WTG block 1
Condition block 1
Shutdown condition
Shutdown condition
...
Condition block 2
Shutdown condition
Shutdown condition
...
WTG2
Condition block 1
Shutdown condition
Shutdown condition
...
WTG

</td><td>

settings area

Drop-down lists with options and input fields for the following operating procedures:

- select/add/remove a WTG
- specify/change block name
- select switch reason for block
- add/change/delete condition blocks
- define/add/change/delete a dataset with shutdown conditions

Condition

The result of the current settings in the settings area is displayed in words

</td></tr>
<tr><td>

display area buttons

</td><td>

settings area buttons

</td></tr>
</table>

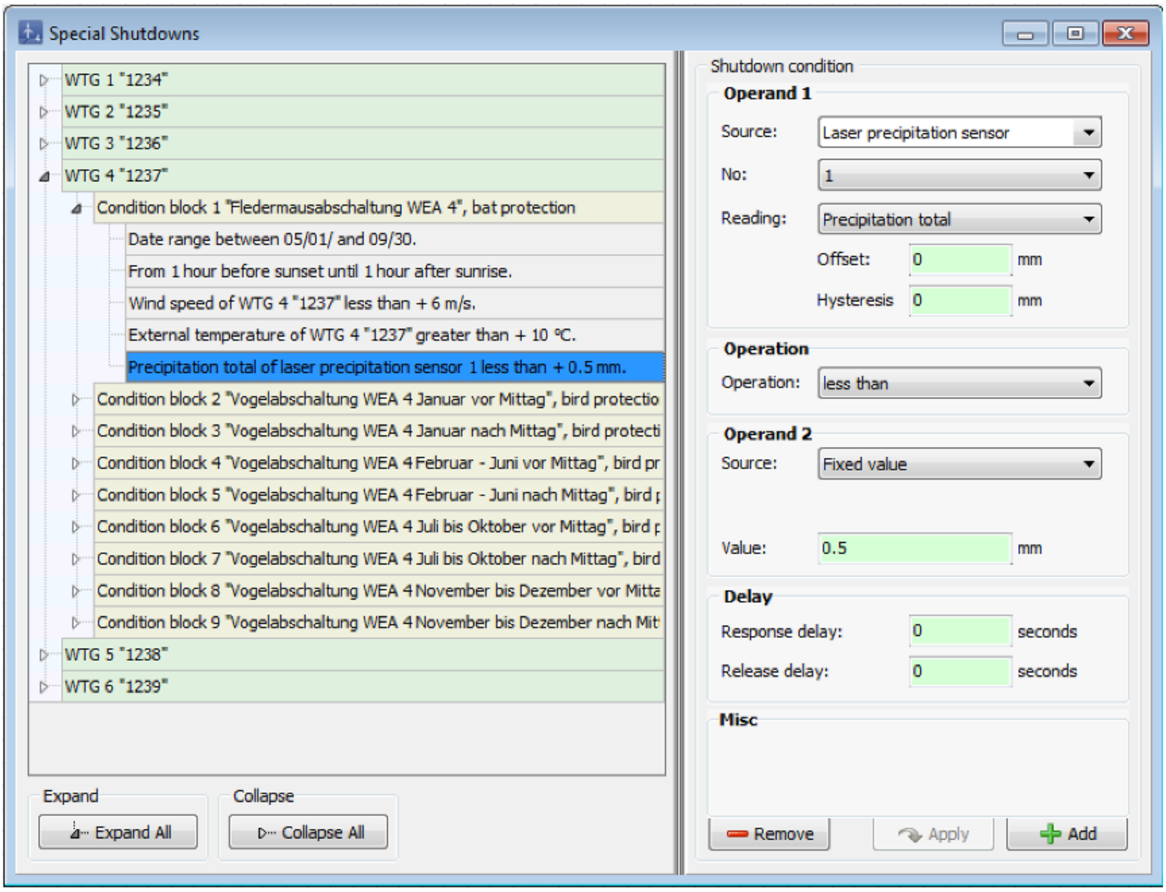
Schematic representation of the **Special Shutdowns** window

The most important elements of the **Special Shutdowns** window are explained in the following table:

Element	Explanation
WTG block	The WTG blocks shown in the display area are highlighted in green: A WTG block (e.g. WTG 1) refers to one WTG and contains at least one condition block (e.g. for protection of bats or protection of birds). And each condition block contains several shutdown conditions (e.g. referring to date, time of day, wind speed etc.).
Condition block	The condition blocks shown in the display area are highlighted in yellow: Each condition block consists of several shutdown conditions that are combined to form a shutdown scenario used to ensure, e.g. that a WTG will be shut down during a specific calendar period during a specific time of the day provided, at the same time, specific meteorological conditions are met.

Element	Explanation
	Condition blocks are linked by a logical **OR**, i.e. the corresponding WTG is shut down as soon as the conditions of **ONE** block are met.
Shutdown condition	Shutdown conditions are highlighted in light gray in the display area: A shutdown condition is a dataset that is created by selecting options from drop-down lists and entering values into input fields in the **Shutdown condition** area (right-hand side of the window). *Date range from 05/01 to 09/30.* Several shutdown conditions are combined to form a condition block, e.g.: *Date range from 05/01 to 09/30.* *From 1 hour before sunset until 1 hour after sunrise* *External temperature of WTG 6 “V1234” less than + 6 m/s* *External temperature of WTG 1 “1234" greater than + 10 °C* **The shutdown conditions within a single condition block** are linked by a logical **AND**, i.e., the corresponding WTG will be shut down only if **ALL** conditions are met.

The following figure shows the **Special Shutdowns** window with a typical shutdown scenario. You will find helpful explanations underneath.



Special Shutdowns window with an example

The window above shows the following:

- 6 WTG blocks have already been defined; only the fourth (WTG 4 "1237") is expanded.
- Condition block 1 of the fourth WTG block serves for the protection of bats and it consists of 5 shutdown conditions.
- The fifth of the 5 shutdown conditions has been selected by mouse click and is therefore highlighted in blue. Its accordingly defined parameters are displayed in the **Shutdown condition** settings area (right-hand side of the window); the result of the settings is displayed in words at the bottom right in the window in the **Conditions** field.

! If a shutdown condition is displayed in **red** or **black** bold letters in the display area of the **Special Shutdowns** or **Night shutdowns** window (left half of the window), then SM4 has detected that an input is "not plausible". Please refer to the information in the Plausibilty check 202 section.

Below you will find a list of the most important general notes regarding the **Special Shutdowns** window.

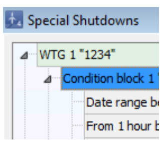
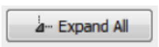
General notes regarding the Special Shutdowns window

- In order to create special shutdowns, one or more condition blocks, each consisting of one or more shutdown conditions, are created for each WTG.
- Condition blocks that have already been created as well as their individual shutdown conditions are displayed on the left-hand side of the window.
- These conditions are specified on the right-hand side of the window under **Shutdown Condition**, see also Shutdown condition input area 201.
- The result of the settings of a single shutdown condition is displayed at the bottom right under **Condition**.
- The conditions within a single block are linked by a logical AND, i.e., the corresponding WTG will be shut down only if ALL conditions are met.
- Several condition blocks are linked to each other by a logical OR, i.e. the corresponding WTG is shut down as soon as the conditions of ONE block are met.
- The SMU continually checks whether or not the defined conditions are met. As soon and as long as all conditions of one condition block are met, the corresponding WTG will be shut down.

> ! If there is more than one condition within a condition block, these conditions are linked by a logical AND, i.e., the corresponding WTG will be shut down only if **ALL** conditions within a condition block are met.
>
> If several condition blocks exist, these blocks are linked by OR, meaning that shutdown will occur already if the conditions of **ONE** block are fulfilled.

Now that you are familiar with the structure and the basic function of the **Special Shutdowns** window, let's get to the details.

The buttons in the **Special Shutdowns window** are described in the following table

Element	Explanation
Left-hand side of the window 	The left-hand side of the window shows the condition blocks that have already been defined for a WTG (in this example this would be WTG 1 with ID 1234). If you click on the small **arrow** on the left-hand side of the WTG or condition block, the condition blocks will be collapsed or respectively expanded. No settings can be made in this area of the screen.
	Expands all condition blocks and conditions that have already been defined (displayed on the left-hand side of screen). You can also use the small **arrows** displayed to the left of the condition block or condition to expand the respective screen element.

Collapse All	Collapses all condition blocks and conditions that have already been defined (displayed on the left-hand side of screen). You can also use the small **arrows** displayed to the left of the condition block or condition to collapse the respective screen element.
Add	Adds the object type that is selected on the left-hand side. **NOTE** This button is active only in the following situations: • when adding a WTG, a WTG was selected from the **WTG** drop-down list (top right) for which no special shutdown has been defined thus far • when adding a condition block, a name was entered under **Block name** (top right) that does not yet exist within the corresponding WTG • a shutdown condition that does not yet exist in the corresponding block has been defined in the settings area. If a shutdown condition has been selected, it can be added as often as required.
Apply	Is used to change an object; the following changes are possible: • change the name of a condition block • change the parameters of a shutdown condition **NOTES** • This button will not be activated until the corresponding name/parameter has been changed. • Changes will only be applied if you confirm them by clicking on **Apply**. Otherwise, the changes will be discarded as soon as you select a different object or close the window.
Remove	Deletes the object that is marked on the left-hand side of the screen. **NOTE** The condition blocks within a WTG are always numbered consecutively, even after a block has been removed. **EXAMPLE** If you remove the second of 3 condition blocks in total, the former “condition block 3” will become “condition block 2”.

See also Practical example 6: Special shutdowns due to bat and bird protection without night slices plus noise protection 39

4.4.1.1 Create a special shutdown – basic steps

This section describes how to set up a special shutdown if none have been defined beforehand.

- Click on (or select *Switching & Measurement> Special Shutdowns*) to open the **Special Shutdowns** window.
- Select the WTG for which a special shutdown needs to be defined from the **WTG** drop-down list on the right-hand side of the screen (top).
- Click on **+ Add** at the bottom right of the screen. The selected WTG will now appear on the left-hand side of the screen.
- Click on the small arrow in front of the blue highlighted WTG on the left-hand side of the screen. **Condition block 1, special shutdown** will now be displayed underneath.
- Click on the small arrow in front of **Condition block 1, special shutdown** on the left-hand side. **<empty>** will now be displayed below, which will later be replaced by the first condition.
- Assign a name for the condition block on the right-hand side of the screen under **Block name** (e.g., bat protection May) and select, e.g. **Bat protection** from the **switch reason** drop-down list.

> **!** The switch reason is important on three accounts:
> - When entering a condition block for bat or bird protection, the correct switch reason must be defined so that SM4 can run the applicable plausibility check 202.
> - The **Switch reason** also tells the SMU in which particular log a shutdown is to be recorded.
> - For the WTG type "via relay", additional DOs can be assigned a switch reason, see Communication Parameters input area 113.

- Click on **Apply** at the bottom right of the screen.
- Click on **<empty>** on the left-hand side of the screen. This line will then be highlighted in blue, and the right-hand side of the screen will display the **Shutdown condition** input area.
- Now select e.g., **Time** from the **Source** drop-down list under **Operand 1** in order to get started with the actual shutdown condition settings. The operands, operations and input fields are explained under **Shutdown condition input area** 201.

> **i** Drag & Drop: If you wish to define shutdown conditions for more than one WTG, you can save time and effort by copying the condition blocks of the first WTG and reuse them for the second WTG with the help of drag & drop. For more information on the drag & drop function for special shutdowns, please refer to the following section:
>
> See also: Easily duplicate special shutdowns using drag & drop 222.

> **!** If a shutdown condition is displayed in **red** or **black** bold letters in the display area of the **Special Shutdowns** or **Night shutdowns** window (left half of the window), then SM4 has detected that an input is "not plausible". Please refer to the information in the Plausibilty check 202 section.

4.4.1.2 Shutdown condition input area

This section describes how to define the actual shutdown conditions. The basic structure is as follows:

Operand 1

Source (e.g., WTG) drop-down list

Number drop-down list

Reading drop-down list (e.g., Outside temperature)

Offset input field(s) (optional)

Hysteresis input field (optional)

will be compared using an

Operation

Operation drop-down list

(greater than, less than, greater than or equal to, less than or equal to, equal to or not equal to)

to

Operand 2

(Fixed value)

and with many reading points, a

Delay

Response delay input box

Release delay input field

can be added to the condition.

Condition

Displays the result of the parameters defined above in words.

The basic structure of each shutdown condition is as shown in the above schematic representation with the exception of conditions for which **Time, Sun** or **External Trigger** is selected under **Source** (see Glossary 371). Sometimes only ONE operand is available, and in some cases neither the **Number** drop-down list nor the optional parameters **Hysteresis**, **Response delay** or **Release delay** are offered. In the case of the **Date range** and **Time range** reading point, you need to fill out the input fields **From** and **To**.

The content of the **Reading** drop-down list also depends on the option selected under **Source.**

The options available in the drop-down lists have self-explanatory names. You will find typical examples of **shutdown conditions** that you can use as a basis for your own projects on the following pages.

For standard **condition blocks** with detailed parameter settings, please refer to Typical condition blocks 218.

4.4.1.3 Plausibility check

Errors can occur when entering shutdown conditions. If these remain undetected, there is a risk of serious fines due to violations of operating requirements on the one hand, and yield losses due to unnecessary shutdowns on the other. Therefore, SM4 performs plausibility checks for certain entries you make in the **Special Shutdowns** or **Night Slice Shutdowns** windows.

How is the plausibility check triggered?

The check is triggered automatically in the following cases:

- You click the **Apply** or **Add** button in the **Special Shutdowns** or **Night Slice Shutdowns** window when adding or editing certain shutdown conditions. Whether or not a check is run and what is checked in each case depends on the type of input, see table "What is checked for an input?" below.
- You change the **switching reason of** a condition block to "Bat protection" or "Bird protection" in the **Special Shutdowns** window.
- You move objects in the **Special Shutdowns** or **Night Slice Shutdowns** window using the Drag&Drop function, see also Duplicating special shutdowns conveniently using Drag&Drop 222.
- You load an existing SM4 project from a file or SMU.
- You start an integrity check*(Tools > Integrity check*), see also **Project Integrity** window 345.
- You select *Project > Configuration / Partial Configuration* to configure the SMU, which automatically triggers an integrity check, see also **Check Configuration** window 159.

What is checked for an input?

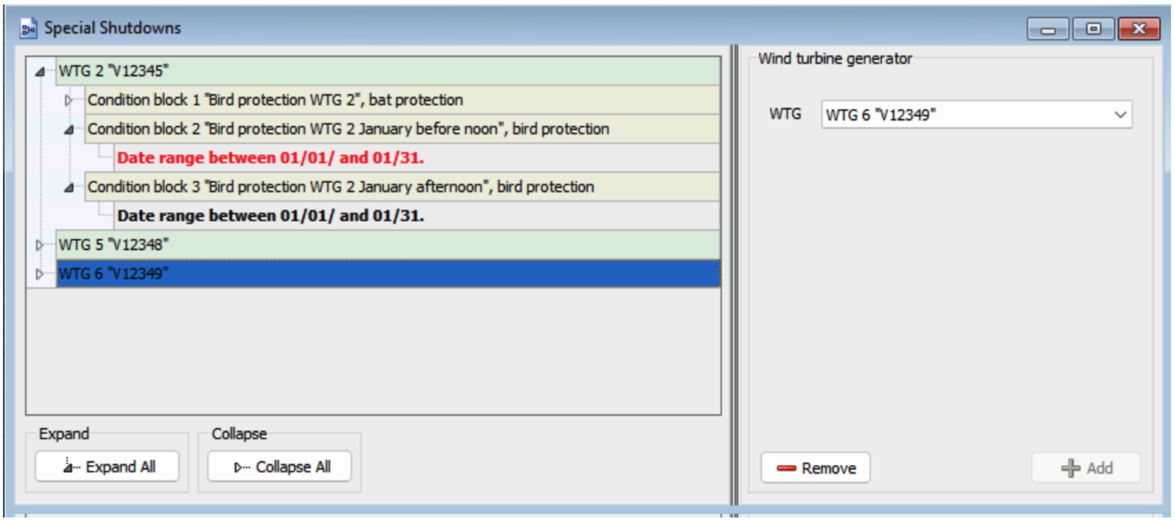
Some plausibility checks are only performed if bat or bird protection is selected as the switch reason for a condition block, or they only apply to the **Night Slice Shutdowns** window. Other checks are run for every switch reason and in both the **Special Shutdowns** and the **Night Slice Shutdowns** window. You will find comprehensive information in the following table.

Element	SM4 detects "not plausible" in the following cases
Bat protection (condition block with switch reason = bat protection)	
Date range	• First date is greater than second date • Start date is before 03/01 • End date is after 11/30
Time range (source of shutdown condition = sun)	• Reading point = sunrise to sunset • Offset at sunrise is greater than 120 minutes • Offset at sunset is greater than 120 minutes and time range is not sunset to sunset
Bird protection (condition block with switching reason = bird protection)	
Date range	• First date is greater than second date • Start date is before 03/01 • End date is after 11/30
Time range (source of shutdown condition = sun)	• Reading point = sunrise to sunset • Offset at sunrise is greater than 120 minutes • Offset at sunset is greater than 120 minutes
Night slice shutdowns	
Date range	• First date is greater than second date • Start date is before 03/01 • End date is after 11/30
Time slices	• Time slice before sunset is longer than 15% of the night • Time slice after sunrise is longer than 15% of the night
Meteorological conditions (check is done for every switch reason)	
Wind speed	• Operation is greater than, equal to, equal to or unequal to • Offset is not equal to zero • Hysteresis is greater than 1 m/s • Value is greater than 7.5 m/s • Response delay or release delay is greater than 1,800 seconds
Outdoor temperature	• Operation is less than, equal to, equal to or unequal to • Offset is not equal to zero

Element	SM4 detects "not plausible" in the following cases
	• Hysteresis is greater than 1 °C • Value is less than 8 °C • Response delay or release delay is greater than 1,800 seconds
Precipitation amount	• Operation is greater than, greater than or equal to, equal to, or un-equal to • Offset is not equal to zero • Hysteresis is greater than 1 mm • Value is greater than 10 mm/h • Response delay or release delay is greater than 1,800 seconds
Humidity	• Operation is greater than, equal to, equal to or unequal to • Offset is not equal to zero • Hysteresis is greater than 5 • Value is less than 80 • Response delay or release delay is greater than 1,800 seconds
Visibility	• Operation is less than, greater than or equal to, equal to, or not equal to • Offset is not equal to zero • Hysteresis is greater than 100 m • Value is less than 800 m • Response delay or release delay is greater than 1,800 seconds
NOTE The values for the meteorological conditions (see above) can also use a calculation as a source. In order for the correct check to be run in this case, you must select the appropriate option in the **In Shutdown Conditions treat as** drop-down list in the **Calculations** window, see Calculations window 252.	
External trigger check	
Source = External trigger	External trigger is equal to 0 (The purpose of this check is to prevent an External Trigger from being accidentally checked for its LOW state, see also Shutdown condition with Source = External Trigger 216).

How can I recognize a negative plausibility check?

Elements identified as "not plausible" are marked in red or black bold letters in the left half (display area) of the **Special Shutdowns** and **Night Slice Shutdowns** windows, see the following example:



Special Shutdowns window (section)

Notes on the above example

- Because the date range defined for Condition block 2 is not plausible (start date is before 03/01), this shutdown condition is shown in **red boldface.**
- The date range defined for condition block 3, which SM4 has also identified as "not plausible", has already been manually declared as plausible by the user (see next section) and is therefore displayed in **black boldface**.

What does a shutdown condition detected as "not plausible" mean?

Red entries prevent a configuration process, i.e. the project fails the integrity check SM4 automatically runs when the configuration is started, and it cannot be transferred to the SMU. If a shutdown condition is to be used despite being "not plausible", the user can manually "declare it as plausible" so that it no longer prevents configuration.

How do I declare a "non-compliant" shutdown condition as plausible?

If you are sure that you want to use a shutdown condition that has been identified as non-plausible, first right-click on the condition shown in **red bold,** click **Plausibility**, and check **Declared as plausible**. The confirmation of non-plausible shutdown conditions is saved when a project is saved, so it does not have to be repeated when the project is reopened.

4.4.1.4 Typical shutdown conditions

The options available in the drop-down lists in the **Shutdown condition** settings area have been named as self-explanatory as possible. However, input fields, such as **Offset**, **Hysteresis**, **Response delay**, **Release delay**, will be explained using helful examples in the following sections:

Shutdown condition with Source = Time 206

Shutdown condition with Source = Sun 207

Shutdown condition with Source = WTG 210

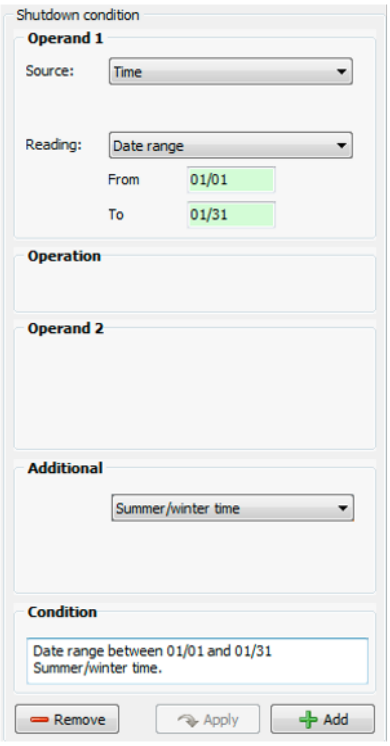
Shutdown condition with Source = POI 213

Shutdown condition with Source = GSM modem 214

Shutdown condition with Source = Calculations 215

Shutdown condition with Source = External trigger 216

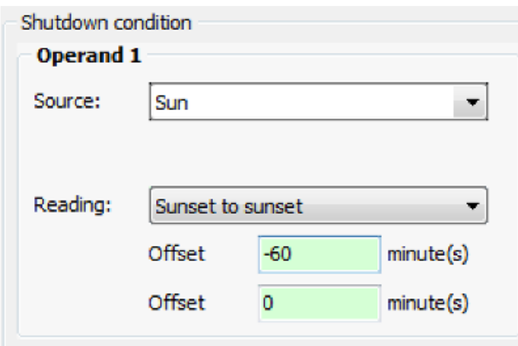
4.4.1.4.1 Shutdown condition with Source = Time

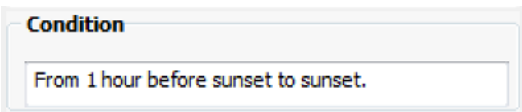


Parameter	Explanation of “Date range” reading
Source	In the **above example**, the **Time** option was selected so that the SMU will compare the current time with a time period defined below.
Reading point	In the **above example**, by selecting the **Date range** option, it was specified that the period to be compared is defined by a date range (**From**/**To**). MM/DD*
Additional	Here you can see whether winter time is used or a time with summer/winter time changeover. Whether or not a selection can be made here depends on the setting under *Project > Project Settings > Time settings > Summer winter time handling*.
Condition	Displays the result of the parameters defined above. This condition is considered to be met whenever the current date is within 01/01 and 01/31. A shutdown condition like this one will not make sense unless it is combined with other shutdown conditions defined within the same block (linked by a logical AND), for example, “Wind speed less than + 6 m/s”.

*The format stated here corresponds to the default settings in the input area **Country-Specific Settings** (*File> Application Settings > ShadowManager 4 > General*) and can be changed there at any time.

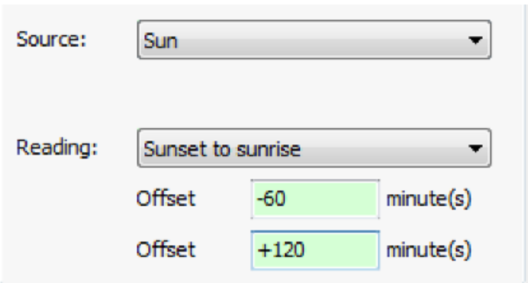
4.4.1.4.2 Shutdown condition with Source = Sun



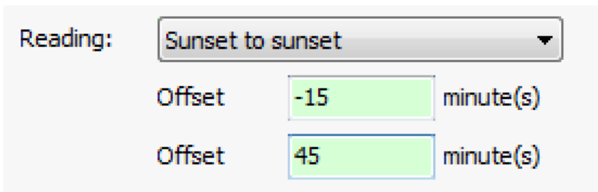
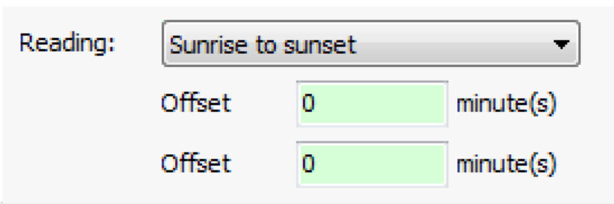


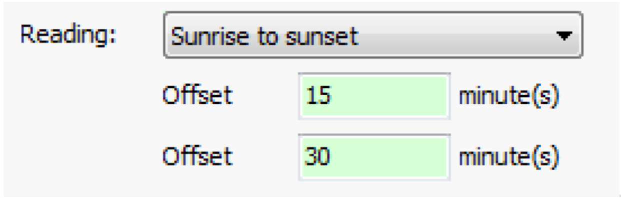
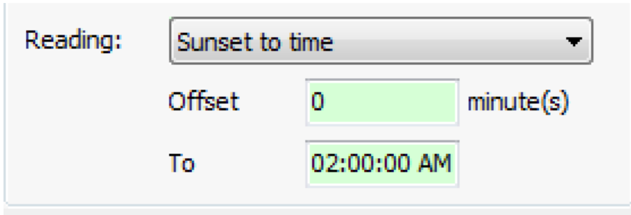
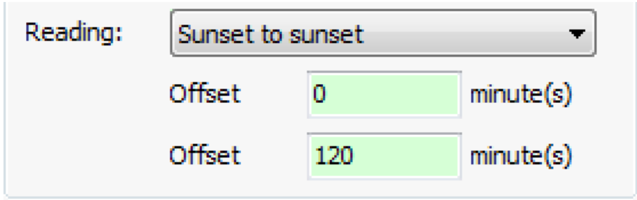
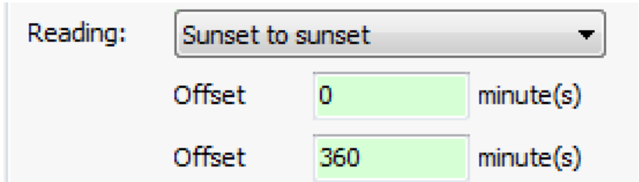
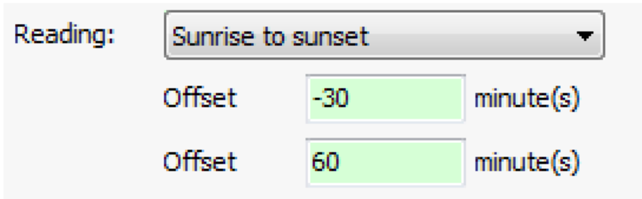
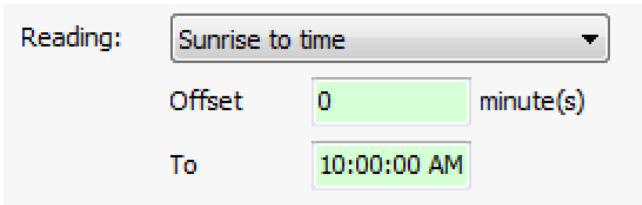
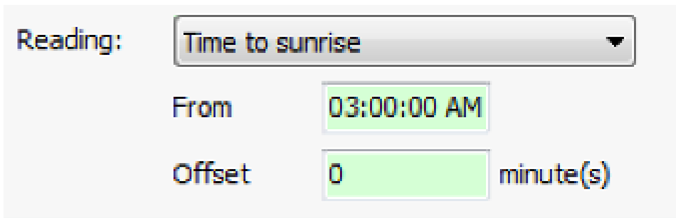
Parameter	Explanation of „Sunset to sunset“ reading
Source	**Sun** was selected **in the above example** in order to define a condition that depends on the current time of sunset or sunrise.
Reading point	**Sunset to sunset** was selected **in the above example** in order to define a condition that depends on the current time of sunset.
Offset	**In the above example**, -60 was entered in the first **Offset** field, while nothing was entered in the second **Offset** field, because the condition is to be considered to be met only until sunset.
Condition	Displays the result of the parameters defined above. This condition is considered to be met as soon as the time left until sunset is 60 minutes or less.

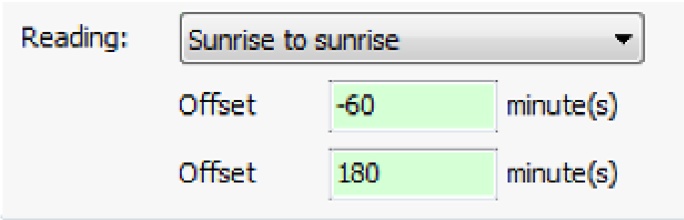
To achieve that the above condition is considered to be met not only until sunset but until 2 hours after sunrise on the next day, the shutdown condition would have to be configured as follows:



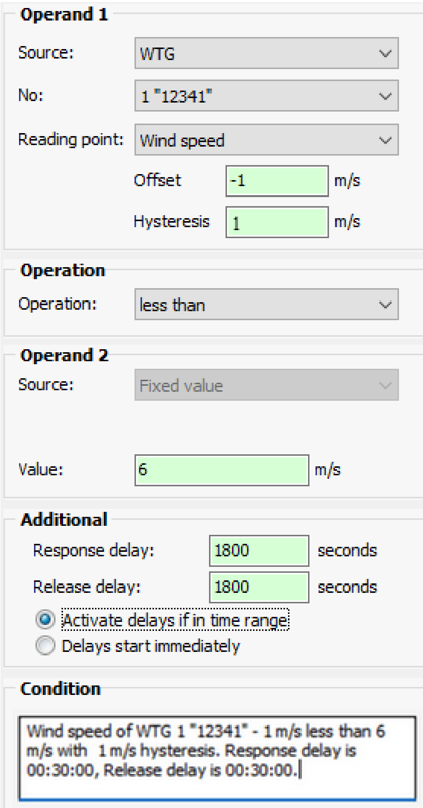
Overview of typical shutdown conditions for Source = **Sun**

<table>
<tr><th>Condition</th><th>Settings</th></tr>
<tr><td>From 15 minutes before sunset to 45 minutes after sunset.</td><td>
</td></tr>
<tr><td>From sunrise to sunset.</td><td>
</td></tr>
</table>

From 15 minutes after sunrise to 30 minutes after sunset.	
From sunset until 02:00:00.	
From sunset until 2 hours after sunset.	
From sunset until 6 hours after sunset.	
From 30 minutes before sunri-se to 1 hour after sunset.	
From sunrise to 10:00:00.	
From 03:00:00 until sunrise.	

From 1 hour before sunrise to 3 hours after sunrise.	

4.4.1.4.3 Shutdown condition with Source = WTG



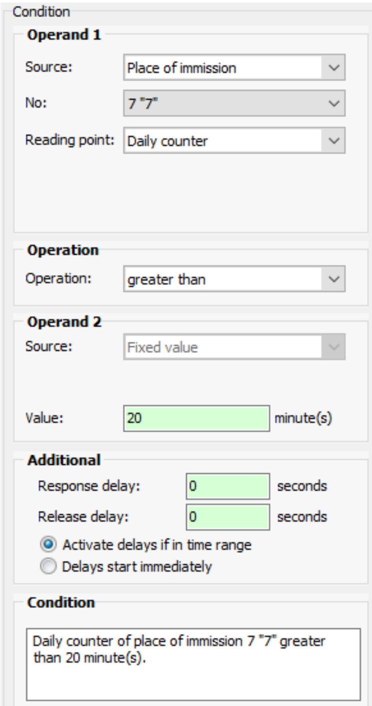
Parameter	Explanation of “Wind speed” reading
Source	The **WTG** option was selected **in the above example** so that the SMU will compare the wind speed measured by the WTG to a fixed value.
Number	Since it is possible to define more than one WTG in a project, you can select a specific WTG here. WTG 1 “12341” was selected **in the above example** in order to have the SMU compare the wind speed measured by this specific WTG to a fixed va-lue.

Reading point	The **Wind speed** option was selected **in the above example** in order to have the SMU compare the wind speed measured by the WTG to a fixed value.
Offset*	Here you can specify a value that corrects the value provided by the WTG. **In the above example**, it is a known fact that the wind speed reading provided by the WTG is always 1 m/s above the actual wind speed. Therefore, a value of -1 m/s was entered here. Decimals possible, decimal point*
Hysteresis*	The hysteresis defines the desired permissible difference between the switching points for start-up or respectively shutdown. To ensure that the WTG will not be switched to frequently during times when the readings are unstable (e.g., gusty winds), you can delay the response by specifying a hysteresis. Only positive values can be entered. The direction in which the hysteresis works depends on the operation (greater than/less than) the value refers to. A hysteresis of 1 m/s was entered **in the above example** to specify that the WTG will be shut down if the wind speed drops below 6 m/s and will be started up when the measured wind speed exceeds 7 m/s. **Example of a shutdown condition with the reading "External temperature"** *External temperature greater than + 14 °C with 2 °C hysteresis*: The WTG is shut down when the external temperature exceeds 14 °C, and it will be started up again as soon as the external temperature drops below 12 °C. **Example of a shutdown condition with the reading "Precipitation"** *Precipitation less than + 0.5 mm with 0.1 mm hysteresis:* The WTG is shut down when the precipitation drops below 0.5 mm and will be started up again as soon as a precipitation of more than 0.6 mm is measured. **NOTE** The hysteresis is applied only if all conditions within one condition block are met (logical AND link).
Operation	The **less than** option was selected **in the above example** to ensure that the WTG is shut down if the wind speed drops BELOW a specific fixed value.
Fixed value*	6 m/h was selected **in the above example** to ensure that the WTG is shut down if the wind speed drops BELOW this value. Decimals possible, decimal point*
Response delay*	To ensure that the WTGs are not switched too frequently (high wear and tear) when conditions relating to wind speed, precipitation or temperature are involved, you can specify here that the shutdown conditions need to be met continuously over a specific period of time before a WTG will actually be shut down.

	A **Response delay** of 1800 seconds was selected **in the above example** to ensure that the WTG will be shut down only after a wind speed of less than 6 m/s has been measured continuously over a period of 30 minutes. Decimals possible, decimal point*
Release delay*	To ensure that the WTGs are not switched too frequently (high wear and tear) when conditions relating to wind speed, precipitation or temperature are involved, you can specify here that the shutdown conditions must NOT be present for a specific period of time before a WTG is actually started up on again after having been shut down due to a special shutdown. A **Release delay** of 1800 seconds was selected **in the above example** to ensure the WTG will not be started up again after a special shutdown until a wind speed of 6 m/s or above has been measured continuously over a period of 30 minutes. Decimals possible, decimal point*
Activate delays if in time range **OR** **Delays start immediately**	If a condition block contains a **Time** condition (e.g., sunset to sunrise), it may be useful to select the upper option (**Activate delays if in time range**). If selected, the parameters **Response delay** and **Release delay** will not take effect right away but only when the time range defined in each case also takes effect. The selection made here has the following effect: **Activate delays in time range** If the wind speed has already fallen below 7 m/s (fixed value of 6 m/s plus offset) long before sunset, the respective WTG is shut down 30 minutes after sunset at the **earliest** since the response delay does not take effect until sunset. **Delays start immediately** If the wind speed has already fallen below 7 m/s long before sunset and the response delay time has also already expired, then the WTG is shut down immediately at sunset and the set response delay **no** longer takes effect. **NOTE** You can choose between the two options, but it is **not** possible to activate both of them or to deactivate both of them. The selection is only relevant if the respective condition block also contains a **Time** condition, otherwise any set delays (response delay, response delay) always take effect immediately.
Condition	Displays the result of the parameters defined above. This condition is considered to be met if WTG 1 measures a wind speed of less than 7 m/s (fixed value plus offset).

*The input format corresponds to the default settings in the input area **Country-specific settings** (*File> Application Settings > ShadowManager > General*) and can be changed there at any time.

4.4.1.4.4 Shutdown condition with Source = POI

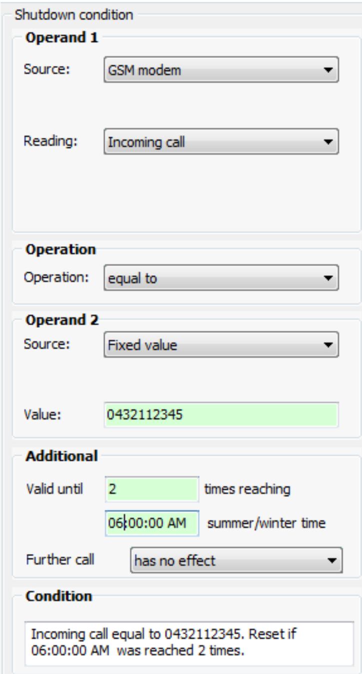


Parameter	Explanation of “Daily counter” reading
Source	**Place of immission** was selected **in the above example** to achieve that the SMU will compare its current counter reading with a number of minutes as defined below.
Number	Since each POI in the project has a daily counter as well as an annual counter, the number of the desired POI needs to be selected here. POI 7 “7” was selected **in the above example** in order to have the SMU compare the shadow impact minutes counted for this specific POI to a fixed value.
Reading point	The **Daily counter** was selected **in the above example** in order to compare the shadow impact minutes counted on the respective day to a fixed value. The only alternative to the Daily counter option in this case is the Annual counter option which is selected in order to have the SMU compare the shadow impact minutes counted in the current year to a fixed value.
Operation	The **greater than** option was selected **in the above example** to ensure that the condition is considered to be met if the counted shadow impact minutes have exceeded the fixed value defined below.
Fixed value	20 minutes was specified **in the above example** to ensure that the condition is considered to be met as soon as the currently counted shadow impact minutes have exceeded this specific value. minutes, decimals are possible, decimal point*

Condition	Displays the result of the parameters defined above. This condition is conside-red to be met as soon as the shadow impact minutes counted for POI 7 have exceeded the value of 20.

*The format stated here corresponds to the default settings in the input area **Country-Specific Settings** (*File> Application Settings > ShadowManager 4 > General*) and can be changed there at any time.

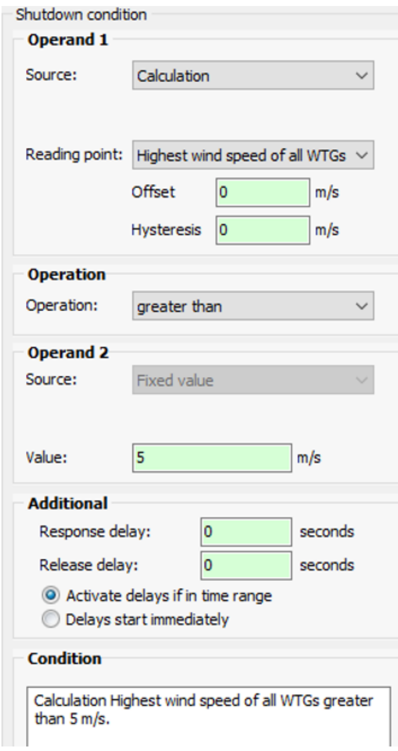
4.4.1.4.5 Shutdown condition with Source = GSM modem



Parameter	Explanation of "Incoming call" reading
Source	**In the example above**, the **GSM modem** option was selected so that the SMU will compare the phone number of the caller with a phone number defined below when an incoming call is received. **NOTE** The **GSM Modem** option is only available if the option **Use GSM modem (RS232)** was selected under *Project > Project Settings > Additional hardware*.
Reading point	The only reading available here is **Incoming Call**.
Operation	The only operation available here is **equal to**.

Value	Phone number of the caller who should be able to switch off by call. Input without spaces
Additional	**In the above example** it was determined that a possible shutdown call should be valid until the time 18:00:00 is reached twice and that another call will have no effect. There are 2 additional options in the **Further call** drop-down list: • **re-starts call** The triggered call is started again from the beginning – the counter is reset to the start value. • **ends call** The call is terminated immediately.
Condition	Displays the result of the parameters defined above. If the caller calls from the defined phone number at 16:00, for example, the deactivation remains in effect for exactly 26 hours. Special shutdowns by telephone call can be combined with other shutdown conditions in the usual way. For example, you could add "From sunrise to sunset" as a further condition, so that shutting down a WTG by phone is only possible if the sun can actually shine at all.

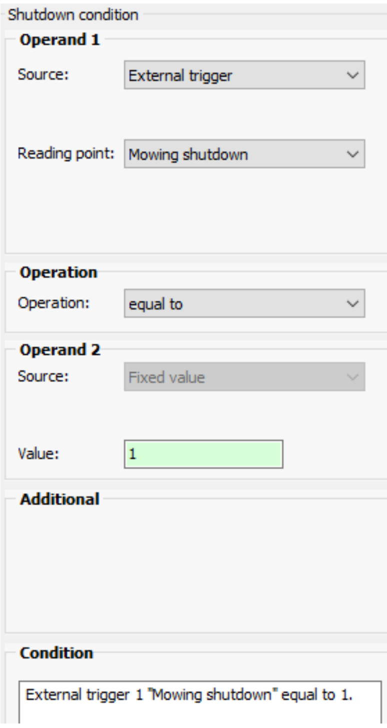
4.4.1.4.6 Shutdown condition with Source = Calculations



Shutdown conditions like this one may be used, e.g., in the following situation: in a wind park project that includes bat protection shutdown conditions, some WTGs are often sheltered from wind due to one or more other WTGs being located nearby. Therefore, the shutdown condition on wind speed is to be applied, **for all WTGs** of the park, based on the reading of the WTG that is picking up the **strongest** wind. This will prevent WTGs (that are located on the lee side of other WTGs and therefore measure **lower wind speeds than actually exist)** from being shut down even though the bat remains in safe harbor due to hard wind.

Parameter	Explanation of “Calculation” reading
Source	In the **above example**, the **Calculations** option was selected in order to have the SMU compare a number determined using a certain “Calculation” to a value defined further below. **NOTE:** The option is only available if at least one calculation has been defined under *Switching & Measurement > Calculations*.
Reading point	The automatic calculation set up in the **Calculations** window to determine the highest wind speed has been selected here.
Operation	“less than” was selected here, since the shutdown concerned was defined the for the purpose of bat protection, and bats only fly at low wind speeds.
Value	Value as required by the authorities.
Additional	Optional settings – for more information on condition on the settings available here, see section Shutdown condition with Source = WTG 210.
Condition	Result of the parameters defined above: Shutdown occurs when none of the WTGs in the wind park measures a wind speed of 5 m/s or more.

4.4.1.4.7 Shutdown condition with Source = External trigger



Parameter	Explanation of “External Trigger” reading
Source	**In the above example**, the **External Trigger** option (see Glossary 371) has been selected in order to have the SMU check whether the external trigger “mowing shutdown” is set or not. **NOTES** • The option is only available if an external trigger has been set up under *Hardware > Sensors and IO Signals > External Triggers* and the external special shutdown interface has been activated in the project settings (*Project > Project Settings*). • External triggers are set via the special shutdown interface (*SMU > Special Shutdown-Interface > Server settings*).
Reading point	Here the external trigger defined in the **Sensors and IO Signals** window was selected.
Operation	This parameter was set to “equal” and **Value** was set to “1” so that the shutdown condition be fulfilled when the external trigger is set.
Value	see above
Condition	Result of the parameters defined above: The respective WTG will be shut down as soon as the condition “mowing shutdown” equals 1.

Please also note the following information box on “External Triggers”.

i There are two basic variants for the use of external triggers in SM4:

Type 1

- a trigger named “mowing shutdown” is define in SM4
- this trigger is included in the special shutdowns of all WTGs that would be affected once a certain meadow is mowed .

If this trigger is subsequently set by an external user, all these WTGs are stopped.

Advantage: comfortable shutdown of several WTGs “at one click”

Type 2

- a separate trigger is defined for each WTG in SM4; its name contains the respective WTG number
- for each WTG, the trigger defined for it is included in the shutdown of that WTG

In order to implement mowing shutdowns for certain WTGs, the external user must set a corresponding number of triggers.

Advantage: more flexible solution, changed affiliations of a WTG to a meadow can be implemented “externally” (no need to reconfigure the SMU).

Furthermore, conditions that cause a mowing shutdown via triggers can be limited to certain periods by including additional conditions (e.g..: sunrise and sunset, date range spring/ summer).

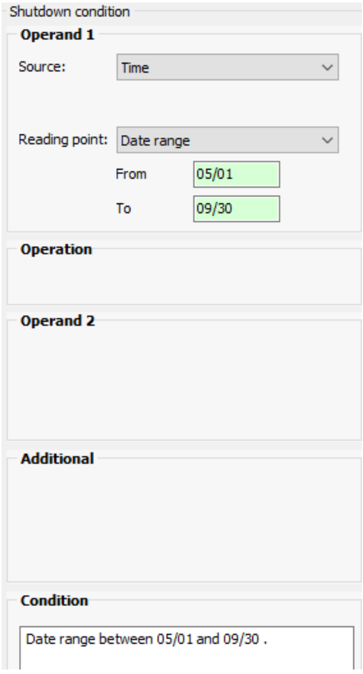
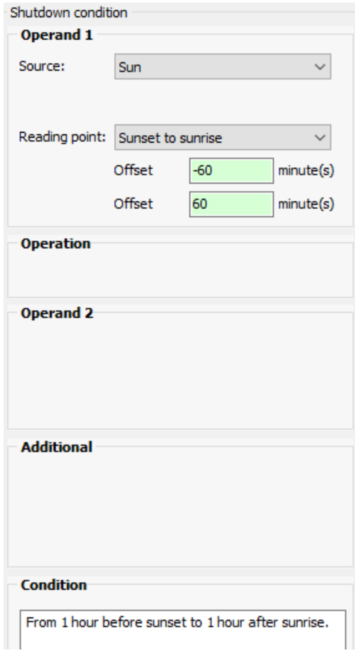
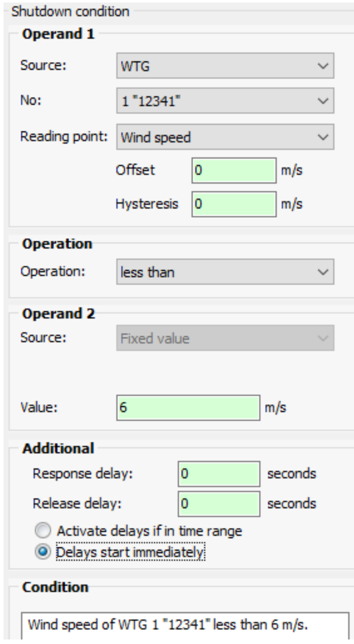
! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

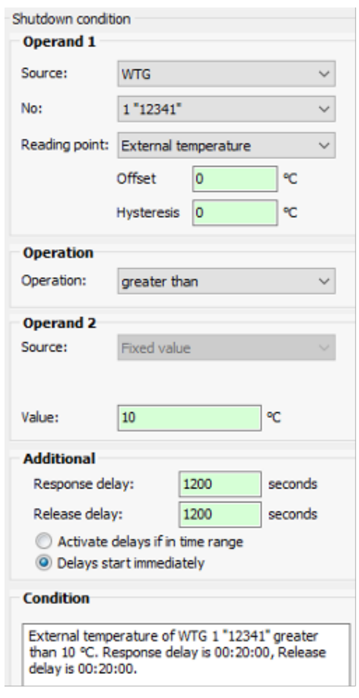
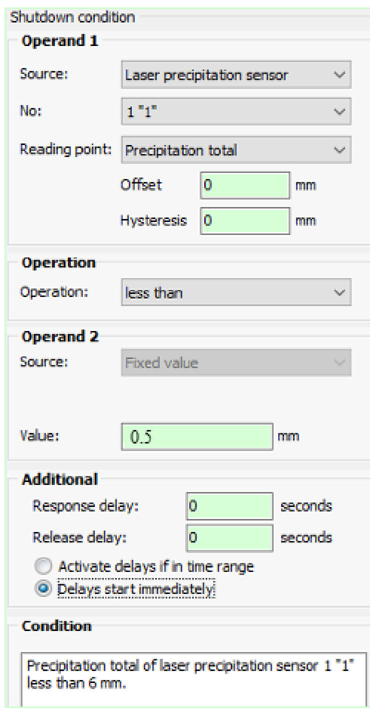
4.4.1.5 Typical condition blocks

In this section, you will find typically used condition blocks with detailed parameter settings, which you can use as a basis for your own projects.

A) Bat protection

Requirement: Shut down WTG 99 “12341” from 1 May to 30 September from 60 minutes before sunset until 60 minutes after sunrise on the following day provided that “this same WTG” (not one of the other WTGs) measures a wind speed of less than +6 m/s and an external temperature of more than +10 °C while precipitation sensor 1 measures a precipitation total of less than + 0.5 mm. The following shutdown conditions must be defined for this condition block:

<table>
<tr><th>Condition 1</th><th>Condition 2</th><th>Condition 3</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
</table>

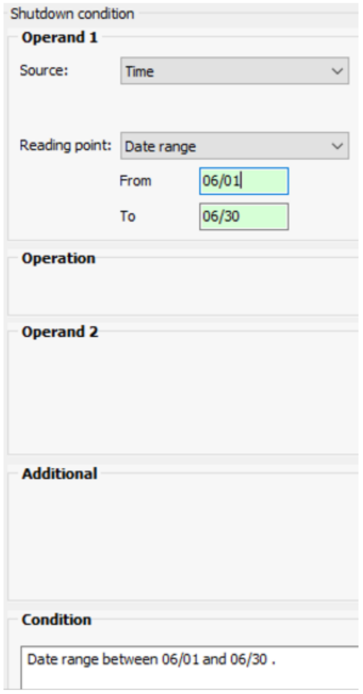
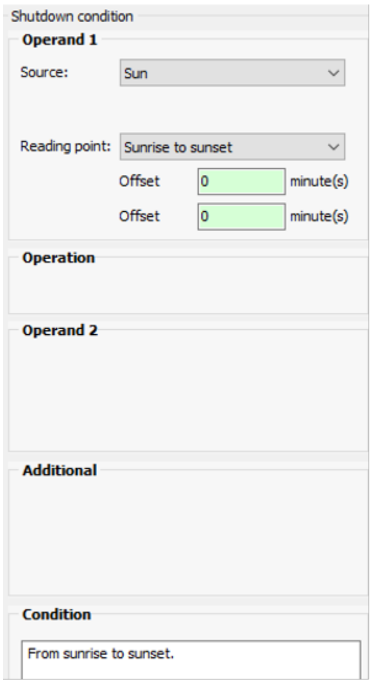
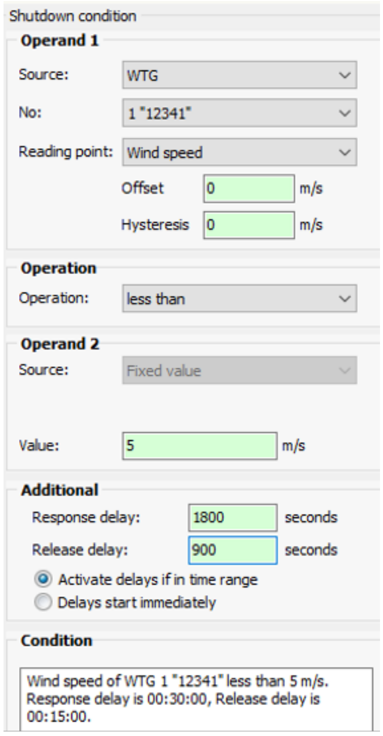
Condition 4	Condition 5
	

See also Practical example 6: Special shutdowns due to bat and bird protection without night slices plus noise protection 39

B) Bird protection

Requirement: Shut down WTG 1 “12341” from 1 June to 30 June from sunrise to sunset provided that this same WTG has measured a wind speed of less than +5 m/s for at least 30 minutes; after a shutdown due to wind speed, this condition must have been fulfilled over a period of at least 15 minutes before the WTG is started up again.

The following 3 shutdown conditions must be defined for this condition block:

<table>
<tr><th>Condition 1</th><th>Condition 2</th><th>Condition 3</th></tr>
<tr>
<td>
</td>
<td>
</td>
<td>
</td>
</tr>
</table>

NOTE

For condition 3, the option **Activate delays if in time range** is selected in the **Additional** input area, so that a shutdown will be carried out 30 minutes after sunset at the earliest. If **Delays start immediately** is selected and the wind speed has already fallen below 5 m/s, e.g., one hour before sunset, the respective WTG would be shut down right at sunset.

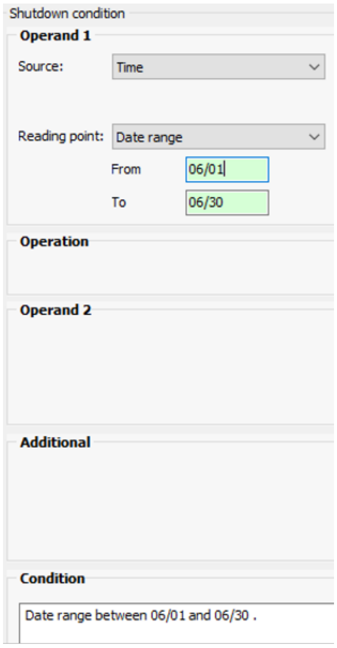
For more information, for example, on the **Additional** input area that see the section on special shutdowns underShutdown condition with Source = WTG 210.

C) Bird protection

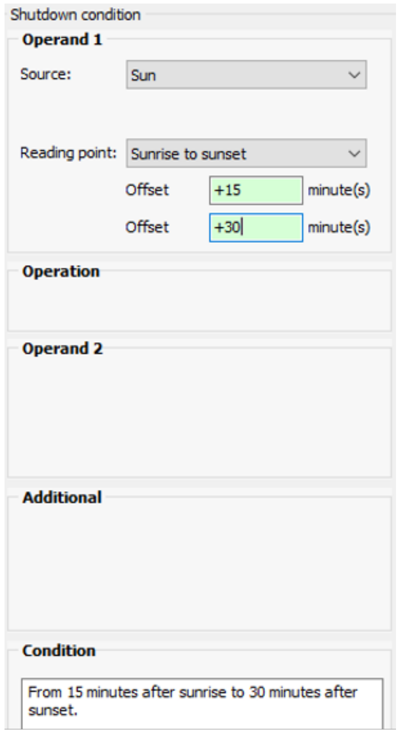
Requirement: Shut down WTG 1 “12341” from 1 June to 30 June from 15 minutes after sunrise to 30 minutes after sunset, if wind speed is less than + 5 m/s at “this same WTG”.

The following 3 shutdown conditions must be defined for this condition block:

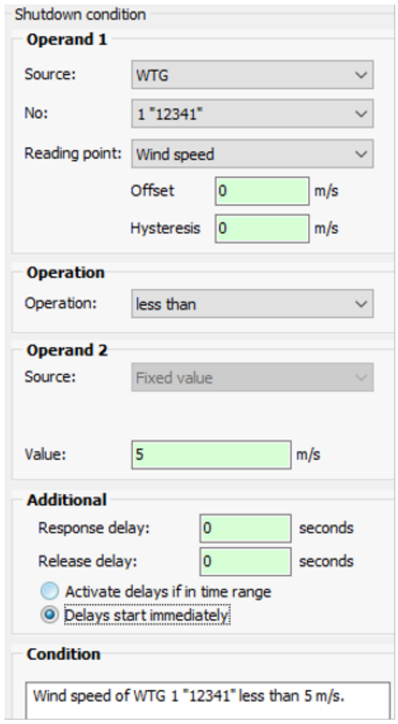
Condition 1



Condition 2



Condition 3



! If a shutdown condition is displayed in **red** or **black** bold letters in the display area of the **Special Shutdowns** or **Night shutdowns** window (left half of the window), then SM4 has detected that an input is "not plausible". Please refer to the information in the Plausibilty check 202 section.

4.4.1.6 Easily duplicate special shutdowns using drag & drop

Defining special shutdowns for each WTG of a big wind park can be a very time-consuming process. Often, the conditions required for several if not all WTGs of a wind park are identical or at least very similar to each other. Therefore, they can be easily copied per drag & drop in order to save time. During this process, references to the source WTG (e.g., “Wind speed of WTG 2 less than +6 m/s”) can be replaced by corresponding references to the target WTG.

In the explanations of this subsection, it is assumed that you are familiar with the basic operation of the **Special Shutdowns** window. If this is not true, please read the following section on Special shutdowns:

Special Shutdowns window 193

Create a special shutdown – basic steps 200

Shutdown condition input area 201

Typical example: Transfer all conditions of one WTG to a new WTG

In many cases, it is useful to transfer the special shutdowns defined for one WTG to a 2nd WTG for which no special shutdowns have been defined thus far. Only 2 steps need to be carried out:

▪ create a new WTG block (target object)

▪ drag the WTG block (source object) that has already been defined to the target object

The new WTG block will now have the same condition blocks including (and shutdown conditions) as those source WTG block. If the latter contains shutdown conditions referring to the source WTG (the "own" WTG), these can be replaced in the target WTG block with references to the target WTG (the user must confirm this in a corresponding dialog window).

Not only WTG blocks but also individual condition blocks or shutdown conditions can be duplicated.

Please pay attention to the following notes when using drag & drop

- An object can only be dragged to an object of the same type (example: a WTG block can only be dragged to another WTG but not to a condition block).
- It is also possible to copy a condition block ***within*** the same WTG block. In this case, you have to decide in a dialog window whether the block should either be moved or added as a new block, see dialog window A below.
- If a shutdown condition object is dragged ***within*** the same condition block, it can only be ***moved*** (in order to change its position in the list of shutdown conditions) – duplicating per drag & drop is **not** possible in this case.
- In order to duplicate a shutdown condition ***within*** the same condition block, select it by clicking on it (will be highlighted in blue) and click on **Add** at the bottom right in the window.
- If you try to drag an object to a "forbidden" target (e.g. you are trying to drag a condition block to a shutdown condition) a prohibition symbol (⃠) will be displayed instead of the mouse pointer.

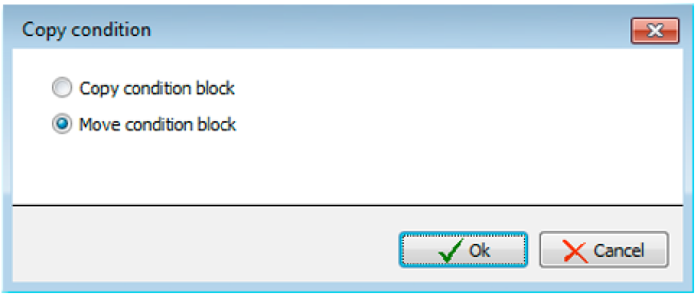
- If you drop a WTG block onto another WTG block, all condition blocks including all shutdown conditions of the source WTG will be **added** to the target WTG block, no matter if the target block is empty or already contains condition blocks (i.e. **nothing will be overwritten**).

- If you drag an object that contains one or more shutdown conditions with a reference to the source WTG (e.g. wind speed of the source WTG less than + 6 m/s“), you have to decide in a dialog window whether the reference should be replaced by a reference to the target WTG (this is typically used) or the reference to the source WTG should remain unchanged, see dialog windows **B**, **C**, **D** below.

All dialog windows you may encounter when using drag & drop are explained in the following.

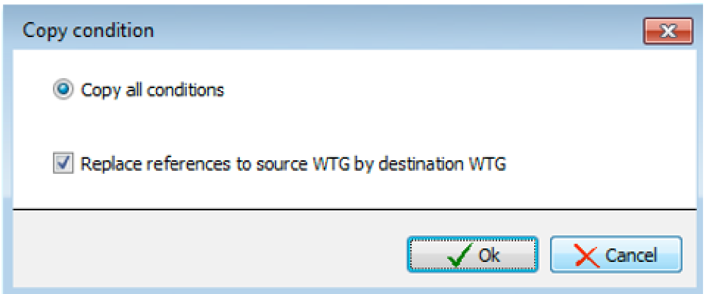
Dialog windows you may encounter when copying or moving an object

A



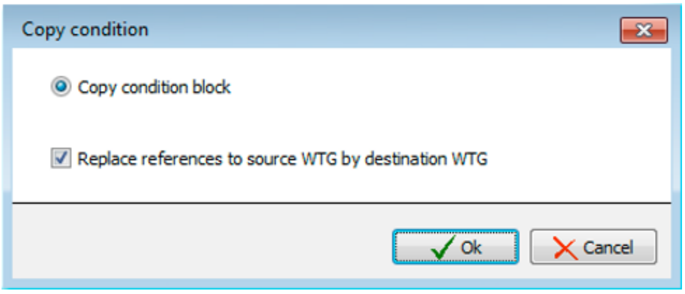
You are moving a condition block within its own WTG block. If you select **Copy condition block**, the condition block will be duplicated (the number of condition blocks increases by **1**). If you select **Move condition block**, nothing will change except for the position of the block.

B



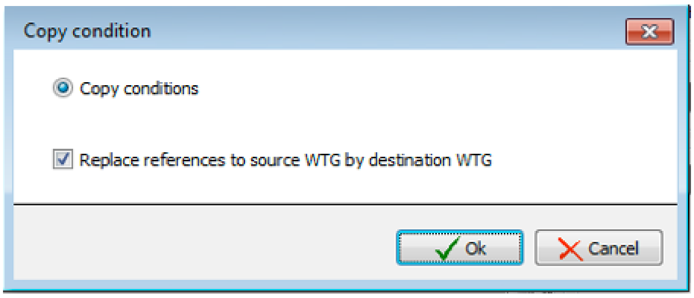
You are copying a WTG block that contains one or more shutdown conditions with reference to the source WTG (the same WTG). If a checkmark is set, the reference will be replaced with a reference to the target WTG (this is typically used), otherwise the reference to the source WTG will remain unchanged.

C



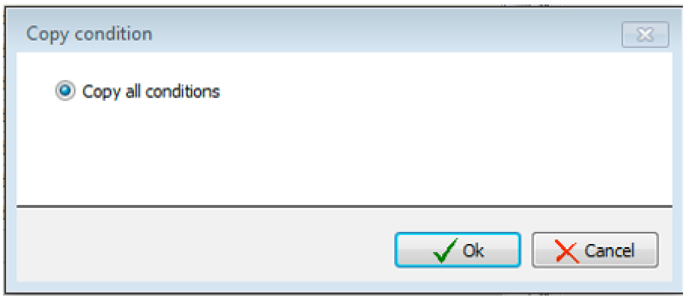
You are copying a condition block that contains one or more shutdown conditions with reference to the source WTG (the same WTG). If a checkmark is set, the reference will be replaced with a reference to the target WTG (this is typically used), otherwise the reference to the source WTG will remain unchanged.

D



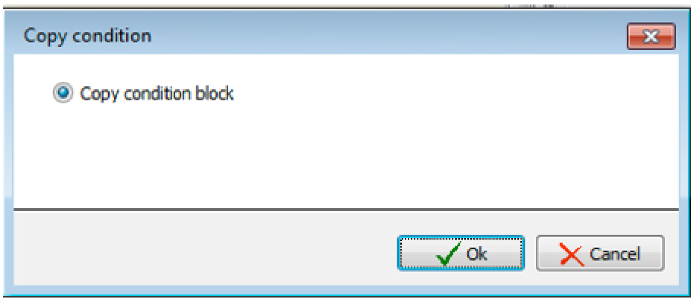
You are copying a shutdown condition with reference to the source WTG (the same WTG). If a checkmark is set, the reference will be replaced with a reference to the target WTG (this is typically used), otherwise the reference to the source WTG will remain unchanged.

E



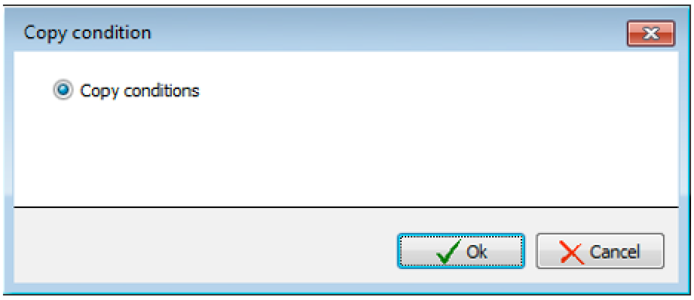
You are dragging a WTG object that contains NO shutdown condition with reference to the source WTG (the same WTG). To complete the process, click on OK. If the target object is **empty**, it will be overwritten; if it is **not empty**, the source object will be added as a new object.

F



You are dragging a condition block that contains NO shutdown condition with reference to the source WTG (the same WTG). To complete the process, click on OK. If the target object is **empty**, it will be overwritten; if it is **not empty**, the source object will be added as a new object.

G



You are dragging a shutdown condition without reference to the "same" WTG. To complete the process, click on OK. If the target object is **empty**, it will be overwritten; if it is **not empty**, the source object will be added as a new object.

! If a shutdown condition is displayed in **red** or **black** bold letters in the display area of the **Special Shutdowns** or **Night shutdowns** window (left half of the window), then SM4 has detected that an input is "not plausible". Please refer to the information in the Plausibilty check 202 section.

4.4.2 Night Slice Shutdowns window

Purpose	Define complex shutdown conditions for bat protection (division of the night into slices with different conditions)
Symbol	
Path	*Switching & Measurement > Night Switching Shutdowns*
Window type	Divided vertically, see Vertically divided windows 21 (basic operation like the **Special Shutdowns** window)
Type of use	Interactive
Reference	Opened project

Some bat protection requirements are so complex that different conditions apply in different Time slices during the night. To fulfill such requirements, SM4 provides Night Slice Shutdowns options. If the bat protection requirements are less complex (shutdown conditions are the same for the entire night), you do not have to use the Night Slice Shutdowns settings and can simply use Special Shutdowns.

The basic structure and operation of the **Night Slice Shutdowns** window are based on the **Special Shutdowns** window. However, date ranges and night slices also exist in addition to WTG blocks, Condition blocks and shutdown conditions in the **Night Slice Shutdowns** window; see the following figure (differences to the **Special Shutdowns** window marked in red):

<table>
<tr><td colspan="2">Night Slice Shutdowns</td></tr>
<tr><td rowspan="2">display area (levels)

Night Slice Shutdowns that have already been defined are displayed here (in different colors according to the level) and can be easily selected or copied per drag & drop.

WTG block 1
Date range...
Time slice 1
Condition block 1
Shutdown condition
Shutdown condition
...
Date range...
Time slice...
Condition block 1
Shutdown condition
Shutdown condition
...
WTG2
Date range...
Time slice
Condition block 1
Shutdown condition
Shutdown condition
...
WTG</td><td>settings area

Drop-down lists with options and input fields for the following operating procedures:

• select/add/remove a WTG
• specify/change/delete date ranges
• define/add/change/delete Time slices
• specify/change block name
• select switch reason for block
• add/change/delete condition blocks
• define/add/change/delete a dataset with shutdown conditions</td></tr>
<tr><td>Condition

The result of the current settings in the settings area is displayed in words</td></tr>
<tr><td>display area buttons</td><td>settings area buttons</td></tr>
</table>

Schematic representation of the **Night Slice Shutdowns** window

Because the operation of the **Night Slice Shutdowns** window is almost no different to that of the **Special Shutdowns** window, only the basic procedures for creating night slice shutdowns are described below. Information on defining the individual shutdown conditions can be found under **Shutdown condition input area** 201.

Basic procedures for creating a Night Slice Shutdown

This section describes how you can set up a Night Slice Shutdown if none have been defined beforehand.

- Open the **Night Slice Shutdowns** window (*Switching & Measurement > Night Slice Shutdowns*).

- Select the respective WTG from the **WTG** drop-down menu at the top right and click on **Add** below.
- Click on the small arrow in front of the selected WTG at the top left in the window.
- Click on the red highlighted Date range and enter **Begin** and **End** at the right. Click on **Apply** at the bottom right in the window.

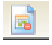
i Date ranges that are defined with data on the year are only valid for the year entered. If no data on the year has been entered, the date range also applies to the following years. Years must be entered with **four digits**.

- Click on the small arrow in front of the date range at the top left in the window. The first Time slice will now be displayed. Click on it to select.
- Select the **Time slice before sunset** option in the drop-down list at the right in the window, enter the desired value for **Time slice length % of the night** (e.g. 15 %) and click on **+ Add** at the bottom of the window. The percentage refers to the time between sunset and sunrise. If no time slice before sunset is required, select **Night time slice** from the dropdown list.
- Click on the arrow in front of **Time slice before sunset** or respectively **Time slice 1**, then click on **Condition block 1**. Now enter the desired name in the **Block name** field on the right and click on **Apply**.
- Click on the arrow in front of **Condition block 1** and then on **<empty>**. The **Condition** input area will now appear on the right.
- Now define the conditions in the **Condition** input area. The operation is identical to that of the **Shutdown condition** area in the **Special Shutdowns** window (see Shutdown condition input area 201).
- Subsequently set up and define all other Time slices and Condition blocks according to the requirements of the authorities (a Night slice for the time after sunrise can also be defined).

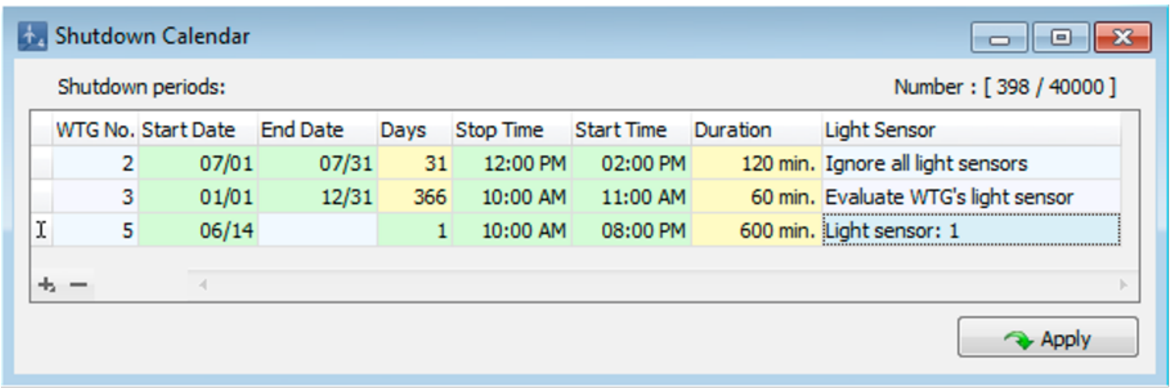
! If a shutdown condition is displayed in **red** or **black** bold letters in the display area of the **Special Shutdowns** or **Night shutdowns** window (left half of the window), then SM4 has detected that an input is "not plausible". Please refer to the information in the Plausibilty check 202 section.

See also Practical example 5: Requirements for bat protection w/ night slices 35

4.4.3 Shutdown Calendar window

Purpose	Define fixed shutdown periods (unconditional)
Symbol	
Path	*Switching & Measurement > Shutdown Calendar*
Type of use	Interactive
Reference	Project

The **Shutdown Calendar** window is used to define fixed shutdown times to be applied regardless of other conditions, such as position of the rotor with respect to the sun. The only condition that can be defined in addition to time is **Sun is shining**, which is determined by the light sensor.



Shutdown Calendar window

General notes on the **Shutdown Calendar** window

- The shutdown times that have already been created are shown in a list. The information **398/40,000** in the upper-right corner of the screen means that 398 (31+366+1, see **Days** column) of 40000 possible shutdown periods have been created so far in this example.
- The shutdown periods are created/edited directly in the columns. To add a new shutdown time, click on the **+** character (bottom left); to remove a shutdown time, select the time to be removed and click on the **-** character (also bottom left).
- Mandatory fields are highlighted in red (only visible in empty lines).
- Correctly defined input fields are highlighted in green.
- If the values defined under **Days** or **Duration** result in a suspiciously long period, the value will be highlighted in yellow.

Operating instructions for the **Shutdown Calendar** window

- Move columns: Columns can be moved by drag & drop.

- Sort by column: You can sort a column according to its heading by clicking on it. If you then click again on the same column heading, the sort sequence will change from ascending to descending or vice versa.
  You can also sort by more than one column heading (criteria). To do this, first press and hold the shift key and then click on the desired column headings. The sorting will be carried out according to the order in which you click on the column headings.

The information, options or buttons are described in the following table

<table>
<tr><th>Element</th><th colspan="2">Explanation/function</th></tr>
<tr><td>WTG No.</td><td colspan="2">Select the No. of the WTG to be shut down during fixed periods of time.</td></tr>
<tr><td>Start date</td><td colspan="2">Specify the first day of the period during which the respective WTGs is to be shut down during a specified period of time.
DD.MM* (without full stop)</td></tr>
<tr><td>End Date</td><td colspan="2">Specify the last day of the period during which the respective WTGs is to be shut down during a specified period of time. However, this field can also remain empty if the parameters Stop time and Start time only apply to the Start date.
DD.MM* (without full stop)</td></tr>
<tr><td>Days</td><td colspan="2">This field will be filled out automatically – you can use it to check that you entered the values correctly.
If you have defined a date range that results in a period of more than 19 days, this field is highlighted in yellow, in order to point out that a WTG will be shut down over a fairly long period of time.</td></tr>
<tr><td>Stop Time</td><td colspan="2">Specify the time at which you want the shutdown period to end. Please also take into account the Summer winter time handling setting (Project > Settings> SMU > Time settings).
24-hour format, HH:MM*</td></tr>
<tr><td>Start Time</td><td colspan="2">Specify the time at which you want the shut-down period to end. Please also take into account the Summer winter time handling setting (Project > Settings> SMU > Time settings).
24-hour format, HH:MM*</td></tr>
<tr><td>Duration</td><td colspan="2">This field will be filled out automatically – you can use it to check that you entered the values correctly. If you have defined a time range that results in a period of more than 29 minutes, this field is highlighted in yellow in order to point out that a WTG will be shut down over a fairly long period of time.</td></tr>
<tr><td rowspan="3">Light Sensor</td><td colspan="2">Select one of the 3 options from the drop-down list:</td></tr>
<tr><td>Option</td><td>Effect</td></tr>
<tr><td>Ignore all light sensors</td><td>The defined shutdown period is applied regardless of any other condition.</td></tr>
</table>

Element	Explanation/function	
	Evaluate WTG's light sensor	The defined shutdown period is applied only if the light sensor of the WTG reports that shadow impact is possible.
	Light sensor: 1... 40	The defined shutdown period is applied only if the selected light sensor reports that shadow impact is possible.
	This button is used to confirm the entered/selected data.	

*The format stated here corresponds to the default settings in the input area **Country-Specific Settings** (*File > Application Settings > ShadowManager 4 > General*) and can be changed there at any time.

! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

4.4.4 On-Demand Shadow Shutdowns window

Purpose	OSS can be used to allow residents of places of immission to switch off WTGs that cause shadow impact using an app on their smartphone.
Icon	
Path	*Switching & Measurement > On-Demand Shadow Shutdowns*
Prerequisite	SMU version 4.2.52 or higher
Usage type	Interactive
Reference	Project

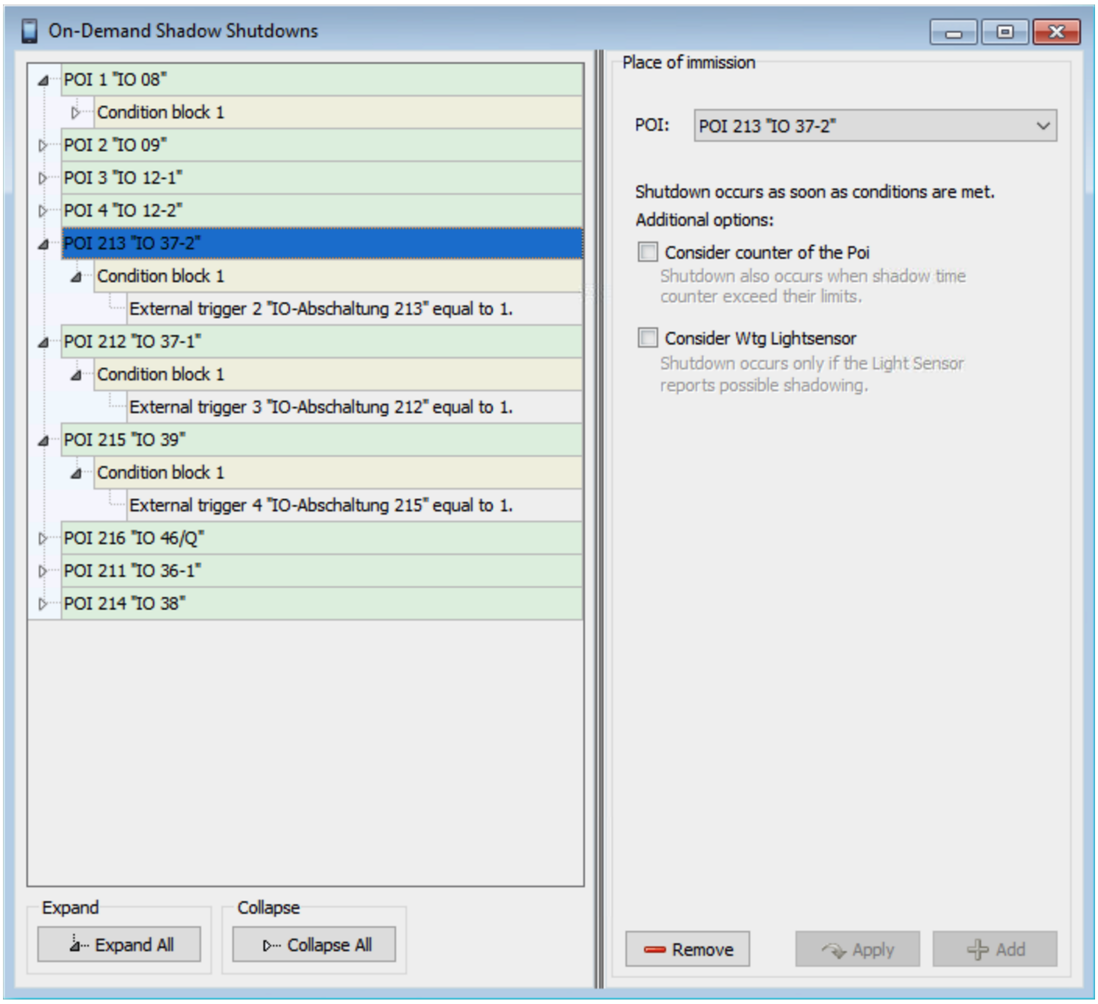
On-demand shadow shutdowns (OSS) allow residents of places of immission (POI) to switch off the WTG(s) causing shadow impact at their POI using an app on their smartphone.

The structure and operation of the vertically divided **Reading Point Switches** window essentially corresponds to the **Special Shutdowns** window. (If you are not familiar with the latter, please start by reading the sections Vertically divided windows 21 and Special Shutdowns window 193.) However, at the top level of this window, you do not select the WTG to be shut down, but a POI whose residents can shut down WTG(s) causing shadow impact on demand.

What is the difference between OSSs and "standard" shadow impact shutdowns?

In the case of "standard" shadow impact shutdowns, a WTG causing shadow impact is shut down only when the annual or daily counters of the affected POIs exceed the upper limit. With OSSs, on the other hand, taking the counters into account can be deselected (see **Consider counter of the POI** in the screenshot below).

In addition, with "standard" shadow impact shutdowns, WTGs are shut down only if the light sensor reports conditions that allow for actual shadow impact. This can also be deselected with OSSs (see **Consider WTG light sensor** in the screenshot below).You will find further information on the next page.



On-Demand Shadow Shutdowns window **(OSS)**

Explanation of the above example window:

- The two options explained above (**Consider counter of the POI** and **Consider WTG light sensor**) are deselected. Therefore, **only** the conditions defined on the left will determine the shutdown of WTGs that cause or could cause shadow impact at the POI.
- To allow residents of POIs to shut down a WTG via smartphone app, define a shutdown condition with an external trigger, as already done in the example above for POIs 213, 212 and 215. External triggers can be defined as software versions of digital inputs, see glossary371. In order to be able to define a trigger as a source in a shutdown condition, you must have created it beforehand under *Hardware > Sensors & IO Signals > External Triggers tab*.
- The residents of the POI can then use a smartphone app to turn off the WTG(s) that cause or could cause shadow impact at their POI.
- Just like several other shutdown windows, the OSS window allows for defining a time range (not visible in the screenshot above) in addition to triggers. However, other options are not available in this window.

NOTE

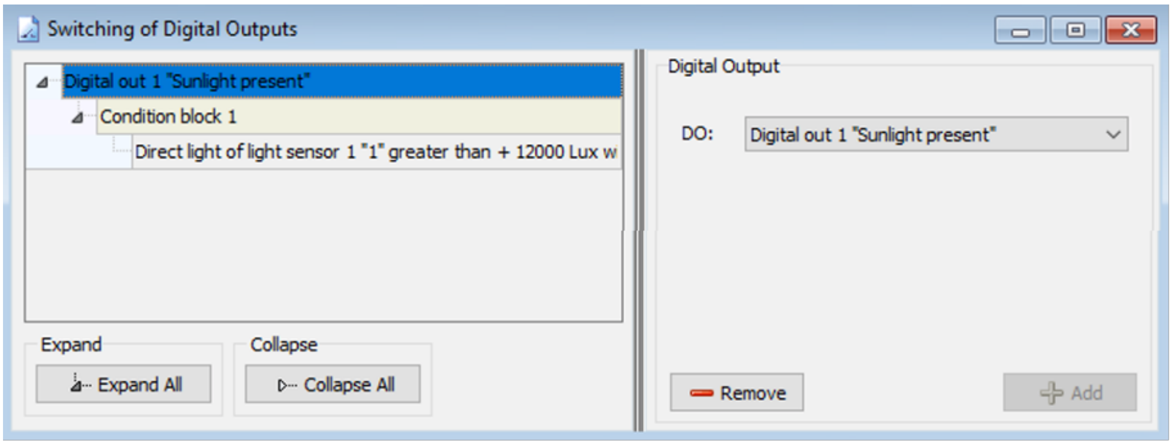
- External triggers can only be used for OSSs and can only be set remotely if (a) an external trigger has been set up beforehand at *Hardware > Sensors and IO Signals > External Triggers* tab and (b) the external Special Shutdown Interface has been activated in the project settings *(Project > Project Settings > Server settings*).
- OSSs trigger an event when they become active. The POI number is recorded for this type of event as the **Default reading point** while the conditions defined at OSSs are recorded as the **Condition reading points**. In addition, you can define **User-defined reading points** (for more information, refer to the Events window 258 section).

4.4.5 Switching of Digital Outputs window

Purpose	Set conditions for switching digital outputs
Path	*Switching & Measurement > Digital out switching*
Type of use	Display + interactive
Reference	Entire project

In this window you can define conditions that set a digital output as soon as they are fulfilled and reset the output as soon as they not fulfilled anymore. The Set and Reset operations trigger events that can be referenced in the Events window 258.

The structure and operation of the vertically divided **Switching Digital Outputs** window essentially corresponds to the **Special Shutdowns** window. If you are not familiar with the latter, please start by reading the sections Vertically divided windows 21 and Special Shutdowns window 193.



Switching of Digital Outputs window

Explanation of the above example window **Switching of digital outputs:**

- The digital output selected in the **DO** drop-down list (right half of the window) has previously been defined in the **Digital Outputs** tab (*Hardware > Sensors and IO Signals*).
- In the above example, the digital output is set when the measured light value of light sensor 1 is greater than 12000 lux, and reset again as soon as the light value has fallen below 11900 lux because of the hysteresis of 100 lux.
- An event is triggered by setting or resetting a digital output. In the **Events** window, the number of the DO and the values of the reading points from the conditions for switching the DO are logged as standard. Further reading points can be added by the user as desired.
- For switching of digital outputs to work, they must be assigned in the **Hardware Assignments** window (*Hardware > Hardware Assignments*), see section Hardware Assignments window 189 for more information.

4.4.6 Single Data Recordings window

Purpose	To record individually selectable measurement data and link/compare them to one another. The corresponding data is output as a separate log.
Symbol	
Path	*Switching & Measurement > Single Data Recording*
Window type	Divided vertically, see Vertically divided windows 21 (basic operation like the **Special Shutdowns** window)
Type of use	Interactive
Reference	Project

In addition to the 3 standard logs (Operation/Shadow impact/Shutdown log) you can also define a user-defined log in SM4 with data that can be individually selected.

Logging can take place cyclically at selected intervals and/or depending on specific log conditions (**Attention**: the actual conditions, which are called “Shutdown conditions” for Special shutdowns, are designated as “Log conditions” here).

The linking logic is the same as for Special shutdowns (condition blocks are linked by OR and conditions by AND).

The basic structure and operation of the **Single Data Recordings** window are based on the **Special Shutdowns** window. However, at the top level, you do not select the WTG to be shut down but a measurement object instead (source and reading) whose values should be logged. See the following figure (differences to the **Special Shutdowns** window are marked in red):

Single Data Recordings	
display area (levels) Single data recordings that have already been defined are displayed here (in different colors according to the level) and can be easily selected or copied by drag & drop. *Measurement object 1* *Condition block 1* *Log condition* *Log condition* ... *Condition block 2* *Log condition* *Log condition* ... *Measurement object 2* *Condition block 1* *Log condition* *Log condition* ... *Measurement object...*	**settings area** Drop-down lists with options and input fields for the following operating procedures: • select /add /change / delete measurement object • specify/change block name • add/change/delete condition blocks • define / add / change / delete datasets with log conditions **Condition** The result of the current settings in the settings area is displayed in words
display area buttons	**settings area buttons**

Schematic representation of the **Single Data Recordings** window

Because operating the **Single Data Recordings** window is almost no different to operating the **Special Shutdowns** window, only the basic procedures for creating measurement data logging are described. Defining individual log conditions corresponds to how shutdown conditions are defined, see **Shutdown condition input area** 201.

Basic procedures for setting up Single Data Recordings window

This section describes how you can set up a Single Data Recording set if none has been defined beforehand.

- Open the **Single Data Recordings** window (*Switching & Measurement > Single Data Recording*).
- Select the desired source in **Source** at the top right.
- If applicable, enter a different number in **No**.
- Select the desired option at **Reading point**.
- If readings should be performed cyclically, set a checkmark at **Cyclic log** and define the **Log interval** underneath.
- Click on **Add** at the bottom of the window.

The following steps are optional

- Click on the small arrow in front of the created measurement object at the top left in the window.
- Now click on the small arrow in front of **Condition block 1**.
- Click on **<empty>.**
- Now define the actual condition in the **Log Condition** input area and then click on **Add**. The operation is identical to that of the **Shutdown condition** area in the **Special Shutdowns** window (see Shutdown condition input area 201).
- You can then set up and define all other measurement objects, condition blocks and log conditions as you wish.

4.4.7 Cyclic Multi Log window

Purpose	• Regular recording of a series of measured values • Define specifications exporting the results in .csv format
Abbreviation	Cyclic Multi Data Recording = CMDR
Path	*Switching & Measurement > Cyclic Multi Data Recording*
Window type	divided vertically, see Vertically divided windows 21 (basic operation similar to the **Special Shutdowns** window)
Type of use	left part: display only; right part: interactive
Reference	Project

Using **Cyclic Multiple Data Recordings**, the regular recording of an entire series of measured values can be conveniently implemented even for larger wind park projects. The subsequent output of the results in csv. format requires little more than clicking a button.

Single Data Recordings (previous section) are also used to log data, however, they require a separate recording being defined for each reading point (e.g., wind speed, temperature), and setting up CMDRs for larger projects, collecting the results and presenting them in a structured csv. file would be very time-consuming.

In the **Cyclic Multi Log** window, on the other hand, the focus is on the measuring interval and measuring conditions:

- You first set up a recording (e.g. data from WTG x) with a timer* (e.g., every 10 minutes).
- If required, you can assign measuring conditions, e.g. a time period (e.g., only record from sunset to sunrise).
- You can then assign several reading points to each of these WT records.
- In addition, the .csv export file can be predefined (e.g. file name and column headers).

*Interval timers are predefined in a separate window, see section Interval Timer window 243.

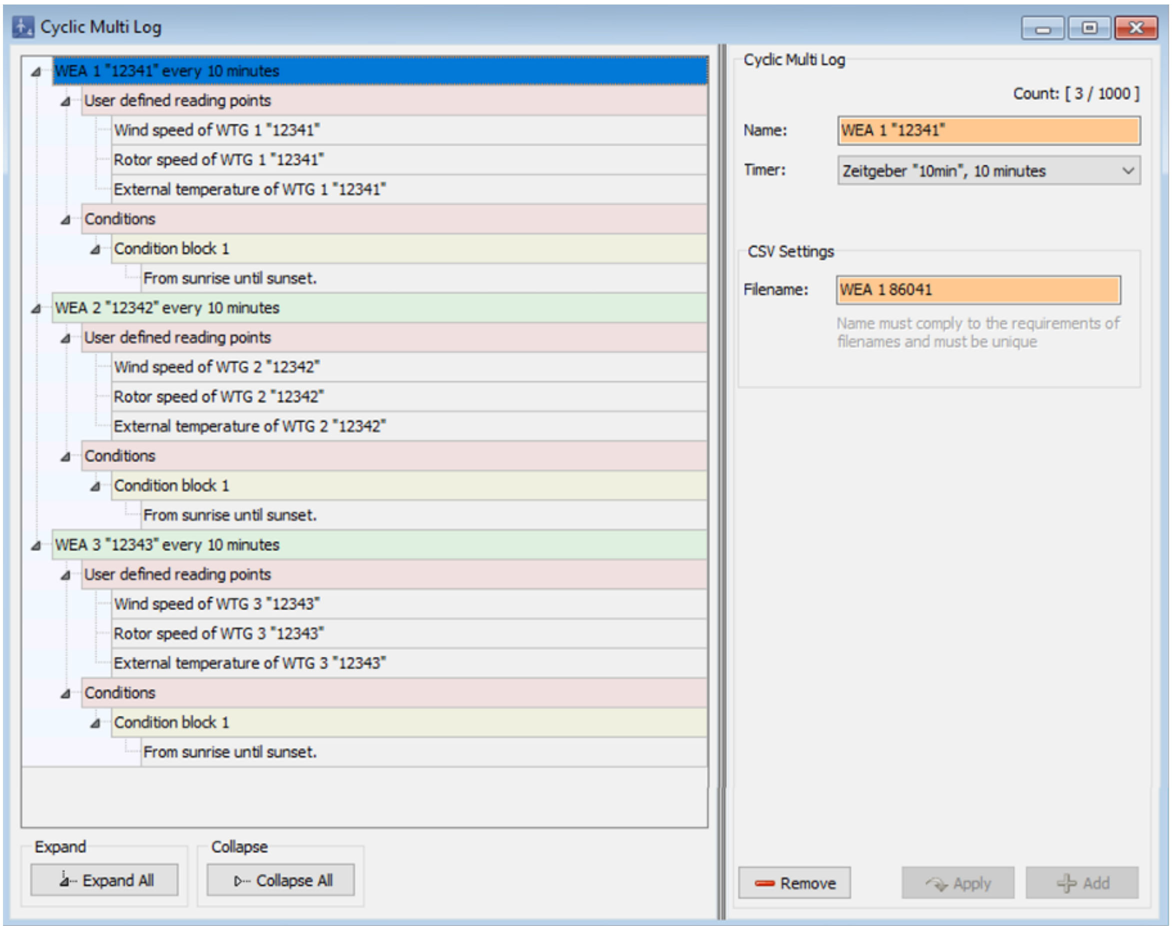
If, for example, in a project of 40 WTGs, four reading points are to be recorded for each of these WTGs, this requirement could be met by defining **just 40** CMDRs instead of **4x40 = 160** single data recordings.

CMDRs in the overall process

Once you transfer a project that contains one or more CMDRs to the SMU, the SMU will the record defined reading points in the specified time grid. Each measurement is logged as an event in a separate number range of the special shutdown log. These results, like all other events, could be filtered and presented in tabular form. However, to take advantage of the CMDR functionality, we recommend using the export function, see overall process:

1. Define CMDRs (*Switching & Measurement > Cyclic Multi Data Recordings*)
2. Save settings and send project to SMU (*Project > Configuration*)
3. Events are logged by the SMU
4. Download log files from SMU (*Logs > Log files SMU*)
5. Under *Logs > Local Log Files* select project and date range and click on **Export**
6. In the **Export Cyclic Multi Log** window, make last settings for the export and start the export.

The following is an example of the **Cyclic Multi Log** window with explanations.



Cyclic Multi Log

In the example window shown above, the task was to record the measured values "wind speed", "rotor speed", and "temperature" for WTG 1–3 of the project every 10 minutes from sunrise to sunset. The following was defined for this purpose:

- green level: three multiple recordings (one per WTG), the name of the recording is supplemented by the respective timer. Timers are defined beforehand in a separate window, see section Interval Timer window 243.

- red level – user-defined reading points: three user-defined reading points per WTG

- red layer – conditions: Condition block with the condition that should be recorded from sunrise to sunset

- The project on which the above example is based comprises 40 WTGs. The desired four reading points can be defined with just 40 CMDRs instead of 120 single data recordings.

In the following you will find further explanations on the **Cyclic Multi Log** window.

The structure and operation of the vertically divided **Cyclic Multi Data Recording** window essentially corresponds to the **Special Shutdowns** window. If you are not familiar with the latter, please start by reading the sections Vertically divided windows 21 and Special Shutdowns window 193.

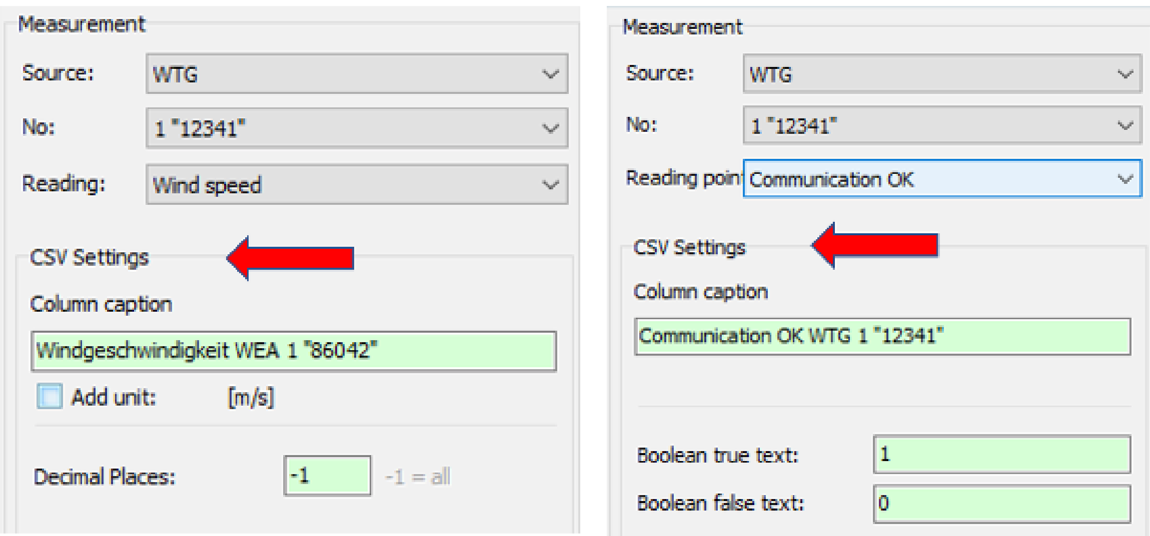
In the following, only those fields or properties are explained that are not self-explanatory or do not apply to vertically divided windows in general.

When creating a new recording (green level), you need to fill in the **Filename** field in the **CSV** Settings section (see above screenshot). Please note the following:

- conventions for Windows file names must be observed (certain characters and names, e.g. " : ; '< > as well as LPT0, COM0 etc. are not allowed), otherwise the field is highlighted in red

- all .csv files of all CMDRs will later be output to the same folder – therefore the file names must be unique so that they won't each other; file names are **not** case-insensitive, i.e., filename = fileName Filename = fileName Filename = fileName

Also when adding the reading points under **User defined reading points** (light gray layer), you will come across the **CSV Settings area, which there, depending on the type of reading point, will look like in one of the following examples:**



Cyclic Multi Data window (sections thereof)

The information, options or buttons are described in the following table

Box	Explanation/function
Column header*	In order to recognize later in the .csv file which value was recor-ded, column headers (captions) can be assigned. When adding a reading point, the name of the reading point is suggested together with the name and number of the source (e.g., sensor, WTG, etc.). **NOTE:** If a WTG or a sensor is assigned a new number, then all shutdowns, shutdown conditions, recordings etc. affected by the change are automatically adjusted. However, this does **NOT** apply to column captions – these must be adjusted manually. Preset by measuring point names, freely editable
Attach unit*/**	Here you determine whether the unit (if applicable) is added to the column header.
Decimal places**	For floating point values, you specify here the number of decimal places the values will have in .csv file.
Text for Boolean true** **Text for Boolean untrue****	Boolean values default to "0" and "1". You can replace this, e.g., with "fail/OK" or "light/shadow".

* Can be edited in the **Export Cyclic Multi Log** window, see Export Cyclic Multi Log window 331.

Can be pre-defined int eh Application Settings** (seeApplication Settings window, Csv-Export, Cycl. Multi Data Recordings. 76) but this only affects new reading points, already defined reading points keep the original settings.

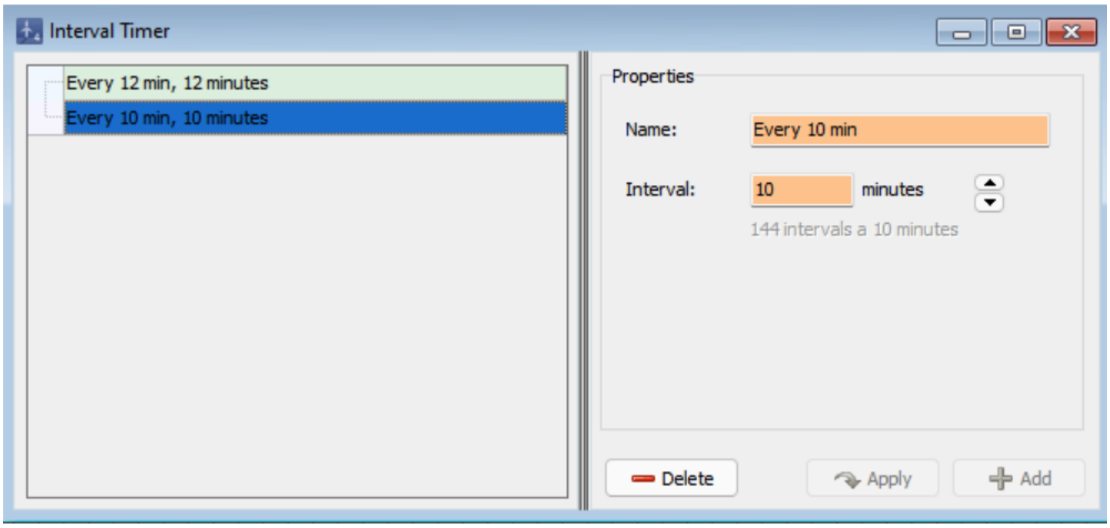
! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

See also Practical example 8: Regular recording of several measured values 46

4.4.8 Interval timer window

Purpose	Define intervals, e.g., for the **Cyclical Multi Data** window.
Path	*Switching & Measurement > Interval Timer*
Type of use	Display + interactive
Reference	Entire project

In this window, you can define intervals that can subsequently be selected as timers in other windows, e.g., in the **Cyclic Multi Log** window.



Interval Timer window

Notes on the **Interval Timer** window

As with any vertically split window 21 the datasets already created are displayed on the left, in this case interval timers, while the actual definition is done on the right.

- Up to 5 timers can be defined
- **Name** field: input freely selectable
- **Interval** field: The interval you enter here must fit “smoothly” into a period of 24 hours. Ergo, intervals such as “7” or “13” are not permissible and therefore cannot be entered (the input field is not green, but has a reddish background). The number of times the value you enter or select with the arrow keys will fit into 24 hours is displayed below the input field. If you select the value using the arrow keys, only permissible values are offered.
- Longest possible interval: 1 interval a day

4.4.9 Condition Flags window

Purpose	Define condition flags for special or night slice shutdowns that can be activated (set) by one set of conditions and cleared (reset) by another
Path	*Switching & Measurement > Calculations*
Window type	Divided vertically, see Vertically divided windows 21 (basic operation similar to the **Special Shutdowns** window)
Type of use	left part: display only; right part: interactive
Reference	can be used in special and night slice shutdowns

In connection with special and night slice shutdowns, it may be necessary or useful to treat a condition defined as a shutdown criterion (e.g., no precipitation present) as "not fulfilled" for a longer time than measured by the respective climate sensor.

A typical situation would be a regulation in the area of bat protection according to which a WTG doesn't have to be switched off for the rest of the night as soon as it rains, i.e., not even if it stops raining in the same night.

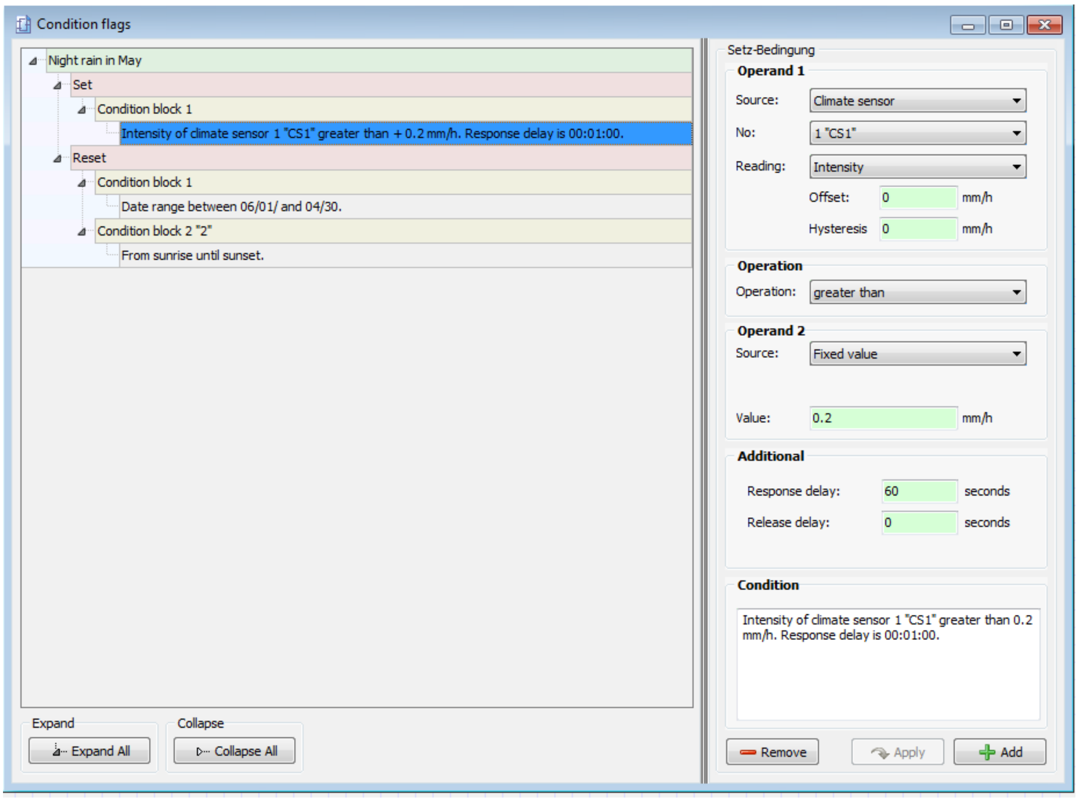
In order to reflect a scenario of this type, special or night slice shutdowns must be supplemented with so-called condition flags, which can be set by one set of conditions and cleared again by another, see also Example 7: Supplement a bat shutdown with condition flags 44.

> **i** Condition flags can only influence the shutdown/startup of WTGs if they are referenced in special or night slice shutdowns. Otherwise, they take no effect.

The structure and operation of the vertically divided **Condition Flags** window essentially corresponds to the **Special Shutdowns** window. If you are not familiar with the latter, please start by reading the sections Vertically divided windows 21 and Special Shutdowns window 193.

> **!** Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

The **Condition Flags** window is described in detail in the following.



Condition Flags window

Explanation of the above **Condition Flags** example window

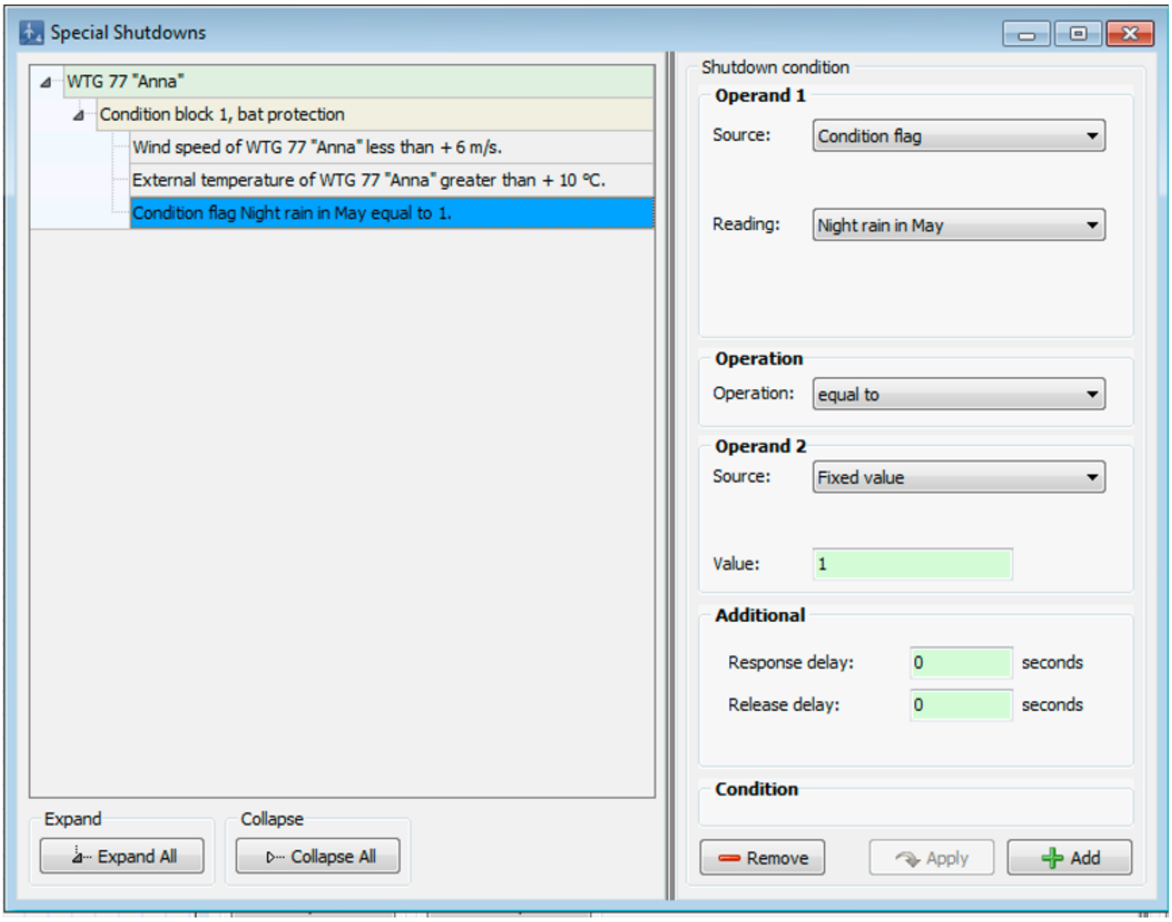
On the left side of the screen a condition flag **(Night-time rain in May**) is displayed, including its **Set** and **Reset** conditions (red layer). As is usual with vertically split windows, it was defined in the right half of the window. The following applies to the value of a flag:

Set condition(s) fulfilled = **1**, **Reset** condition(s) fulfilled = **0**

A flag is therefore set (i.e., **1** is returned) if the **Set** conditions are true. It remains set even if the **Set** conditions no longer apply. In the example above, the flag is set as soon as precipitation is measured. If it stops raining again, the flag will remain set.

A flag is cleared (i.e., **0** is returned) if the **Reset** conditions apply. Once the **Reset** conditions no longer apply, the **Set** conditions take over. In the example above, the flag can only be effective in the month of May and even then, only during the night.

On the following, the above example of **Night rain in May** is also used to describe how condition flags are used in special or night slice shutdowns.



Special Shutdowns window with condition flag

Explanation of the above **Special Shutdowns** example window

The **Night rain in May** condition flag can be defined as a reading for special shutdowns provided that the **Condition flag** option was selected as the **Source**.

In the above example, the WTG should "normally" be shut down as soon as it is warmer than 10 degrees and the wind is blowing at less than 6 m/s. The condition flag is used to ensure that the system is **not** shut down if these two conditions are met while at the same time it is raining or has rained.

The first two shutdown conditions (wind speed and external temperature) are overridden as soon as the condition flag (the third shutdown condition) is activated because the result is 1. In this case, the condition "Condition flag Night rain in May equals 0" is no longer fulfilled and a shutdown is therefore no longer possible, since the shutdown conditions within one condition block are connected to each other by a logical AND. The block (the shutdown) therefore only takes effect if ALL conditions are fulfilled. For the above example, this means in other words: As long as it does not rain during May nights, the other two shutdown conditions can cause the WTG to be shut down. Once it starts raining so that the condition flag is set, wind and temperature become irrelevant and remain so for the rest of the night:

- As a reminder: The following rules apply to conditions flags with regard to Set and Reset:

- A flag is set (i.e. it returns **1**) if the Set conditions apply.
  It remains set, even if the Set conditions no longer apply.
  In the above example, the fact that it is raining sets the flag. It remains set even when it has stopped raining.

- A flag is cleared (i.e. it returns **0**) if the Reset conditions apply.
  Once the Reset conditions no longer apply, the Set conditions take over.

In the example above, the flag is reset when the current date is before or after May or the sun has risen. Whether it rains or not is not relevant anymore. If the Reset condition is not met anymore, i.e. a May night begins, then the precipitation condition takes effect. This means here in particular that if it has already started raining before the night begins, the flag is set immediately as soon as the night begins.

i Condition flags can only influence the shutdown/startup of WTGs if they are referenced in special or night slice shutdowns. Otherwise, they have no effect.

Concluding general notes on condition flags

- As already mentioned, condition flags can only be used in special and night slice shutdowns, but not in single data recordings (measurement data logging).
- Furthermore, they cannot be used as reading points in events of the special shutdown log. They can therefore neither be added by the user nor can they be automatically taken over as condition reading points from special and night slice shutdowns.
- Condition flags trigger an event when they are set or reset
  (see Events window 258).

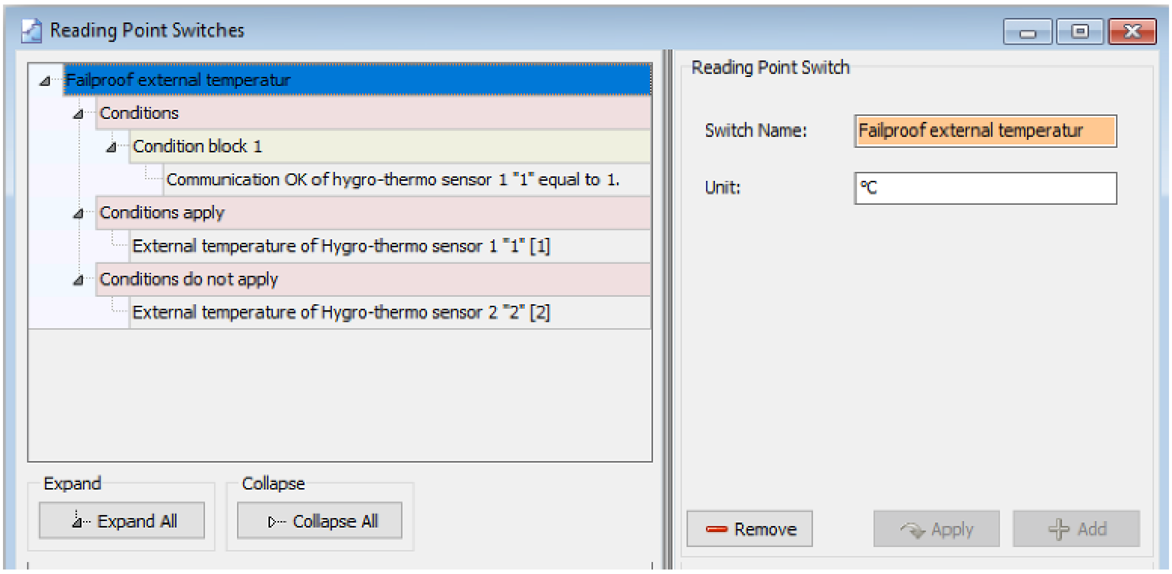
! Please be very careful when entering values in Shadow Manager. Incorrect parameter values may result in avoidable wear and tear, loss of earnings, problems with authorities or residents and in the worst-case force operators to decommission wind turbine generators.

4.4.10 Reading Point Switches window

Purpose	Set up automatic switching between two reading points (e.g. to increase the reliability of sensors)
Path	*Switching & Measurement > Reading Point Switches*
Type of use	Display + interactive
Reference	Entire project

In this window you can, for example, set up automatic switching between the reading points of two sensors. If one of the two sensors fails, the second sensor supplies the required measured values in its place. The reading point switch acts as an "independent" sensor and can be used like one, e.g. in special shutdowns. This improved fail-safety could also be set up directly in the **special shutdowns** window, but only with considerably more work.

The structure and operation of the vertically divided **Reading Point Switches** window essentially corresponds to the **Special Shutdowns** window. If you are not familiar with the latter, please start by reading the sections Vertically divided windows 21 and Special Shutdowns window 193.



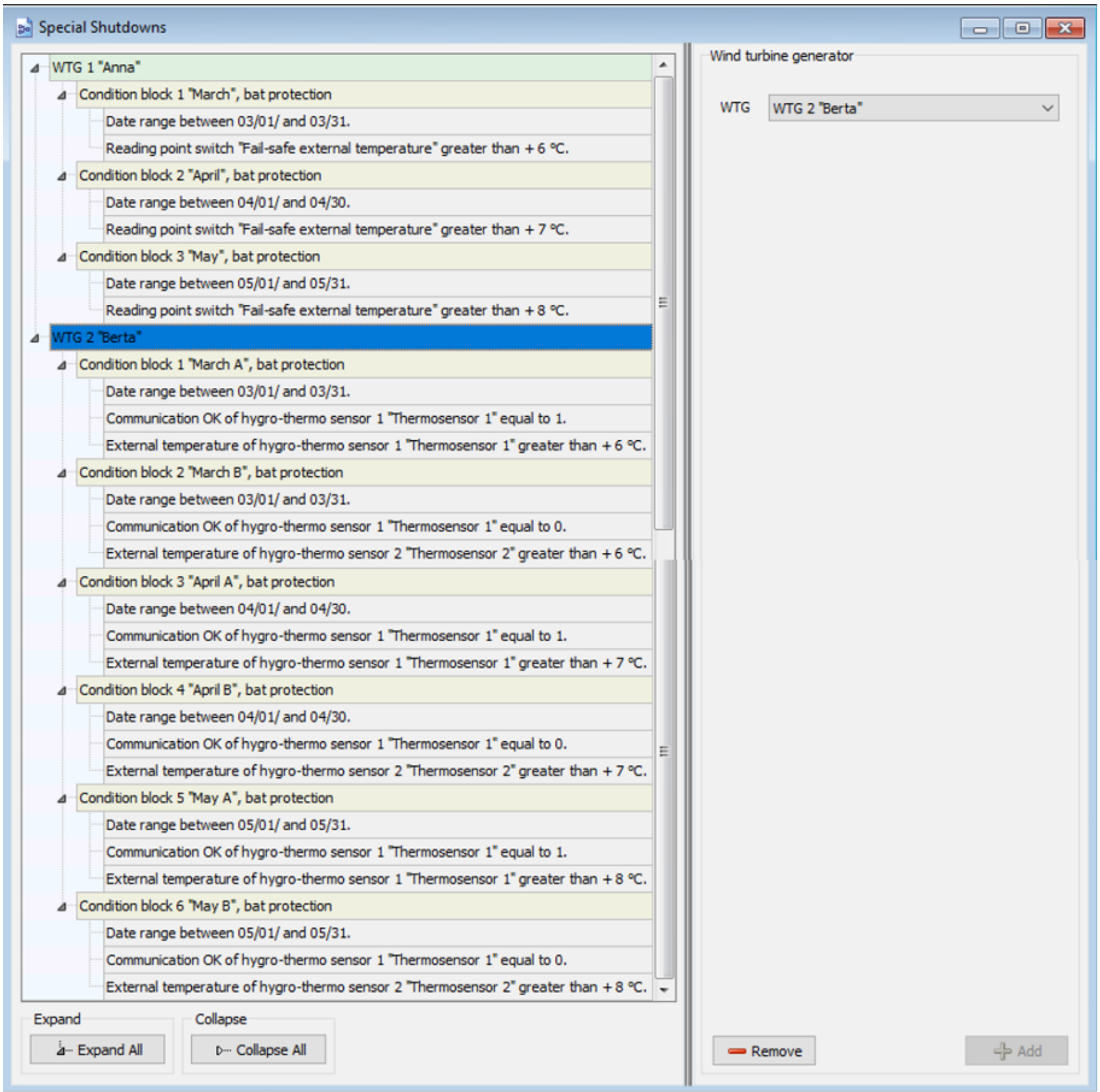
Reading Point Switches window

Notes on the above example for **reading point switches**

- On the right side, a name for the changeover switch has been entered (failproof external temperature), optionally a unit could be added.
- The function of the changeover switch can be seen on the left: Its (only) condition is to be considered true if **Communication OK** has the value 1, i.e. is "OK". If this is the case, the changeover switch supplies the temperature mesured by sensor 1. Only if this condition does not apply, the value of sensor 2 is passed on.

- The same options are available in the **Source** drop-down list for **Conditions, Conditions apply** and **Conditions do not apply** as in the windows **Special Shutdowns**, **Night Shutdowns,** etc. window, so the possiblities are rather endless.

On the next page you will find an example of setting up a "fail-safe external temperature", once **with** measuring point changeover switch, once **without**.



Special Shutdowns window (WTG 1 **with** reading point switches, WTG2 **without**)

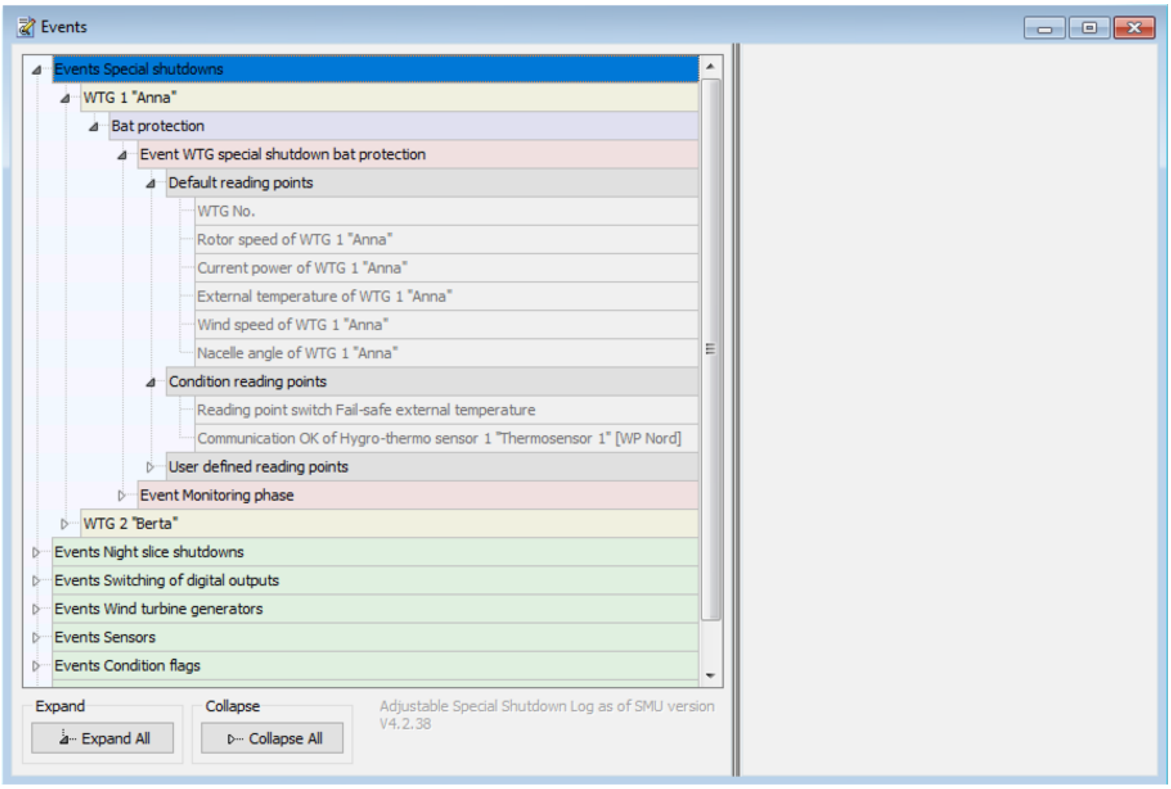
Notes on the above example

- Here you can see that the setup effort for WTG 2 **without** reanding point switches was significantly higher than that for WTG 1 **with** reading point switches. The savings in effort also apply to maintenance, of course.
- Reading point switches are also particularly useful for night slice shutdowns, where the night is divided into 10 or more slices and separate condition blocks and conditions have to be defined for each slice.

Since no separate events are logged for reading point switches, you will find more information on this topic on the next page.

Output values of reading point switches in the log (events)

Reading point switches don't trigger any events. Their output value as well as the measured values in their switchover conditions that have led to an output value are not logged automatically. Since these values are nevertheless interesting, especially if they have contributed to a special shutdown, for example, the measured values of reading point switches to be logged are included in the event record of the corresponding special shutdown, as can be seen in the following example.



Events window (using the example of WTG 1 "Anna")

Notes on the above example window **Events**

- Under the event "WTG special shutdown bat protection" of WTG 1, you can see that the first entry under Condition reaing points" is the output value of the reading point switch; this is the normal entry for the shutdown condition of the special shutdown itself.
- In addition, the communication status of thermo sensor 1 is displayed there, and this originates from the switching condition of the reading point switch. Thus, if a special shutdown occurs, all relevant values are logged with the event "WTG special shutdown".

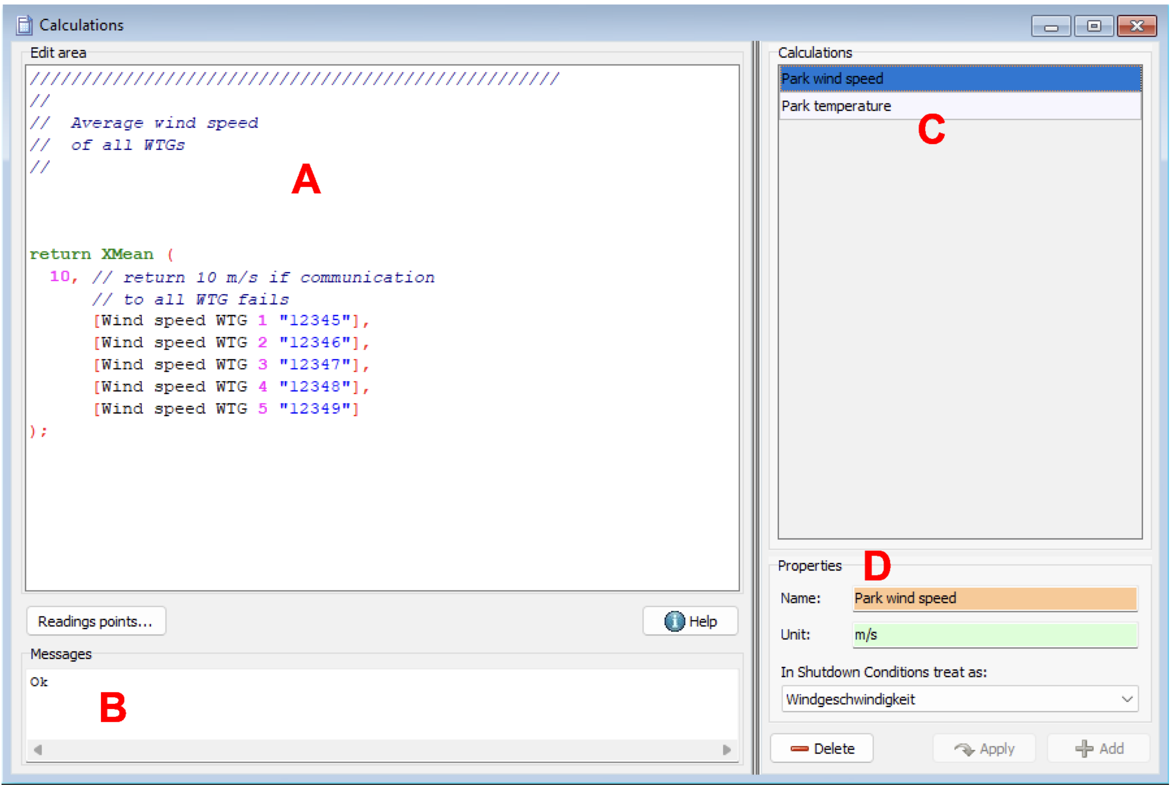
4.4.11 Calculations window

Purpose	Define automatic calculation of certain values to use them in shutdown conditions of Special Shutdowns and Night Slice Shutdowns, Single Data Recordings or as user-defined reading points in the Special Shutdown Log, etc.
Path	*Switching & Measurement > Calculations*
Type of use	Display + interactive
Reference	Entire project

Use this window to define the automatic calculation of certain values, such as

- the average of a measured value over a certain period of time or
- the average park wind speed from the wind speeds of all WTGs,

and then use them as measured values of a sensor for shutdown conditions of Special Shutdowns and Night Slice Shutdowns, Single Data Recordings, etc.



Calculations window

The **Calculations** window is divided into the following four areas:

A Edit area – here you can enter the syntax for the calculation and additional comments if desired.

B Messages (display only) – calculations must comply with a certain syntax. On the one hand, errors that you may have made in the input area are reported here, and on the other, the system displays which entry it expects next.

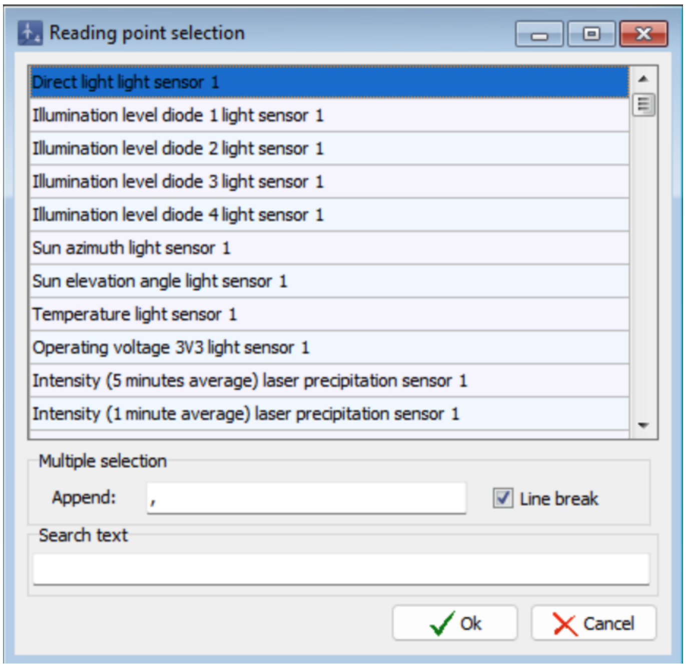
C Calculations (selection only) – any calculations that have already been defined are listed here and can be selected in order to **Delete** an existing calculation, **Apply** changes or **Add** a new one.

D Properties

- here, a calculation is given a name and optionally a unit. The calculation can then be referenced under this name, for example in a shutdown condition.
- **In Shutdown Conditions treat as**: Here you can define the way the result of a calculation is to be checked in a shutdown condition. If you select **Wind speed** here, then, in the windows **Special Shutdowns** or **Night Slice Shutdowns,** every shutdown condition that uses the current calculation will be checked according to the plausibility rules for wind speed. The "neutral" option would be **Not meteorological –** shutdown conditions with a calculation marked this way are not checked for plausibility**.** See also Plausibility check 202.

You will find an overview of the **Calculations**window in the following table

Element	Explanation
Input area	Here you can enter the actual calculation function; the following are currently possible: • **Minimum/Maximum** (e.g., maximum value of wind speeds measured by 2 or more sensors) • **Mean value** (e.g., average value of the intensity of illumination measured by a sensor over a period of 1–60 minutes) • **Rolling mean value** (e.g., repeated calculation of the average value of the intensity of illumination measured by a sensor over a period of 1–60 minutes) • **"Fail-safe" mean value** (e.g., average park wind speed from values of 2 or more sensors whose failure can be detected, and definition of a default value that will be used as a functional result in the event that all sensors have failed). The calculations have to comply with a certain syntax, which is explained in a separate section, seeSyntax for the input area in the Calculations window 255
	The names of the reading points of sensors must be entered exactly (even one additional or missing space makes them unrecognizable for SM4), but if you click on **Readings**, you can easily select one or more of the reading points available in the project in the following window:

<table>
<tr><td></td><td>


You can filter the list of readings by making an entry in the Search text field. This field defaults to the word at which the cursor was positioned in the input area of the Calculations window. This word will be replaced there as soon as you close the Reading point selection window by clicking Ok.

In the list of reading points, several entries can be marked simultaneously and applied to the input area of the calculations window. Before applying them, you can specify a separator to be inserted between the individual entries in the Multiple selection field and also specify that a line break be inserted between the entries.</td></tr>
<tr><td>Calculations</td><td>Any calculations that have already been defined are listed here and can be selected in order to Apply changes to an existing calculation or Add a new one.</td></tr>
<tr><td>
</td><td>Serves to add a new calculation and is only active if a name has been entered for that calculation that does not yet exist in the list in the top right-hand corner of the window.</td></tr>
<tr><td>
</td><td>Is used to edit an existing calculation and is only active if a calculation has been selected in the list and something has been changed.

Changes will only be applied if you confirm them by clicking on Apply. Otherwise, the changes will be discarded as soon as you select a different calculation or close the window.</td></tr>
<tr><td>Name</td><td>Unique name of the calculation, no requirements.</td></tr>
<tr><td>Unit</td><td>Here you can define the unit for the result of a calculation. This text is used, for example, for shutdown conditions.</td></tr>
</table>

4.4.11.1 Syntax for the input area in the Calculations window

The input of a function must correspond to a certain definition language and syntax. Both will be explained in this section.

General notes

- The keyword "return" serves to return the result of the calculation.
- The parameters are entered in round brackets, the reading points in square brackets, the end is indicated by a semicolon, example:

  ```
  return max ([reading 1], [reading 2]);
  ```

- The keywords of the definition language are in English – even if SM4 is set to German, "return" remains English. However, names of reading points are language dependent and are switched accordingly.
- The input area works much the same way as a standard text editor. You can mark, copy, delete, paste, etc. and also undo actions with Ctrl+z.
- Comments on the calculation can be entered in the input area. They start with two slashes and apply to the rest of the line, example:

  ```
  // Maximum wind speed
  return max ([reading 1], [reading 2]);
  ```

  Other than that, line breaks have no effect. You can write everything in one line or insert breaks as you wish. The text can also be further formatted with spaces.

On the following pages you will find information on the syntax and further explanations of the individual calculation functions.

4.4.11.1.1 Calculation function “Minimum/Maximum”

Explanation: This function returns the highest/lowest value from the series of the specified measurements.

Syntax: min ([reading1], [reading2], ... [reading99])

max ([reading1], [reading2], ... [reading99])

Reading: any reading of a sensor

reading1…99

at least 2 reading points

Example: Maximum value of wind speed values measured by 3 sensors:

```
//Maximum wind speed WTG 1 to 3

return max (
[Wind speed WTG 1 "Anna"],
[Wind speed WTG 2 "Berta"],
[Wind speed WTG 3 "Charlotte"]
);
```

4.4.11.1.2 Calculation function “Mean value”

Explanation: Within the time period, values of the reading point are recorded on a regular basis. Once the time period has elapsed, the mean value is determined from the recorded values.

This function returns a new value for each time period.

Syntax: mean ([reading1], time period)

Reading: any reading of a sensor

Time period: Time period in minutes over which the values of a reading point are averaged.

Value range: 1–60 minutes

Example: Mean value of the intensity of illumination measured by a sensor over a period of 30 minutes

```
 // Rolling mean 30 min
return fmean (
[Illumination level diode 1 light sensor 1], 30);
```

4.4.11.1.3 Calculation function “Rolling mean value”

Explanation Values of the reading point are recorded on a regular basis. After each measured value recording, a new mean value is calculated from the latest measured values that were recorded during the specified period of time.

This function returns a new value for each measured value recording.

Syntax: fmean ([reading1], time period)

Reading: any reading of a sensor

Time period: Time period in minutes over which the values of a reading point are averaged.

Value range: 1–60 minutes

Example: Repeated calculation of the mean value of the intensity of illumination measured by a sensor over a period of 30 minutes

```
 // Rolling mean 30 min
return fmean (
[Illumination level diode 1 light sensor 1], 30);
```

4.4.11.1.4 Calculation function “Fail-safe mean value”

Explanati-on This function calculates the sum of the values of the specified reading points and divides the result by the number of reading points. If a sensor fails, its measured value is set to 0 and the number of reading points is reduced by 1. If all sensors fail, the default value is returned.

Syntax: xmean (default, [reading1], [reading2], [reading3], .. [reading99])

Reading: reading1…99

Reading of a sensor whose failure can be detected

at least 2 reading points

Example: An average park wind speed is to be determined from the wind speeds of all three WTGs. For this purpose, these reading points are entered as parameters for the xmean function. If the communication to one (or more) WTGs fails, the average park wind speed is only determined from the remaining WTGs and is thus distorted as little as possible. If the communication to all sensors fails, the result of the function is 10.

```
 // Failsafe mean with default
 return xmean (10,          // Return 10 m/s if communication to all WTGs fails
[Wind speed WTG 1 "1234"], // These are the candidates
[Wind speed WTG 2 "1235"], // from which the mean value
[Wind speed WTG 3 "1236"]);// is calculated
```

4.4.12 Events window

Purpose	• Display the reading points (measured values) that are automatically logged for a shutdown event • Add your own (user-defined) reading points
Symbol	
Path	*Switching & Measurement > Events*
Window type	Divided vertically, see Vertically divided windows 21 (basic operation like the **Special Shutdowns** window)
Type of use	left part: only display right part: interactive regarding user defined reading points
Reference	Project

The SMU writes events such as “WTG stop due to special shutdown", “Start of a night slice" or “Sunrise" into a log that can be downloaded in SM4. However, the will only be useful if it also records values that were measured at the time of an event, for example wind speed, humidity, etc. Some reading points are automatically recorded by the SMU and cannot be deleted or changed in the window described here. Others can be added by the user as desired, because often different reading points are relevant for each project.

The following reading points are available:

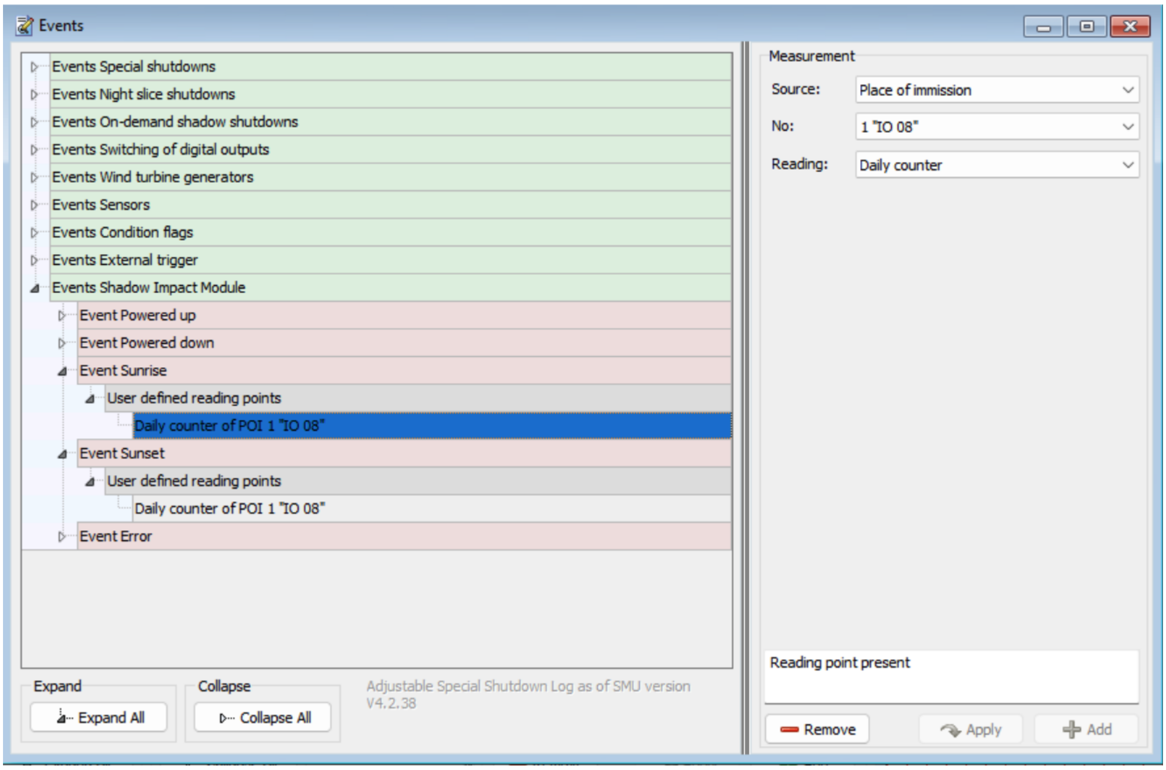
Default reading points
These reading points are permanently stored in SM4 and cannot be changed or deleted by the user. This ensures that the most important reading points are always recorded in the log.

Condition reading points
These reading points were used when defining shutdown conditions and can **only be edited there**. With the help of condition reading points, the log can show why a WTG was switched off at a certain time, e.g., because the hygro-thermo sensor exceeded a certain temperature. This makes much more sense if there are several conditions: the log will then also reveal which of conditions led to the stop (e.g., temperature or humidity or wind speed).

User-defined reading points
The user can add these reading points as required. User-defined calculations (*Switching & Measurement > Calculations*) can serve as a reading here. Reading points that are already included in the default or condition reading points cannot be added **again**.

The structure and operation of the vertically divided **Events** window essentially corresponds to the **Special Shutdowns** window. If you are not familiar with the latter, please start by reading the sections Vertically divided windows 21 and Special Shutdowns window 193.

For more information about the **Events** window, see the following pages.



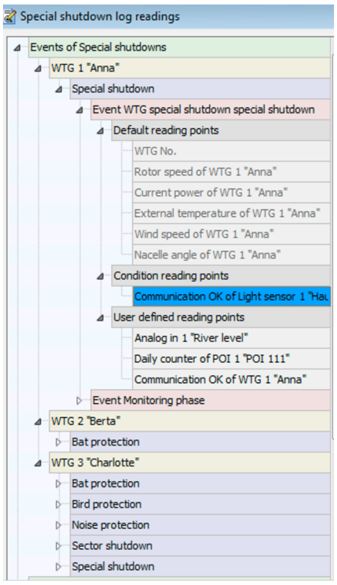
Events window (example)

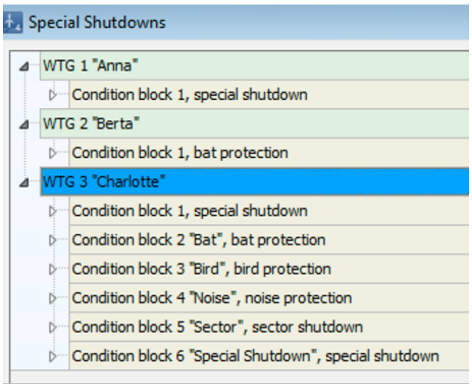
Notes regarding the **Events** window:

- At the first level (green level) there are 9 logical groups of areas in which events can occur.
- The groups of the first level each have a different number of subordinate levels.
- In the example window above, only the **Events of shadow impact module** level is expanded; its first sub-level contains 5 possible events (red level). As a second subordinate level, there is only the **User-defined reading points** level (gray level).
- In the above example, the reading point **Daily counter of POI 1** was added to the events **Sunrise** and **Sunset** and would therefore be written into the special shutdowns log. Because nothing was defined for the event **Error**, a possible error would be logged here without further measured values.
- As is usual with vertically divided windows, the left part is a read-only area while the user-defined values are set in the right part of the window. There you can select from the set of reading points of WTGs, sensors etc. available in the project.
- The currently activated level is highlighted in blue and can be edited in the right part of the window, provided it is of a type that can be edited.

The following screenshots show examples of all logical groups on the first level, each of them followed by a short explanation

Events Special Shutdowns





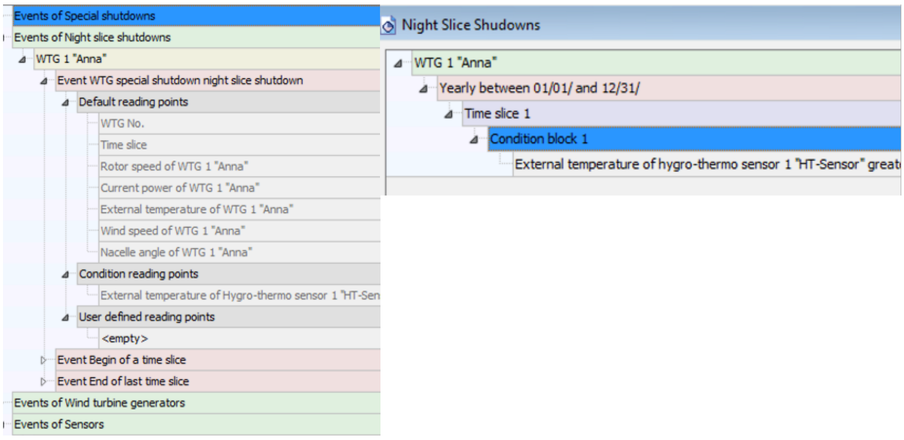
Screenshot on the left

- Of all the logical event groups, the **Events of Special Shutdowns** group is the most complex. Here there is an additional purple level, which classifies events according to the reason for shut-down.
- There are just 2 events for each shutdown (red level).

Screenshot on the right

- Shutdown reasons are defined in the condition blocks of the **Special Shutdowns** window.
- Shutdown reasons that have been defined several times (WTG3, condition blocks 1 and 6) are summarized in the **Events** window. Therefore, the left picture, under WTG 3 “Charlotte”, shows 5 instead of 6 reasons for shutdown.

Events Night Slice Shutdowns



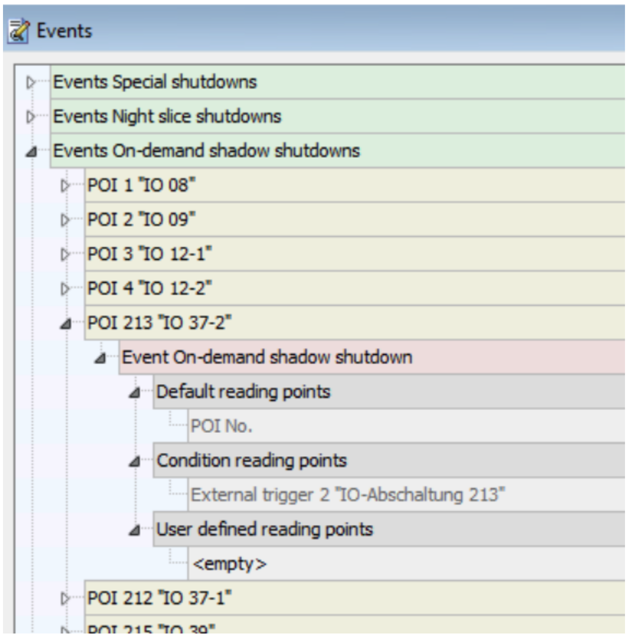
Screenshot on the left

- In the left picture you can see that only WTG 1 has a night slice shutdown (yellow level). If night slice shutdowns had been defined for other WTGs in the project as well, these would also be displayed here.
- There are 3 events for each shutdown (red level)
- On the reading points level, there are also the Condition reading points. The reading points that were used when defining shutdown conditions are automatically listed here. With the help of Condition reading points, the log can show why a WTG was shut down at a certain time, e.g. because reading reported by the hygro-thermo sensor exceeded a certain temperature. This makes much more sense if there are several conditions: the log will then also reveal which of conditions led to the stop (e.g. temperature or humidity or wind speed).

Screenshot on the right

- Here you can see that for WTG 1 a night slice shutdown with a shutdown condition regarding the external temperature was defined. This is reflected in the **Events** window.

Events On-Demand Shadow Shutdowns



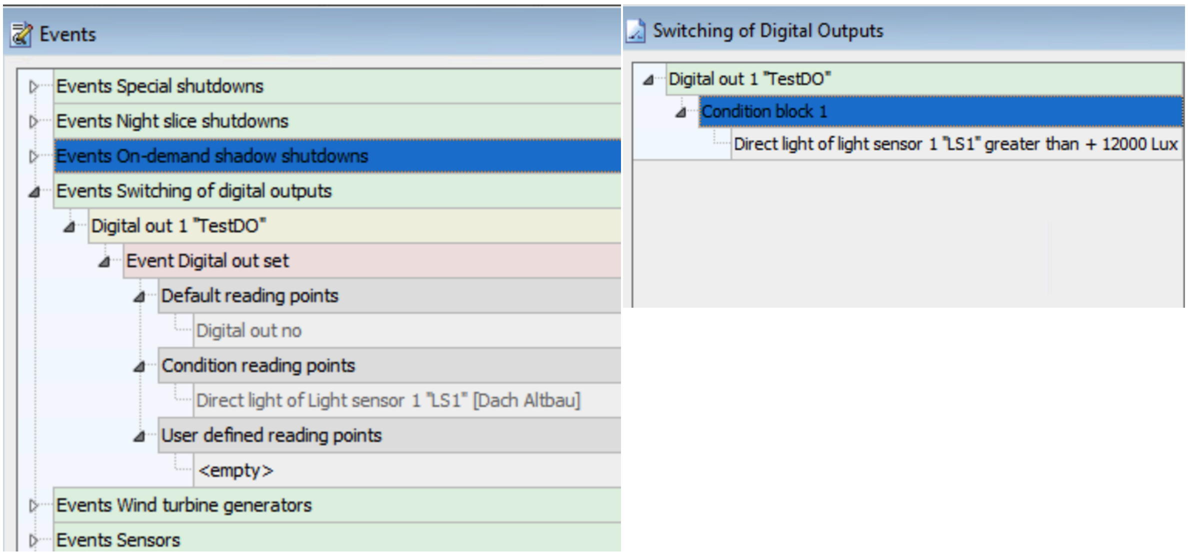
Screenshot on the left

- Each POI, for which an OSS has been defined *(Switching & Measurement > On-Demand Shadow Shutdowns*), has only one possible event (red level).
- For each event, the POI number is recorded as the only Default reading point.
- The conditions defined at the respective OSS are entered as Condition reading points.
- Additionally, you can define User-defined reading points.

Screenshot on the right

- Here you can see that an external trigger has been referenced in the **On-Demand Shadow Shutdowns** window**.** This is listed in the **Events** window as a Condition reading point.

Events Switching of Digital Outputs



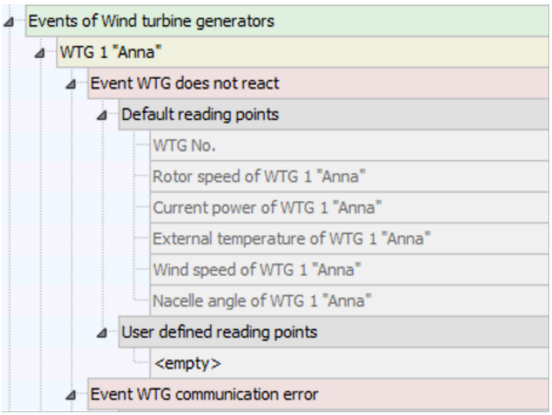
Screenshot on the left

- Digital outputs trigger an event when they are set.
- There is only one possible event for each digital output (red level).
- Default reading points (here only the number of the respective digital output) are fixed elements in SM4 and can neither be changed nor deleted by the user. This ensures that the most important reading points are always recorded in the log.
- On the reading points level there are Condition reading points in addition to Default and Condition reading points. Here, the reading points that were used when creating shutdown conditions are recorded automatically. With the aid of Condition reading points, it is possible to identify in the log as to why a digital output was set at a certain time, e.g. because the hygro-thermo sensor exceeded a certain temperature. This makes more sense if there are several conditions, because the log then also shows which of them led to the DO being set (e.g. temperature or humidity or wind force).

Screenshot on the right

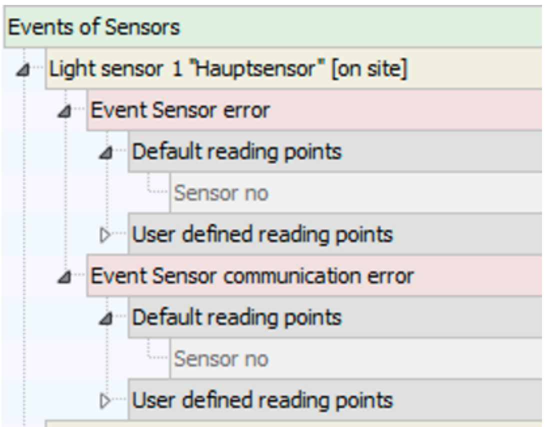
- Here you can see that a condition created for setting such an output has been set in the **Switching of Digital Outputs** window. This condition is listed in the **Events** window as a Condition reading point.

Events of Wind Turbine Generators



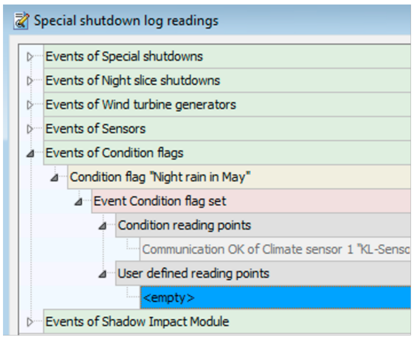
- Each WTG can trigger 9 different events (red level) (only 2 of them are visible in the screens-hot).
- The number of default reading points (gray level, 6 per event) is also higher than in the case of the sensors.
- In order to limit the number of reading points logged for an event, only those reading points that are not yet included in the **Default reading point**s can be added under **User-defined reading points**. Example: If you would try to add the reading point **Wind speed of WTG 1** in the settings area on the right side of the window, the **Add** button would remain inactive. This principle applies to all events.

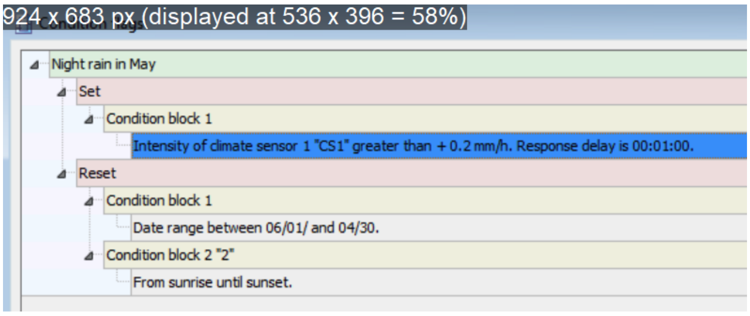
Events of Sensors



- There are only 2 possible events for each sensor (red level)
- Default reading points (for sensors only **Sensor no**) are fixed elements in SM4 and cannot be changed or deleted by the user. This ensures that the most important reading points are always recorded in the log.

Events of Condition Flags





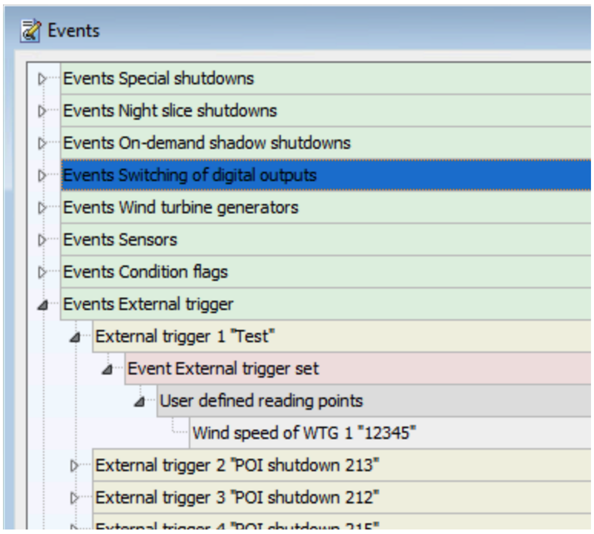
Screenshot on the left

- Condition flags trigger an event when they are set or reset
- The reading points entered here are the Condition reading points of the set or reset conditions of the flag.
- The user can also add additional reading points from other sensors.
- There are no Default reading points here.

Screenshot on the right

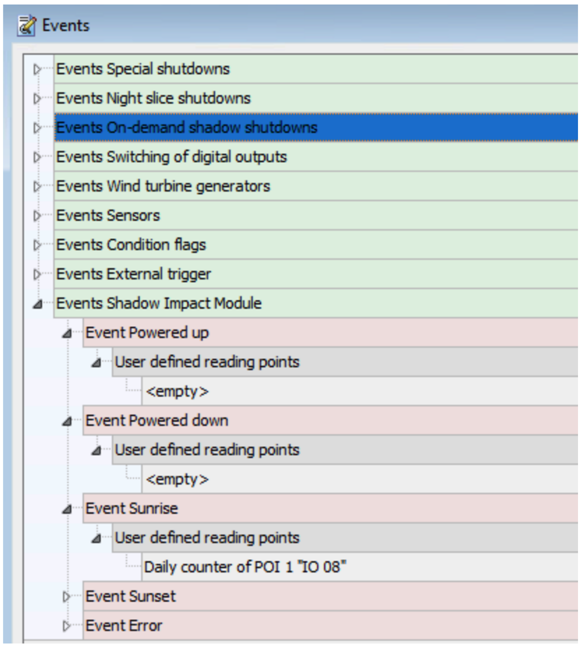
- Here you can see that in the **Condition Flags** window, the "Intensity of climate sensor 1" condition has been created for setting the condition flag "Night rain in May". This is reflected in the **Events** window as a Condition reading point.

Events External Triggers



- For each trigger there is only 1 possible event (red level).
- There are neither Default reading points nor Condition reading points.
- Instead, you can "freely" define a wide variety of reading points under **User-defined reading points**.

Events Shadow Impact Module



- There are 5 possible events in the **Events Shadow Impact Module** group (red level).
- There are neither Default reading points, nor Condition readings points.
- Instead, you can "freely" define a wide variety of reading points under **User-defined reading points**.

NOTE

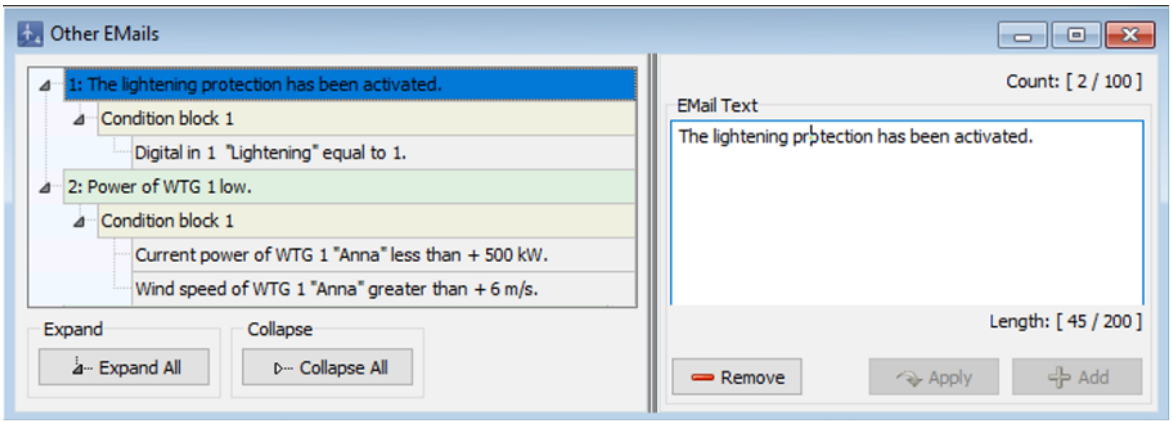
The maximum number of reading points per event is 27. This number consists of 7 default reading points for night slice shutdowns and 20 additional possibilities for reading points from conditions, as well as user-defined reading points.

4.4.13 Other Emails window

Purpose	Define emails to be triggered by conditions
Path	*Switching & Measurement > Email*
Type of use	Display + interactive
Reference	Entire project

This window allows you to define email messages that are sent automatically depending on certain conditions, for example, when the power of a WTG falls below a certain value.

The structure and operation of the vertically divided **Other Emails** window essentially corresponds to the **Special Shutdowns** window. If you are not familiar with the latter, please start by reading the sections Vertically divided windows 21 and Special Shutdowns window 193.



Other Emails window

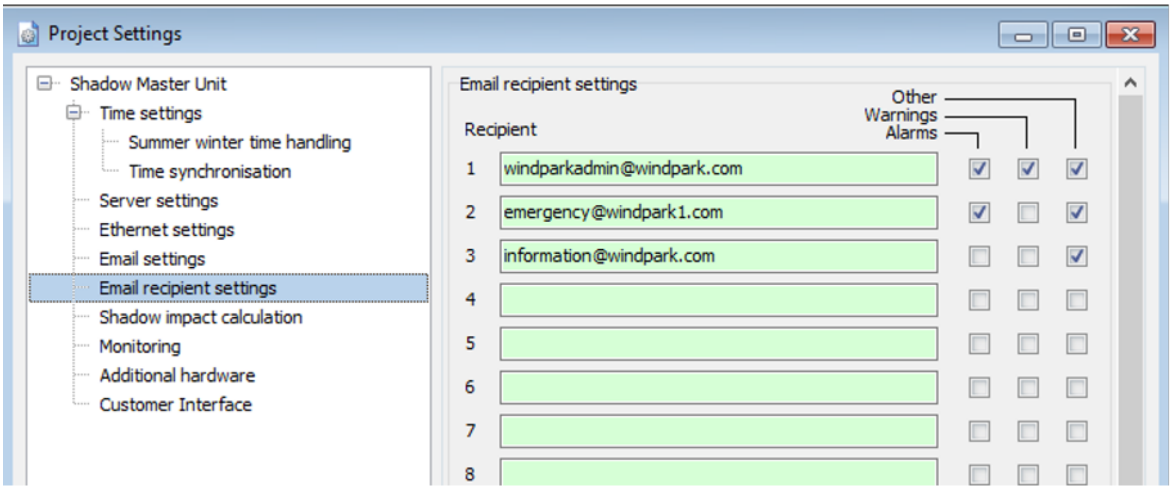
Explanation of the above example window:

- As you see in the upper right corner, 2 out of 100 possible other emails have been defined so far.
- green level: On the green level you set up the email yourself. 200 characters are possible.
- yellow level: Here you set up one or more condition blocks (logical OR operation).
- gray level: Here you set up one or more conditions (logical AND operation) that must be fulfilled in order for the corresponding e-mail to be sent.
- In the above example, email 1 is sent if the condition Lightning = 1 is fulfilled at digital input 1.
- Email 2 is only sent if less than 500 kW power is generated at WTG 1 while more than 6m/s wind speed is measured at the same time. In order to cause email 2 to be sent when only one of these conditions is fulfilled, they would have to be created in different condition blocks.

- At the bottom right, you can see that 45 of the possible 200 characters have been used for email 1.
- Please also pay attention to the following note…

NOTE

The intended recipients of the emails defined in this window must be defined in the **Project Settings** window (*Project > Project Settings > Email recipient settings*) and activated in the **Other** box, see the following screenshot:



Project Settings window (section thereof), recipients of **other** e-mails activated

4.5 SMU menu

The following table provides you with an overview of the **SMU** menu.

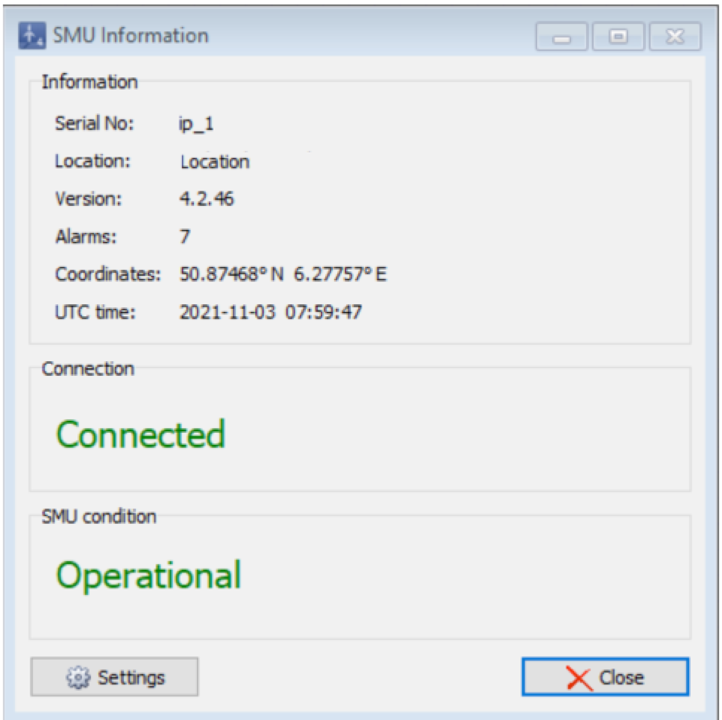
Menu item	Purpose
SMU Information 270	Check the availability of the SMU
Alarms 272	Display and acknowledge currently active alarms, carry out test alarms
Phone option 274	Set GSM modems for the use of the telephone option (**Places of Immission** window)
User Management	
Shadow Manager Interface 277	Store individually defined users with corresponding right groups in the SMU
Special Shutdown-Interface 279	Create/edit/remove user for special shutdown interface und Assign trigger numbers to users
Time	
Set time manually 282	Manually set the time and date of the SMU
Check time deviation 283	Check the time of the SMU manually
Tools	
SMU Update... 285	Update SMU software from an external location
SMU Ping 286	Check whether the target of the network connection can be rea-ched (via direct connection to the SMU)

Click on a menu item to jump directly to more information.

4.5.1 SMU Information window

Purpose	SMU Information window
Path	*SMU > SMU Information*
Right group	Viewer
Prerequisites	Online connection to SMU, dongle
Type of use	Display+ Dialog
Reference	Project

This window shows almost the same information as the connectivity window (*Tools -> SMU Connectivity*), but here the information is provided via a different channel, namely via the direct connection between SM4 and the SMU. The connectivity window, on the other hand, obtains the information via the SMU website; access to this may be blocked by the park operator for security reasons. If the website is not accessible, you can use the window described here to display the required information.



SMU Information window

You will find a detailed description of this window in the following table

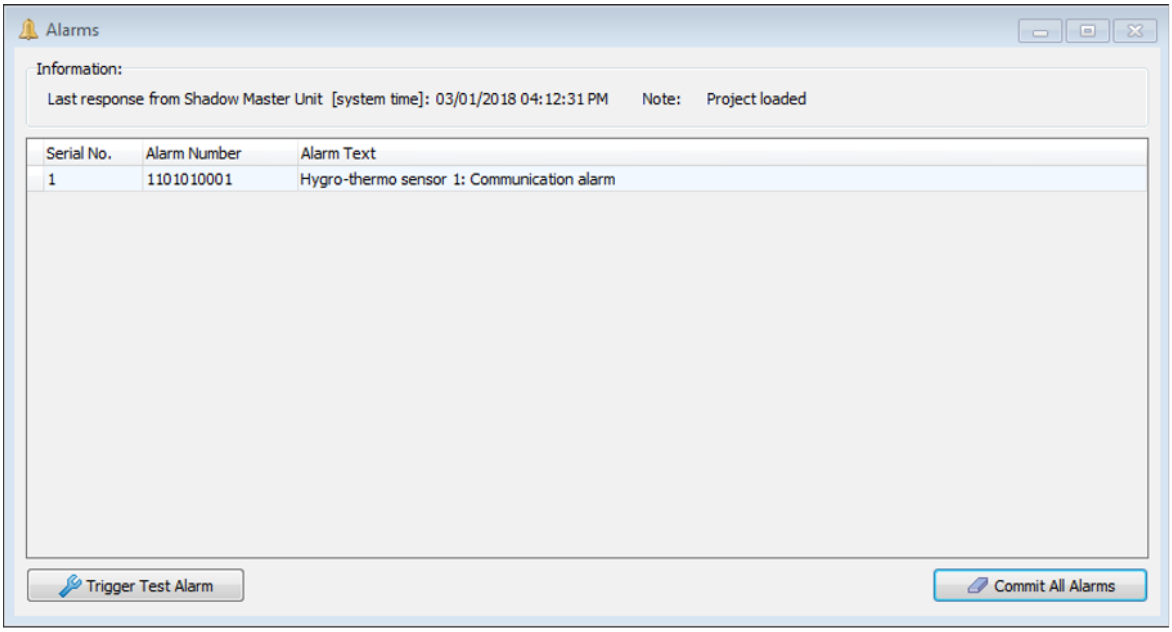
Element	Explanation
Serial No.	Serial number of the SMU
Location	Location of the SMU according to the **Project Data** window
Version	Version of the SMU
Alarms	If alarms are present, their number is displayed here
Coordinates	Coordinates of the location of the SMU according to **Project data** window
UTC time	Current UTC time
Connection	One of the following connection states is displayed here: **Connected** Connection to SMU has been established **Disconnected** Connection to SMU was disconnected **preparing...** Connection to SMU is being established
SMU Status	One of the following SMU conditions will be displayed here: --- Status cannot be determined, e.g., because SMU cannot be reached **Operational** The SMU is ready for operation, an existing shadow project is being processed **preparing…** The SMU is started, e.g., after an update **Stop** The SMU shuts down, e.g., before an update
Settings	Clicking here opens the **Application Settings** window, **Live data** section, where you can specify the intervals at which live data windows should be updated.
Close	Closes the window.

4.5.2 Alarms window

Purpose	Display and acknowledge currently active alarms, carry out test alarms
Path	*SMU > Alarms*
Right group	Alarms, Viewer (acknowledge and test alarm not possible as a viewer)
Prerequisites	Online connection to the SMU – acknowledging alarms and initiating test alarms only with dongle
Type of use	Display + interactive
Reference	Project

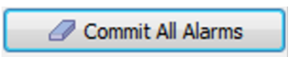
If you have established an online connection to an SMU (*File > Connect*), you can display currently active alarms here. **Alarms** right group users can also acknowledge alarms and initiate test alarms.

! It is essential to check what consequences the respective alarm will have for the SMU prior to initiating a test (e.g., stop command to the WTG).



Alarms window

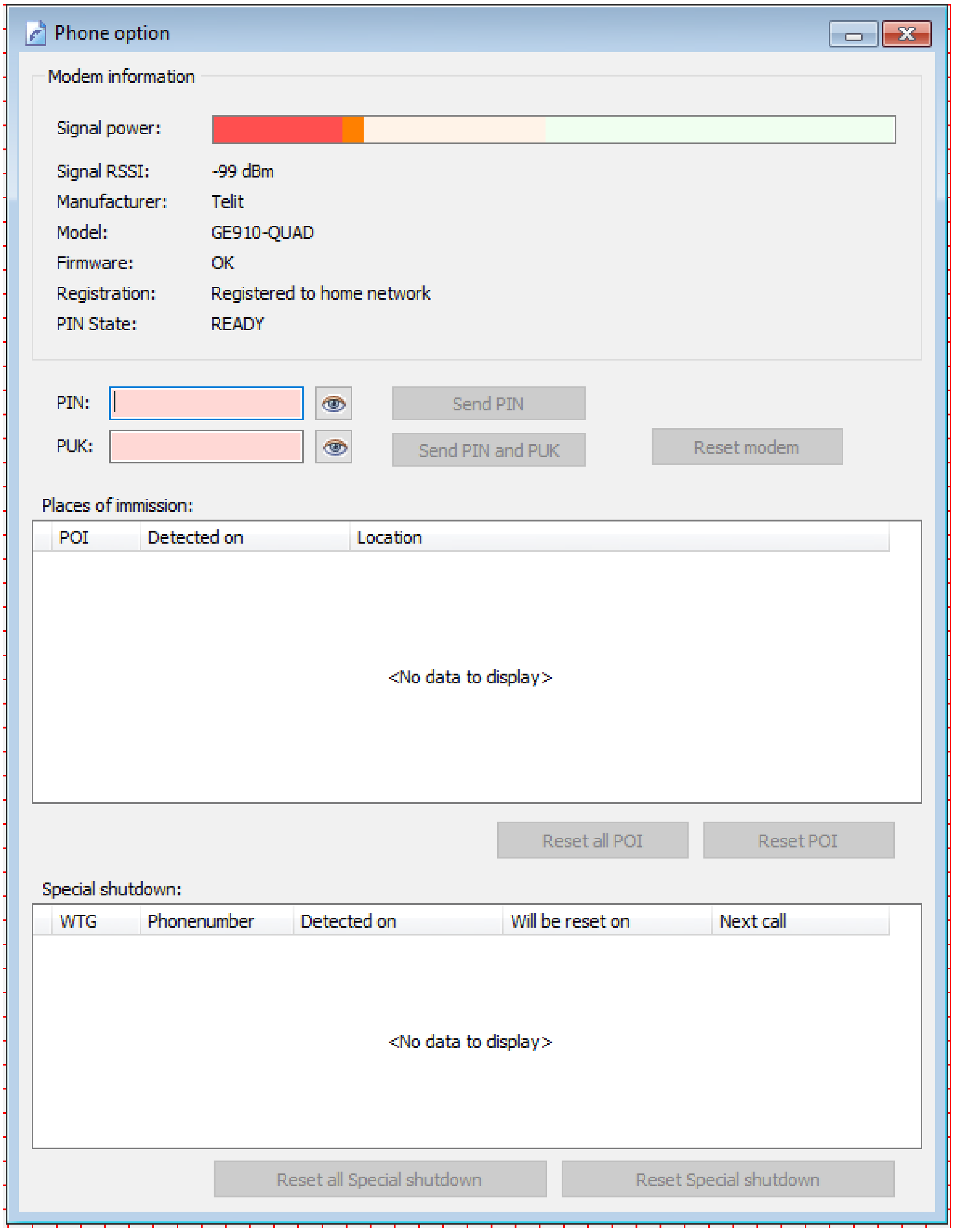
The information, options or buttons are described in the following table

Element	Explanation
Last response from the Shadow Impact module [system time]	SM4 received its last response from the SMU at the date and time displayed here.
Note	Depending on the status of the live data shown in the list below, the following can be displayed here: **Project loaded** – The project file of the shadow impact scenario running on the SMU is has been downloaded. **No project found** – A shadow impact scenario could not be found on the SMU. **Loading project…** – The project file of the shadow impact scenario running on the SMU is being downloaded.
Ser. No.	Consecutive number of the alarm
Alarm Number	Fixed number of the respective type of alarm
Alarm Text	A self-explanatory term is displayed for the respective alarm in this column. **NOTE** Please get in contact with us every time a fatal alarm occurs. The alarm text of fatal alarms always contains the request “Please contact NorthTec”. Example: *SWMP01MainStartOpLog internal alarm: Please contact NorthTec*
	A test alarm can only be initiated by a user who is assigned the **Alarms** right group. Triggering a test alarm may be necessary, e.g., to check that the alarm message is being correctly sent by email. **NOTE** It is essential to check what consequences the respective alarm will have for the SMU prior to initiating a test (e.g., stop command to the WTG).
	An alarm can only be committed if the reason no longer exists.

4.5.3 Phone Option window

Purpose	• Get information about the modem and the signal quality • Set GSM modems for the use of the telephone option (**Places of Immission** window and **Special Shutdowns** window)
Path	*SMU > Phone option*
Right group	Viewer
Prerequisites	• Online connection to the SMU • SMU version V4.2.34 or later • **Use GSM modem** (RS232) must be selected under *Project Settings > SMU > Additional hardware*
Type of use	Display + interactive
Reference	Entire project

In this window you make the settings of the GSM modem, which is required for the Phone Option functionality – the Phone Option is used to switch off WTGs by calling a specific phone number (*Project > Places of Immission > Phone option*, for further information see Phone Option sub window 139).



Phone option window

The information, options or buttons are described in the following table

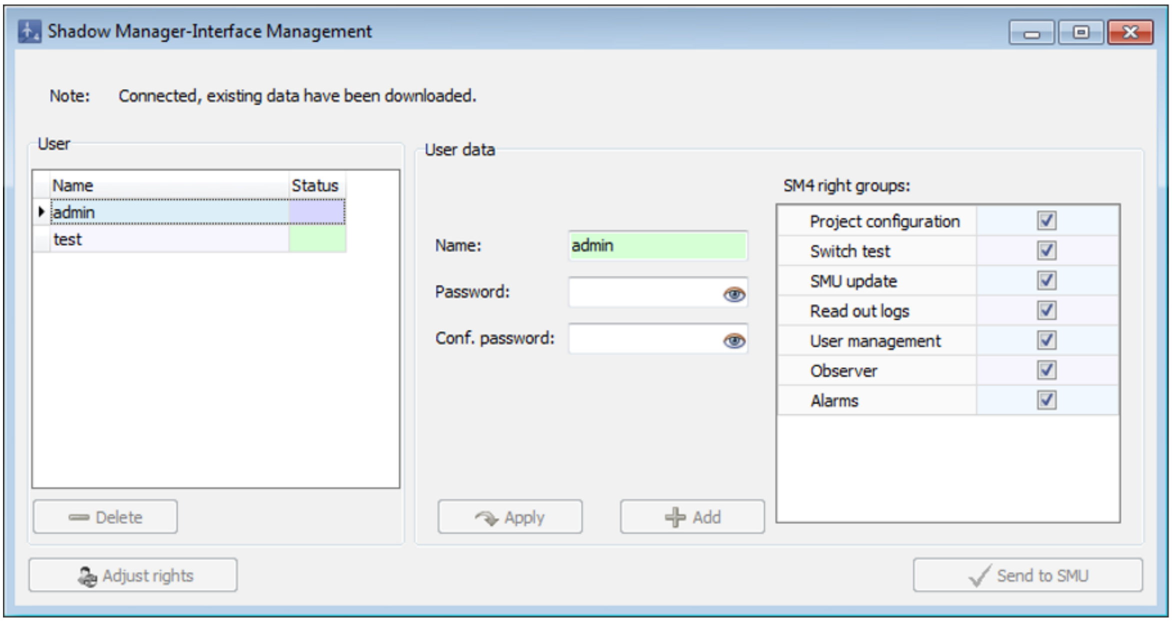
Element	Explanation
Top part of the window **Modem information** – This information is read out from the modem (display only).	

Element	Explanation
Signal power	Optical interpretation of the signal quality displayed at **Signal RSSI**
Signal RSSI	Display of signal quality in dBm
Manufacturer, Model, Firmware	Fixed data of the modem
Registration	Indicates whether the modem has dialed into the network of the mobile network operator or respectively the current status of the di-al-in.
PIN State	Indicates whether the card is ready for use or if a PIN (or PUK) must be entered for that card. **READY**: no action required **SIM PIN**: PIN must be entered **SIM PUK**: PUK must be entered. In addition, the new PIN must be specified.
Middle part of the window	
PIN: Send PIN **PUK: Send PIN and PUK**	Here you can enter the PIN and PUK of the phone card inserted in the modem. • If you click on an eye , the PIN or PUK will displayed/hidden.
Reset modem	To temporarily disconnect the modem from the power supply (via relay) using this button in order to reset the modem, a check mark must be set at **Use "Modem reset"** (*Project > Project Settings > Monitoring*). The corresponding digital output (DO) must also be assigned.
Bottom part of the window	
Places of Immission	Calls to the POIs are reset daily at 00:00 by the SMU.
Special Shutdowns	For special shutdowns, the time of the reset and the reaction to a further call can be defined. This setting is made when defining the special shutdown.

4.5.4 Shadow Manager Interface Management window

Purpose	Store individually defined users with corresponding right groups in the SMU
Path	*SMU > Shadow Manager Interface*
Right group	User Management
Prerequisites	Online connection to the SMU
Type of use	Display + interactive
Reference	Entire project

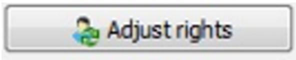
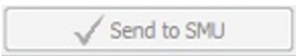
If you have established an online connection to an SMU (*File > Connect*), you can add individually defined users and assign them specific right groups in addition to the users **admin** and **northtec**, which are included as default at delivery.



Shadow Manager Interface User Management Window

The information, options or buttons are described in the following table

Element/area	Explanation
User	Currently available users are displayed in the left third of the window. If you select a user, you can see which right groups they are assigned on the right-hand side. **The** users **admin** and **northtec** are default users that are available upon delivery. You can delete these after you have assigned the User management group a new user if you do not want anyone else to have access.

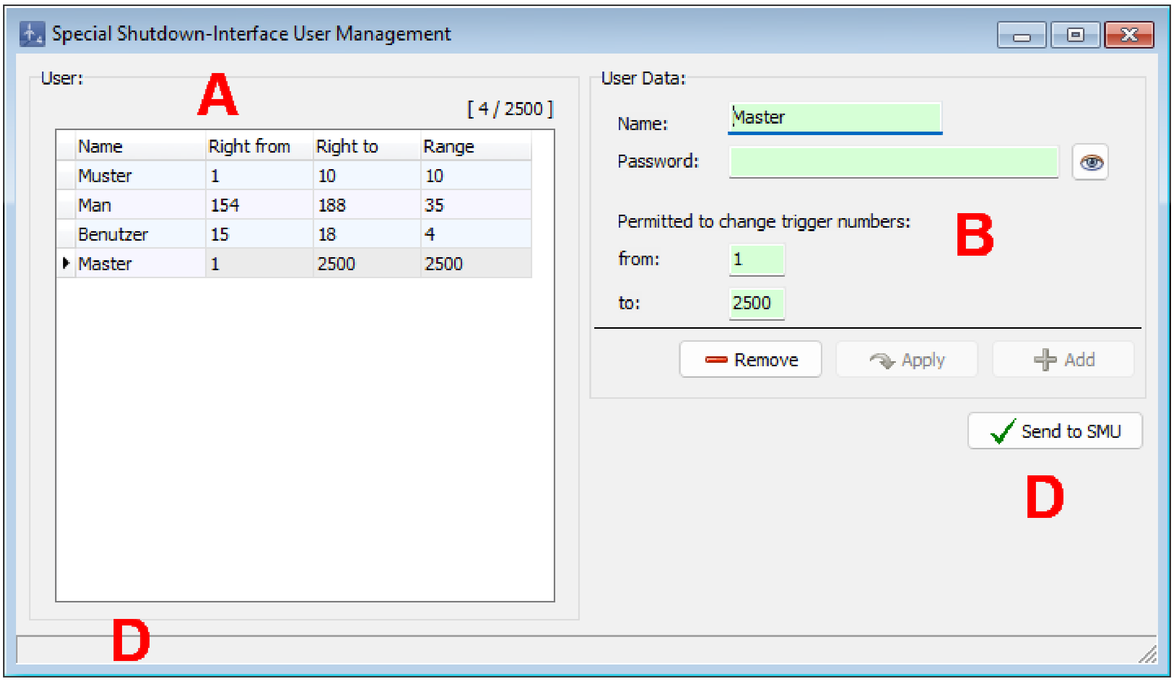
Element/area	Explanation
	NOTE If you delete the two default users before you assign a new user or the access data for the newly assigned user gets lost, it is no longer possible to connect to the system!
	Deletes a user selected in the list.
	While an online connection to the SMU is being established, the rights of the logged-in user are checked for changes. If it is determined that something has changed, the following dialog is displayed: *“Your user rights must be updated in the SMU User Management window. If you do not have access to the SMU User Management, please contact the administrator.”* In this case, click **Adjust rights** to trigger the update. **NOTE** The button remains active even after clicking and after the update has been completed. There is no dialog that confirms that the update was completed successfully. The button is only deactivated in the following cases: • the SMU version is older than 4.2.18 • the connection to the SMU is established and the data have not yet been initialized • SM4 does not support the communication protocol version of the SMU
User Data	To create a new user, assign them a corresponding name in the middle part of the window, enter the same password twice and then click on **Add**. To change the password or the assignment of right groups to a user, select the user on the left, carry out the desired changes and then click on **Apply**.
SM4 Right Groups	The SM4right groups, with self-explanatory names, are pre-defined and cannot be changed. They can only be activated/deactivated by placing or removing the checkmark.
	If you have created a new user, deleted an existing one, or changed the rights of an existing user, these changes do not take effect until you click **Send to SMU**.

! If you delete the two default users before you assign a new user or the access data for the newly assigned user gets lost, it is no longer possible to connect to the system!

4.5.5 Special Shutdown-Interface User Management window

Purpose	• Create/edit/remove user for special shutdown interface • Assign trigger numbers to users
Path	*SMU > Special shutdown interface*
Right group	Project configuration
Prerequisites	Online connection to SMU, SMU version 4.2.44 or higher, external triggers
Type of use	Interactive
Reference	Project

If you have established an online connection to an SMU (*File > Connect*), you can use this window to define users who can access the special shutdown interface. In addition, you can assign specific trigger numbers to defined users or revoke them (for more information, see "External triggers" in the Glossary 371).



Special Shutdown-Interface User Management window

The above window is divided into the following sections

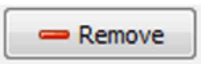
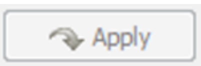
A List of already created users (data as downloaded from the SMU or data created/edited via this window); the current/maximum number of users is displayed on the right above the list.

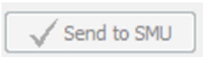
B Input fields and buttons for user data

C Button for sending the current user data to SMU

D Progress bar for receiving/ sending user data from/ to SMU

You will find a detailed description of this window in the following table.

Element/area	Explanation
User	
[x/2500]	x = Number of already created users of max. 2500
User	List of created users (data downloaded from the SMU or created/edited in this window). If you select a user in the list, the data of this user will be displayed on the right.
User Data	
Name	Here you enter the name of a user to be created. 1–19 ASCII characters, no spaces, must be unique
Password	Here you enter or change the password of the user to be created. 1–31 ASCII characters, no spaces **NOTE** If you leave this field blank when editing an existing user, and then click **Apply**, the “old” password is retained.
From	In the **from** and **to** fields, you specify the trigger numbers to which the respective right shall apply. 1–2500, muss be less than or equal to
By	see above from–2500, must be greater than or equal to from
	Deletes the user selected in the list completely. available when • a user is selected in the list • no data is being transferred between SM4 and the SMU
	Confirms changed user data. available when • a user is selected in the list • valid changes have been made to an entry

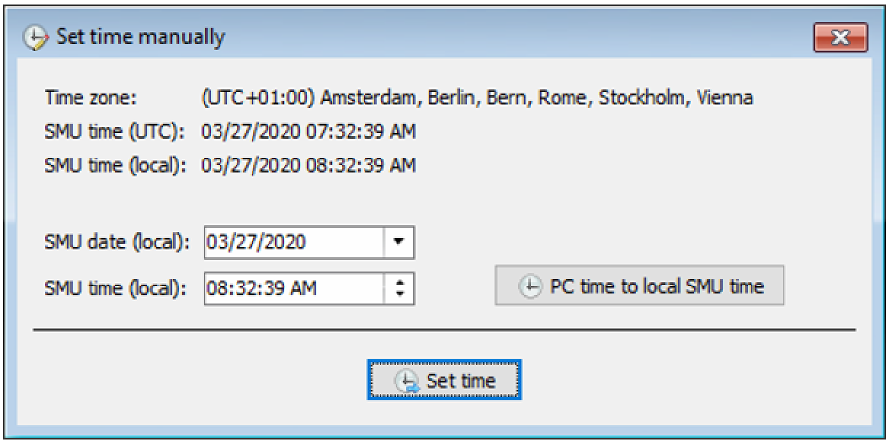
Element/area	Explanation
	• no data is being transferred between SM4 and the SMU
	Adds newly created users. available when • all entries are valid • max. number of users not reached • no data is being transferred between SM4 and the SMU
	If you click here, the existing and changed user data will be sent to or retrieved from the SMU. A bar at the bottom of the window shows the progress. only available if user data have been changed

Once the connection to the SMU is disconnected, the **Special Shutdown-Interface User Management** window will be closed automatically.

4.5.6 Set time manually window

Purpose	Manually set the time and date of the SMU
Path	*SMU > Set time manually*
Prerequisites	Dongle, online connection to the SMU
Type of use	Interactive
Reference	Project

If you have established an online connection to a SMU (*File > Connect*), you can manually set the SMU time here.



Set time manually window

Notes on the window above

- The upper third of the window displays the current time zone of the SMU and the current time of the SMU in UTC as well as in local time.
- In the middle part there are two input fields where you can enter the date and time to be set for the SMU. Both input fields refer to the local time of the SMU.
- If you click on PC time to local SMU time to the right of the input fields, the local PC time is re-trieved, converted according to the local time of the SMU and written into the input fields. The conversion is based on the time zone set in the SMU.
- If you click **Set time** at the bottom of the window, the date and time as shown in the input fields will be sent to the SMU.
- During log operations (directory check and download), the time cannot be set manually. The corresponding option in the menu is then deactivated (*SMU > Set time manually*).

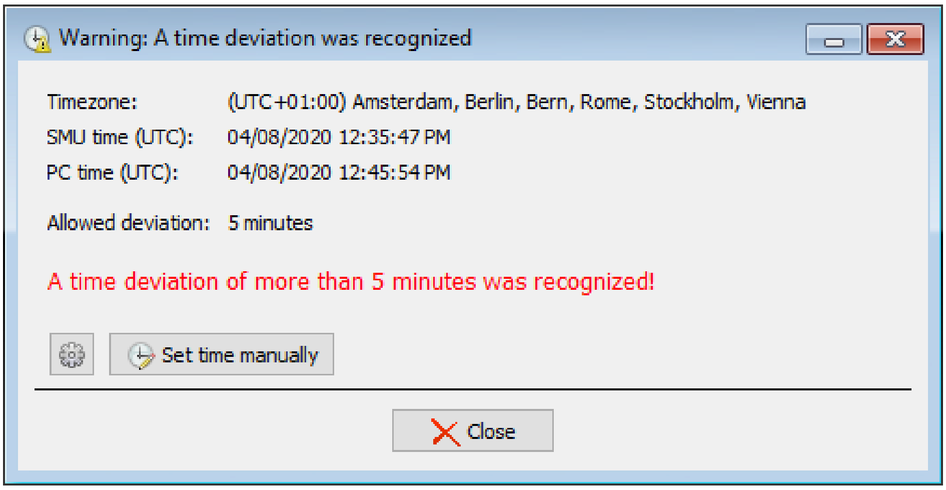
4.5.7 Check Time Deviation menu item

Purpose	Check the time of the SMU manually
Path	*SMU > Check Time Deviation*
Right group	Project configuration
Prerequisites	Dongle, online connection to the SMU
Type of use	Interactive
Reference	Project

When you select the **Check Time Deviation** menu item, the system will check whether the time of the SMU (UTC) is different from the time of the computer (UTC). The deviation tolerance can be defined in the *Application Settings* (*File > Application Settings > Warning limits > SMU time > Allowed deviation*). You can set values from one minute to one year (all values in minutes).

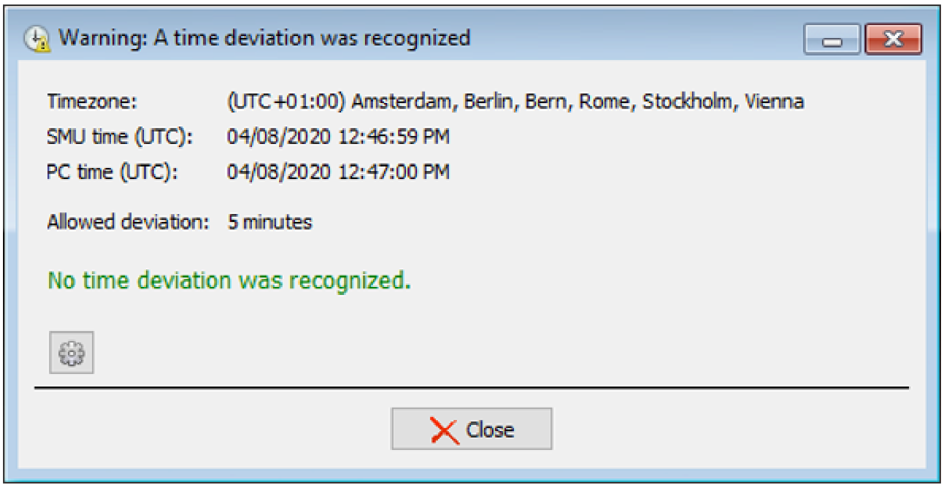
After you have selected the menu item, it may take a few seconds until the result is displayed, depending on the load of the SMU.

If the deviation determined during automatic check exceeds the permitted value, the following window opens:



Warning: A time deviation was recognized window

If the deviation determined during automatic check **does not** exceed the permitted value, the following window opens:



Warning: A time deviation was recognized window

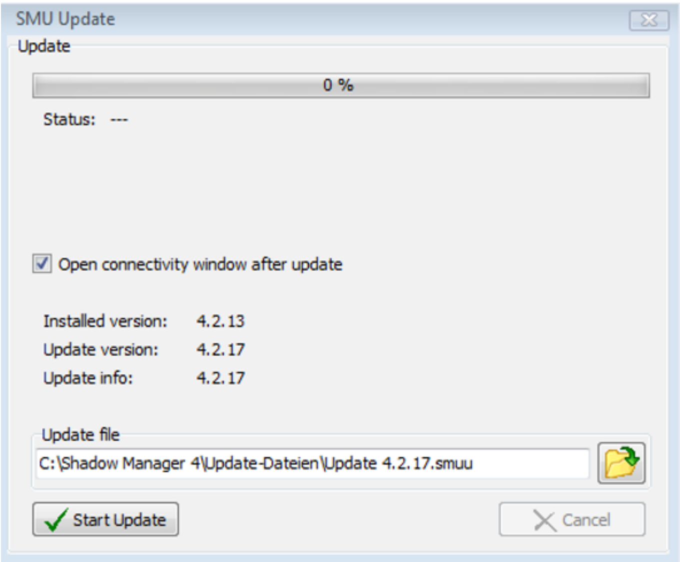
Notes on the above windows

- The windows display the current time zone of the SMU, the time of the SMU (UTC) and the time of the computer (UTC). The permitted deviation is also displayed.
- If you click on the gear symbol, you are taken directly to the **Allowed deviation** setting.
- The button **Set time manually** only appears if a dongle is connected. Clicking this button takes you directly to the **Set time manually** window.
- While logs are being downloaded from the SMU, this function and the **Set time manually** function are not available.
- When you establish a connection to the SMU, the system carries out an Automatic check of the SMU time 56.

4.5.8 SMU Update window

Purpose	Update SMU software from an external location
Path	*SMU > SMU Update*
Right group	SMU update
Prerequisites	Online connection to the SMU
Type of use	Interactive
Reference	Project

If you have established an online connection to a SMU (*File > Connect*), you can update its software.



SMU Update window

Notes on the window above

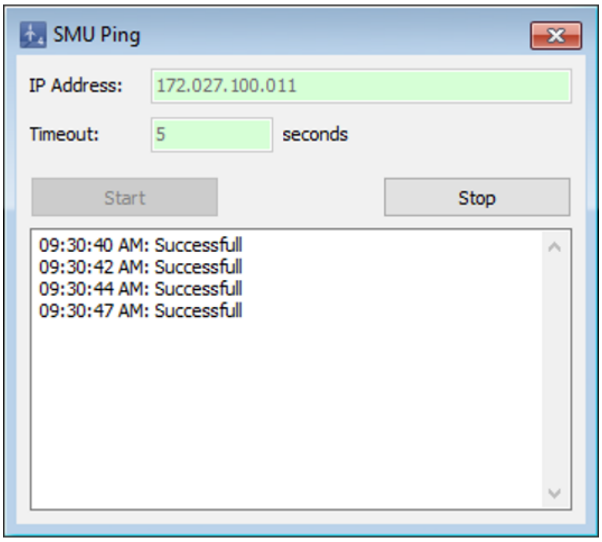
- To perform an update, click on the folder symbol at the bottom right and select the path for the update and the update itself.
- If you set a checkmark at **Open connectivity window after update**, you can identify in the **Connectivity** window whether, after carrying out an update, the SMU has reconnected and is ready for operation. This helps you avoid unsuccessful attempts to connect to the SMU.
- Once you have clicked on **Start Update**, the bar at the top will display the update progress.
- Please do not remove the dongle while the update is running, as this could cause the software to not function properly.

4.5.9 SMU Ping window

Purpose	Check whether the target of the network connection can be reached (via direct connection to the SMU)
Path	*SMU > SMU Ping*
Prerequisites	Dongle, online connection to SMU, SMU offers ping possibility
Type of use	Interactive
Reference	Project

If you have established an online connection to an SMU (*File > Connect*), you can check in this window whether the target of the network connection to be set up or already set up can be reached in principle. This function is usually only used when setting up a network connection or in the event of problems with the same, but not in normal operation.

i When "pinging", a specific data packet is sent to a network address. If there is a receiving instance, it will a response packet back to the sender. If this works, one can assume that a connection is possible.



SMU Ping window

Notes on the window above

- In the top line, specify the destination to be "pinged”.
- The timeout below determines how long to wait for a response. If the response comes back within this time, then this ping is reported as "Successful", otherwise as "Timeout error".
- The ping mechanism runs until you click on **Stop** or close the window.

4.6 Realtime Data menu

The following table provides you with an overview of the **Realtime Data** menu

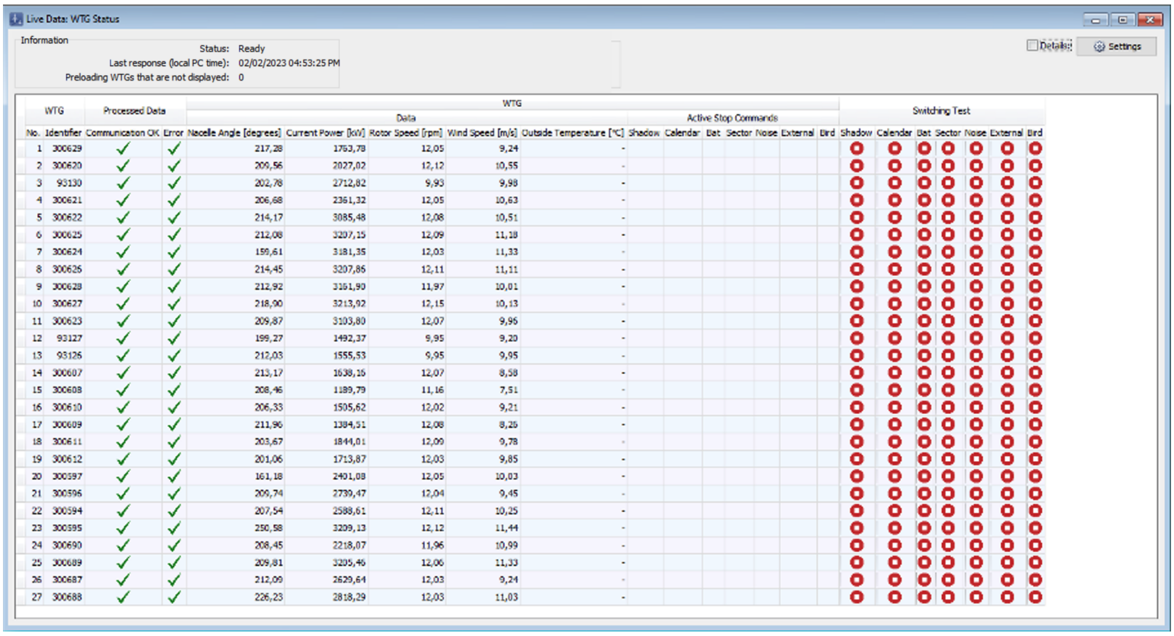
Menu item	Purpose
WTG Status 288	Display data received by the SMU from the wind turbine generators (WTG) and execute switching test
Light Sensors 291	Display the sensor data live
Laser Precipitation Sensors 294	Display the sensor data live
Hygro Thermo Sensors 297	Display the sensor data live
Climate Sensors 300	Display the sensor data live
iSpin Sensors 303	Display the sensor data live
Visibility Sensors 306	Display the sensor data live
External Trigger 312	Display and test triggers defined in the project
Calculations 314	Display calculations defined in the project with current calculation result
POI Counter Readings 316	Visualize shadow impact

Click on a menu item to jump directly to more information.

4.6.1 Live Data: WTG Status

Purpose	Display data received by the SMU from the wind turbine generators (WTG) and execute switching test
Path	*Realtime Data > WTG Status*
Right group	Switching test or view (no switching test possible as viewer)
Prerequisites	Online connection to the SMU, dongle (for switching test)
Type of use	Display + interactive
Reference	Entire project

If you have established an online connection to an SMU (*File > Connect*), you can display the live data the SMU receives from the WTGs and perform a shutdown test individually for every switch reason.



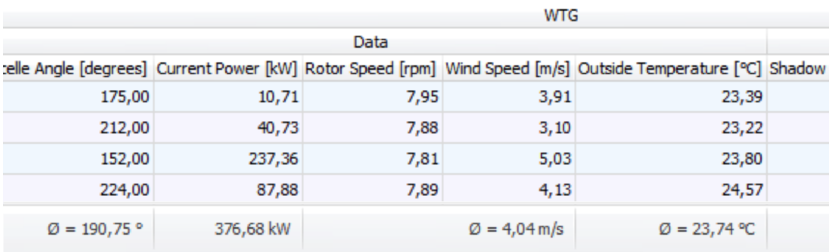
Live Data: WTG Status (without footer, see table below)

Notes on the window above

- Information on the individual columns can be found on the next page.
- If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right. Only the content of the standard columns is explained in the table on the next page as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.

The information, options or buttons are described in the following table

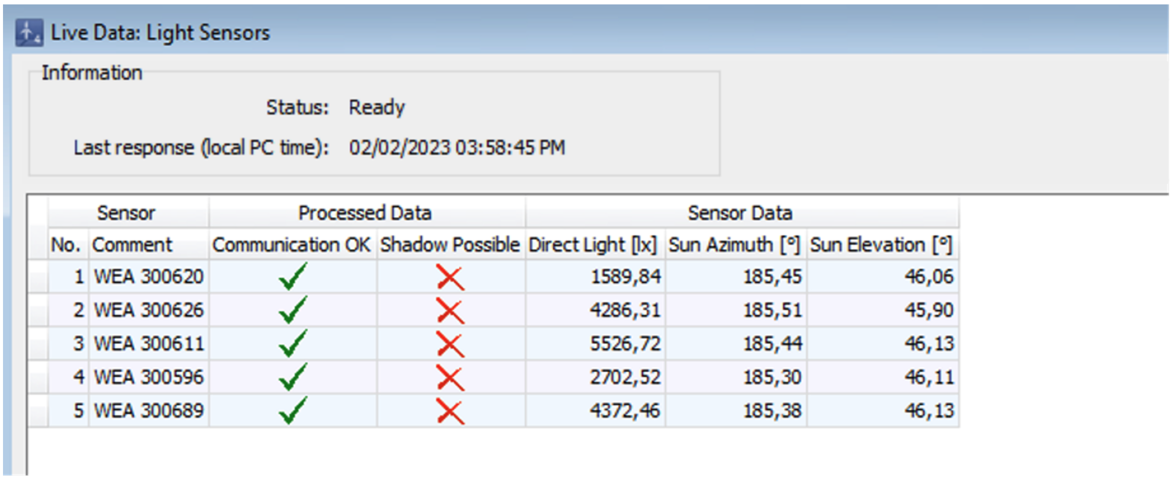
Element	Explanation
Last response (local PC time)	SM4 received its last response from the SMU at the date and time displayed here.
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing** – The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready** – The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*). **Disconnected** – Connection to the SMU has been disconnected, displayed live data are no longer up to date.
Preloading WTGs that are not displayed	This figure indicates the number of WTGs that do not belong to the "own" wind park and have nevertheless been set up in the project as there are places of immission in the project at which these "foreign" WTGs cause shadow impact (*Project > Wind Turbine Generators*). Since the SMU cannot communicate with these foreign WTGs, it does not receive any data from them and cannot switch them.
No.	Consecutive number of the WTG.
Identifier	WTG identifier as defined in the **Add/Edit WTG** window.
Communication OK	The status of the communication channel to the WTG is displayed here. ✓ – Communication to the WTG possible ✗ – Communication to the WTG not possible, e.g., due to incorrect IP address or network problems
Error	This is a collective error for the following situations: ✗ – If a communication error has been detected (see above), a red cross is also displayed here. Even if the WTG does not respond to a stop command issued by the SMU, an error is signaled here. ✓ – If the communication is ok and the WTG responds to stop commands, the green checkmark is displayed here.
Nacelle Angle [degree]	Analog or digitally determined value, depending on the WTG type.

<table>
<tr><th>Element</th><th>Explanation</th></tr>
<tr><td>Current Power [kW]</td><td>self-explanatory</td></tr>
<tr><td>Rotor Speed [rpm]</td><td>self-explanatory</td></tr>
<tr><td>Wind Speed [m/s]</td><td>self-explanatory</td></tr>
<tr><td>Outside Temp. [°C]</td><td>self-explanatory</td></tr>
<tr><td>Active Stop Commands:
Shadow/ Calendar/ Bat/ Sector/ Noise/ External/ Bird</td><td>If a system has been stopped due to shadow impact, calendar shut-down etc., this is indicated here by a green checkmark.</td></tr>
<tr><td>Switching test:
</td><td>You can test here whether the shutdown procedure is working by clicking on the corresponding red button for every individual switch reason (shadow, calendar, bat, etc.). This option is frequently used if not all WTGs are switchable at the time of installation of the SMU to test the shutdown procedure at a later point in time, even externally.</td></tr>
<tr><td></td><td>If you would like to display all available information and not just the standard columns, select the Details option in the window at the top right. Only the content of the standard columns is explained in the table as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.</td></tr>
<tr><td></td><td>If you click on this button, the Application Settings window, Update intervals for live data windows (File > Application Settings > Live Data) input area opens. The interval can be changed there.</td></tr>
<tr><td>Footer</td><td>Park data is displayed in a footer; note the following:
Mean values are indicated with "Ø =" .
Power is displayed as the sum of all column values.
Values are only included in the calculation if:
the communication is ok
no error is present
the value is recorded (possibly only visible under details, '-' is then displayed as value if not recorded)

<table>
<tr><th colspan="6">WTG</th></tr>
<tr><th colspan="5">Data</th><th></th></tr>
<tr><th>elle Angle [degrees]</th><th>Current Power [kW]</th><th>Rotor Speed [rpm]</th><th>Wind Speed [m/s]</th><th>Outside Temperature [°C]</th><th>Shadow</th></tr>
<tr><td>175,00</td><td>10,71</td><td>7,95</td><td>3,91</td><td>23,39</td><td></td></tr>
<tr><td>212,00</td><td>40,73</td><td>7,88</td><td>3,10</td><td>23,22</td><td></td></tr>
<tr><td>152,00</td><td>237,36</td><td>7,81</td><td>5,03</td><td>23,80</td><td></td></tr>
<tr><td>224,00</td><td>87,88</td><td>7,89</td><td>4,13</td><td>24,57</td><td></td></tr>
<tr><td>Ø = 190,75 °</td><td>376,68 kW</td><td></td><td>Ø = 4,04 m/s</td><td>Ø = 23,74 °C</td><td></td></tr>
</table>
</td></tr>
</table>

4.6.2 Live Data: Light Sensors

Purpose	Display live data from the light sensor(s) of the wind park
Path	*Realtime Data > Light Sensors*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	display only
Reference	Project

If you have established an online connection to an SMU (*File > Connect*), you can display live data of the connected light sensors in this window.



Live Data: Light Sensors

Information

Status: Ready

Last response (local PC time): 02/02/2023 03:58:45 PM

Sensor		Processed Data		Sensor Data		
No.	Comment	Communication OK	Shadow Possible	Direct Light [lx]	Sun Azimuth [°]	Sun Elevation [°]
1	WEA 300620	✓	✗	1589,84	185,45	46,06
2	WEA 300626	✓	✗	4286,31	185,51	45,90
3	WEA 300611	✓	✗	5526,72	185,44	46,13
4	WEA 300596	✓	✗	2702,52	185,30	46,11
5	WEA 300689	✓	✗	4372,46	185,38	46,13

Live Data: Light Sensors window

Notes on the window above

- The figure above only shows a section of the **Live Data: Light Sensors.**
- Information on the individual columns can be found on the next page.
- If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right (not included in the figure). Only the content of the standard columns is explained in the table on the next page as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.

The information, options or buttons are described in the following table

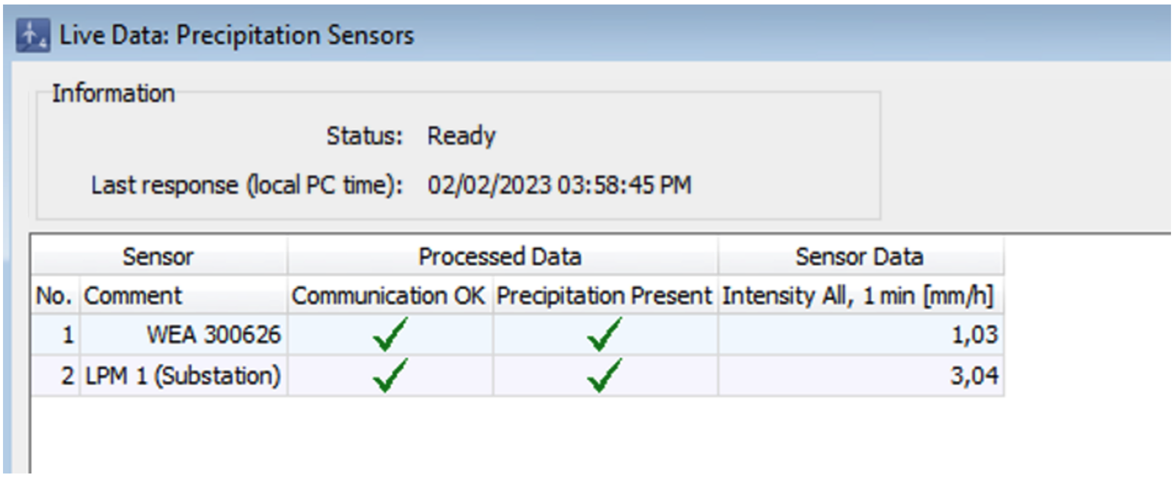
Element	Explanation
Last response (local PC time)	SM4 received its last response from the SMU at the date and time displayed here.
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing** – The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready** – The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*). **Disconnected** – Connection to the SMU has been disconnected, displayed live data are no longer up to date.
Sensor	
No.	Sequential No. of the light sensor.
Comment	Name as entered in the **Sensors and IO Signals** window (*Hardware > Sensors and IO Signals*).
Processed Data Two types of data can be displayed here in addition to information on e.g., Communication, Error Status, Last receipt: (a) data SM4 uses or processes in any way, e.g. as off-line values when a sensor is not accessible; (b) data edited by the SMU, e.g. to generate averaged values of reading points, such as "Precipitation present" in the case of a laser precipitation sensor.	
Communication OK	The status of the communication channel to the WTG is shown here. ✓ Communication to sensor possible ✗ Communication to sensor not possible, e.g. due to incorrect IP address or network problems
Shadow Possible	✓ Shadow impact possible ✗ No shadow impact possible

Element	Explanation
Sensor Data Data displayed here as received from the sensor	
Direct Light [lx]	The value measured by the four photo diodes of the light sensor.
Sun Azimuth [°]	Value calculated by the sensor itself.
Sun Elevation Angle [°]	Value calculated by the sensor itself.
	If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right. Only the content of the standard columns is explained in the table as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.
	If you click on this button, the **Application Settings** window, **Update intervals for live data windows** (*File > Application Settings > Live Data*) input area opens. The interval can be changed there.

4.6.3 Live Data: Laser Precipitation Sensors

Purpose	Display live data on the wind park's laser precipitation sensors
Path	*Realtime Data > Laser Precipitation Sensors*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	display only
Reference	Project

If you have established an online connection to an SMU (*File > Connect*), you can display live data of the connected laser precipitation sensors in this window.

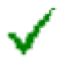


Live Data: Laser Precipitation Sensors window (section)

Notes on the window above

- The figure above only shows a section of the **Live Data: Laser Precipitation Sensors.**
- Information on the individual columns can be found on the next page.
- If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right (not included in the figure). Only the content of the standard columns is explained in the table on the next page as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.

The information, options or buttons are described in the following table

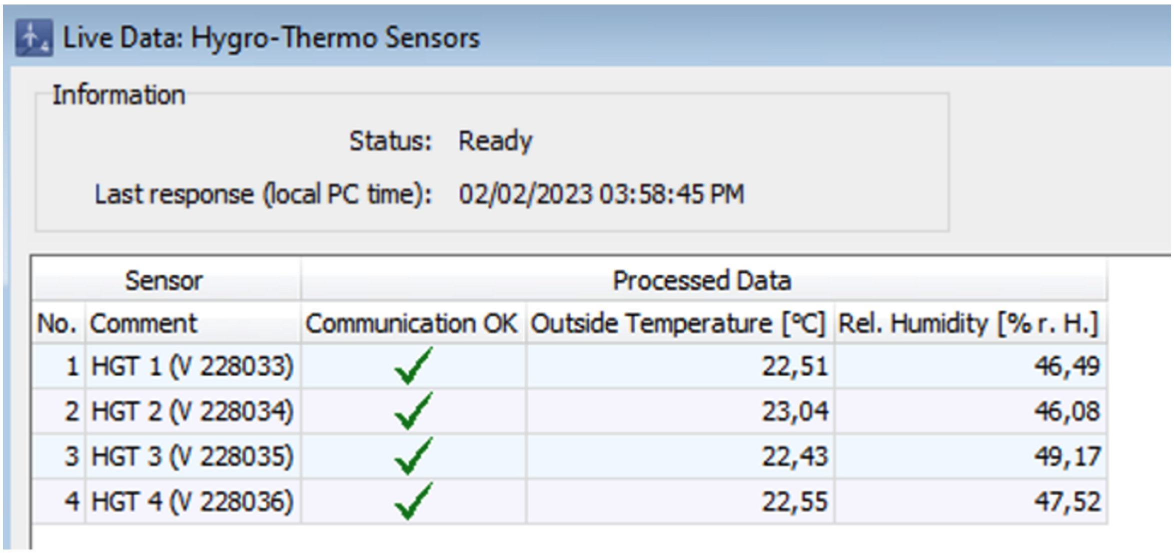
Element	Explanation	
Last response (local PC time)	SM4 received its last response from the SMU at the date and time displayed here.	
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing** The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready** The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*). **Disconnected** Connection to the SMU has been disconnected, displayed live data are no longer up to date.	
Sensor		
No.	Sequential No. of the laser precipitation sensor.	
Comment	Name as entered in the **Sensors and IO Signals** window (*Hardware > Sensors and IO Signals*).	
Processed Data Two types of data can be displayed here in addition to information on e.g., Communication, Error Status, Last receipt: (a) data SM4 uses or processes in any way, e.g. as off-line values when a sensor is not accessible; (b) data edited by the SMU, e.g. to generate averaged values of reading points, such as “Precipitation present” in the case of a laser precipitation sensor.		
Communication OK	The status of the communication channel to the WTG is displayed here.	
		Communication to sensor possible
		Communication to sensor not possible, e.g. due to incorrect IP address or network problems
Precipitation Present	see **Processed Data** above	

Element	Explanation
Sensor Data Data displayed here as received from the climate sensor	
Intensity All, 1 min [mm/h]	The precipitation amount measured by the sensor at intervals of one minute.
	If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right. Only the content of the standard columns is explained in the table as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.
	If you click on this button, the **Application Settings** window, **Update intervals for live data windows** (*File > Application Settings > Live Data*) input area opens. The interval can be changed there.

4.6.4 Live Data: Hygro-Thermo Sensors

Purpose	Display live data on the wind park's hygro-thermo sensors
Path	*Realtime Data > Hygro-Thermo Sensors*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	display only
Reference	Project

If you have established an online connection to an SMU (*File > Connect*), you can display live data of the connected hygro-thermo sensors in this window.

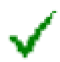


Live Data: Hygro-Thermo Sensors window (section)

Notes on the window above

- The figure above only shows a section of the **Live Data: Hygro-Thermo Sensors.**.
- Information on the individual columns can be found on the next page.
- If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right (not included in the figure). Only the content of the standard columns is explained in the table on the next page as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.

The information, options or buttons are described in the following table

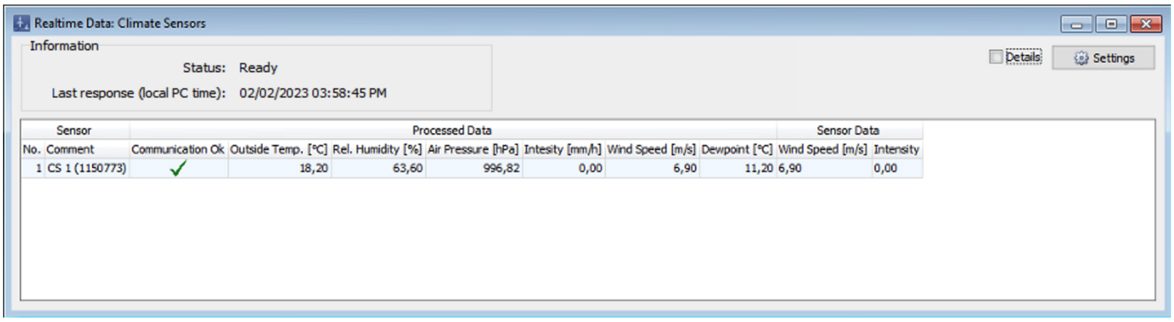
Element	Explanation	
Last response (local PC time)	SM4 received its last response from the SMU at the date and time displayed here.	
Note	Depending on the status of the live data shown in the list below, the following can be displayed here:	
	Preparing	The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist).
	Ready	The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*).
	Disconnected	Connection to the SMU has been disconnected, displayed live data are no longer up to date.
Sensor		
No.	Sequential No. of the hygro-thermo sensor.	
Comment	Name as entered in the **Sensors and IO Signals** window (*Hardware > Sensors and IO Signals*).	
Processed Data Two types of data can be displayed here in addition to information on e.g., Communication, Error Status, Last receipt: (a) data SM4 uses or processes in any way, e.g. as off-line values when a sensor is not accessible; (b) data edited by the SMU, e.g. to generate averaged values of reading points, such as "Precipitation present" in the case of a laser precipitation sensor.		
Communication OK	The status of the communication channel to the WTG is displayed here.	
		Communication to sensor possible
		Communication to sensor not possible, e.g. due to incorrect IP address or network problems
Outside Temperat. [°C]	see **Processed Data** above	
Rel. Humidity [% r.F.]	see **Processed Data** above	
 	If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right. Only the content of the standard columns is explained in the table as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.	

Element	Explanation
	If you click on this button, the **Application Settings** window, **Update intervals for live data windows** (*File > Application Settings > Live Data*) input area opens. The interval can be changed there.

4.6.5 Live Data: Climate Sensors

Purpose	Display real-time data of the wind park's climate sensors
Path	*Realtime Data > Climate Sensors*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	display only
Reference	Project

If you have established an online connection to an SMU (*File > Connect*), you can display live data of the connected climate sensors in this window.

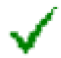
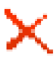


Live Data: Climate Sensors

Notes on the window above

- Information on the individual columns can be found on the next page.
- If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right. Only the content of the standard columns is explained in the table on the next page as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.

The information, options or buttons are described in the following table

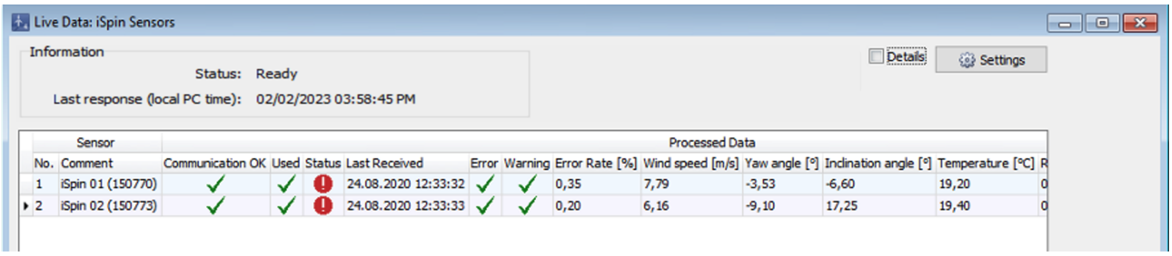
Element	Explanation
Last response (local PC time)	SM4 received its last response from the SMU at the date and time displayed here.
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing** – The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready** – The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*). **Disconnected** – Connection to the SMU has been disconnected, displayed live data are no longer up to date.
Sensor	
No.	Sequential no. of the climate sensor
Comment	Name as entered in the **Sensors and IO Signals** window (*Hardware > Sensors and IO Signals*).
Processed Data Two types of data can be displayed here in addition to information on e.g., Communication, Error Status, Last receipt: (a) data SM4 uses or processes in any way, e.g. as off-line values when a sensor is not accessible; (b) data edited by the SMU, e.g. to generate averaged values of reading points, such as "Precipitation present" in the case of a laser precipitation sensor.	
Communication OK	The status of the communication channel to the WTG is displayed here.  Communication to sensor possible  Communication to sensor not possible, e.g. due to incorrect IP address or network problems
Outside Temperature [°C], Rel. Hum. [%] etc.	see **Processed Data** above
Sensor Data Data displayed here as received from the climate sensor	
	If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right. Only the content of the standard columns is explained in the table

Element	Explanation
	as the detailed view is intended exclusively for technicians for the pur-pose of troubleshooting.
	If you click on this button, the **Application Settings** window, **Update intervals for live data windows** (*File > Application Settings > Live Data*) input area opens. The interval can be changed there.

4.6.6 Live Data: iSpin Sensors window

Purpose	Display real-time data of the wind park's iSpin sensors
Path	*Realtime Data > iSpin Sensors*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	display only
Reference	Project

If you have established an online connection to an SMU (*File > Connect*), you can display live data of the connected iSpin sensors in this window.



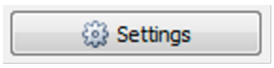
Live Data: iSpin Sensors window

Notes on the window above

If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right. Only the content of the standard columns is explained in the table on the next page as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.

The information, options or buttons are described in the following table

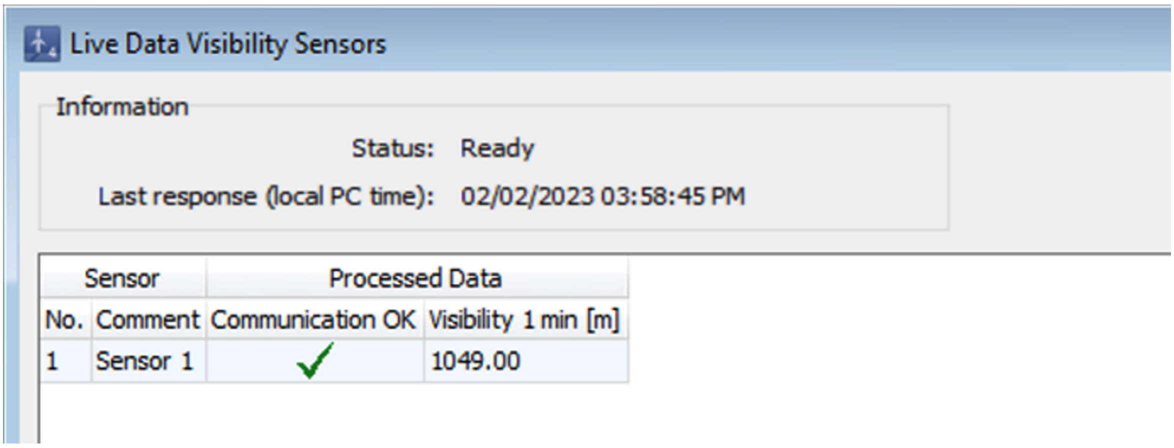
Element	Explanation
Last response (local PC time)	SM4 received its last response from the SMU at the date and time displayed here.
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing** – The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready** – The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*). **Disconnected** – Connection to the SMU has been disconnected, displayed live data are no longer up to date.
Sensor	
No.	Sequential number of the iSpin sensor
Comment	Name as entered in the **Sensors and IO Signals** window (*Hardware > Sensors and IO Signals*).
Processed Data Two types of data can be displayed here in addition to information on e.g. Communication, Error Status, Last receipt: (a) data SM4 uses or processes in any way, e.g. as off-line values when a sensor is not accessible; (b) data edited by the SMU, e.g. to generate averaged values of reading points, such as “Precipitation present” in the case of a laser precipitation sensor.	
Communication OK	The status of the communication channel to the WTG is displayed here. ✓ – Communication to sensor possible ✗ – Communication to sensor not possible, e.g. due to incorrect IP address or network problems
Used	A green checkmark indicates that basically all is fine with the sensor.
Status	Various individual information concerning communication and error status of the sensor is displayed here as follows: ✓ – Communication exists, no warning at the sensor ✗ – There is no communication to the sensor, or the sensor reports an error

Element	Explanation
	 Communication exists, but the sensor reports a warning
Last Received	Date and time of the last time data were received from the sensor.
Error	Indicates as follows whether the sensor reports an error:
	 The sensor reports no errors, everything is fine
	 The sensor reports a serious error
Warning	Here it is indicated as follows whether a warning is pending:
	 No warning is pending
	 There is a warning pending
Error Rate [%]	The error rate indicates the ratio between (a) the requests sent to a sensor and (b) the correctly received responses to them. However, many situations lead to an answer being falsely judged as incorrect: • Timeout – no response was received. • Incorrect content of the response, e.g. unexpected values or range overruns • Checksum error in the response data Possible reasons for this: network problems, interference, power supply problems and much more. It is not possible to say in general terms what error rate is acceptable in a particular situation. In principle, the error rate should be as low and constant as possible.
Wind Speed [ms], Yaw Angle [°] etc.	see **Processed Data** above
	If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right. Only the content of the standard columns is explained in the table as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.
	If you click on this button, the **Application Settings** window, **Update intervals for live data windows** (*File > Application Settings > Live Data*) input area opens. The interval can be changed there.

4.6.7 Live Data: Visibility Sensors

Purpose	Display real-time data of the wind park's visibility sensors
Path	*Realtime Data > Visibility Sensors*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	display only
Reference	Project

If you have established an online connection to an SMU (*File > Connect*), you can display live data of the connected visibility sensors in this window.



Live Data: Visibility sensors window (section)

Notes on the window above

- The figure above only shows a section of the **Live Data: Visibility Sensors**window.
- If you would like to display all available information and not just the standard columns, check the **Details** option in the window at the top right (not included in the figure). Only the content of the standard columns is explained in the table on the next page as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.

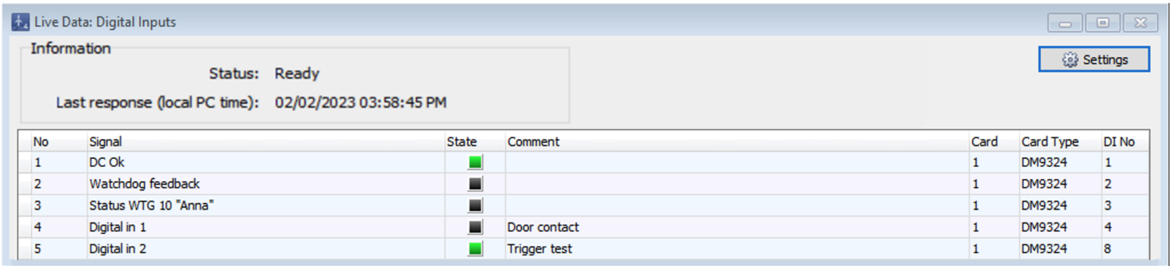
The information, options or buttons are described in the following table

Element	Explanation
Last response (local PC time)	SM4 received its last response from the SMU at this time.
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing** – The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready** – The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*). **Disconnected** – Connection to the SMU has been disconnected, displayed live data are no longer up to date.
Sensor	
No.	Sequential no. of the visibility sensor
Comment	Name as entered in the **Sensors and IO Signals** window (*Hardware > Sensors and IO Signals*).
Processed Data : Two types of data can be displayed here in addition to information on e.g. Communication, Error Status, Last receipt: (a) data SM4 uses or processes in any way, e.g. as off-line values when a sensor is not accessible; (b) data edited by the SMU, e.g. to generate averaged values of reading points, such as “Precipitation present” in the case of a laser precipitation sensor.	
Visibility 1 min	The visibility in meters measured by the sensor at intervals of one minute.
Communication OK	The status of the communication channel to the WTG is displayed here.  Communication to sensor possible  Communication to sensor not possible, e.g. due to incorrect IP address or network problems
	If you would like to display all available information and not just the standard columns, select the **Details** option in the window at the top right. Only the content of the standard columns is explained in the table as the detailed view is intended exclusively for technicians for the purpose of troubleshooting.
	If you click on this button, the **Application Settings** window, **Update intervals for live data windows** (*File > Application Settings > Live Data*) input area opens. The interval can be changed there.

4.6.8 Live Data: Digital Inputs

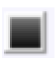
Purpose	Display digital input data in real time
Path	*Realtime Data > Digital Inputs*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	display + dialog
Reference	Project

If you have established an online connection to an SMUF(*File > Connect*), you can display the digital inputs defined in the current project and their state in this window.



Live Data: Digital Inputs

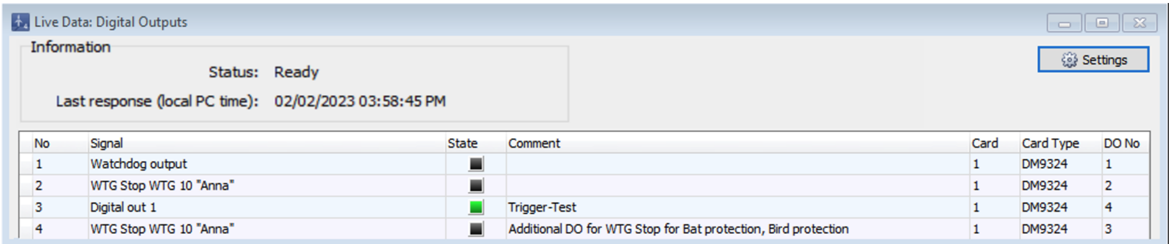
The information, options or buttons are described in the following table

Element	Explanation
Last response (local PC time)	SM4 received its last response from the SMU at the date and time displayed here.
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing** The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready** The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*). **Disconnected** Connection to the SMU has been disconnected, displayed live data are no longer up to date.
No.	Consecutive number of the signal
Signal	Name of the digital input as defined in the **Sensors and IO Signals** window (*Hardware > Sensors and IO Signals*).
State	 = 1  = 0
Card	Number of the card on which the digital input is located.
Card Type	-
DI No	Number of the digital input as in the **Sensors and IO Signals** window *(Hardware > Sensors and IO Signals*).
	If you click on this button, the **Application Settings** window, **Update intervals for live data windows** (*File > Application Settings > Live Data*) input area opens. The interval can be changed there.

4.6.9 Live Data: Digital Outputs

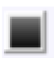
Purpose	Display digital output data in real time
Path	*Realtime Data > Digital Outputs*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	display + dialog
Reference	Project

If you have established an online connection to an SMUF(*File > Connect*), you can display the digital outputs defined in the current project and their state in this window.



Live Data: Digital Outputs

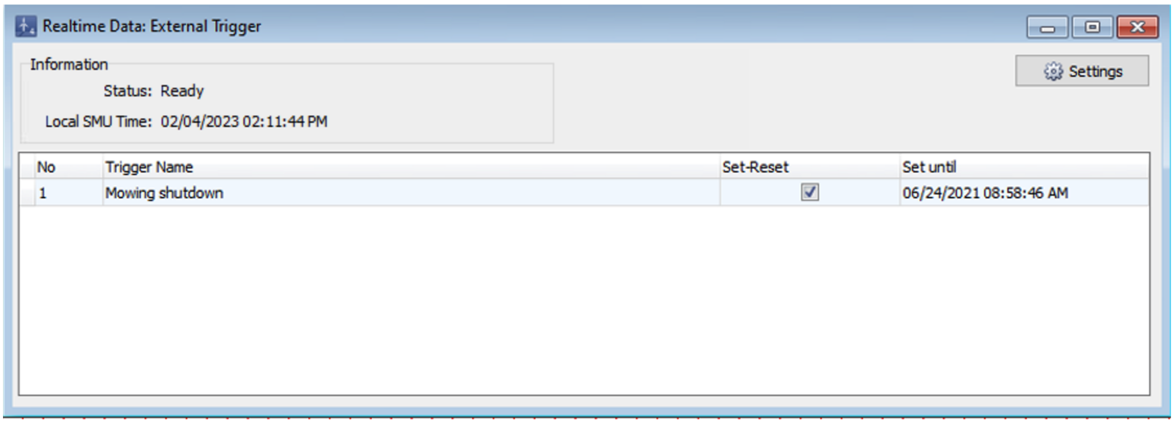
The information, options or buttons are described in the following table

Element	Explanation
Last response (local PC time)	SM4 received its last response from the SMU at the date and time displayed here.
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing**: The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready**: The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*). **Disconnected**: Connection to the SMU has been disconnected, displayed live data are no longer up to date.
No.	Consecutive number of the signal
Signal	Name of the digital output as defined in the **Sensors and IO Signals** window (*Hardware > Sensors and IO Signals*).
State	 = 1  = 0
Card	Number of the card on which the digital output is located.
Card Type	-
DI No	Number of the digital output as in the **Sensors and IO Signals** window *(Hardware > Sensors and IO Signals*).
	If you click on this button, the **Application Settings** window, **Update intervals for live data windows** (*File > Application Settings > Live Data*) input area opens. The interval can be changed there.

4.6.10 Live Data: External triggers

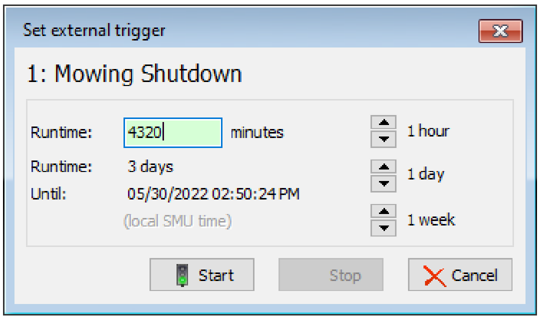
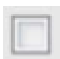
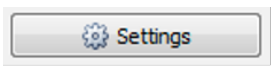
Purpose	• Display triggers defined in the project • Change states of triggers for test purposes
Path	*Realtime Data > External Trigger*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	display + dialog
Reference	Project

If you have established an online connection to an SMU (*File > Connect*), you can use this window to display the external triggers defined in the current project (see Glossary 371) and their state (reset or set to a specific time). In addition, it is possible here to change the state of a trigger for test purposes or to correct false triggers.



Live Data: External triggers

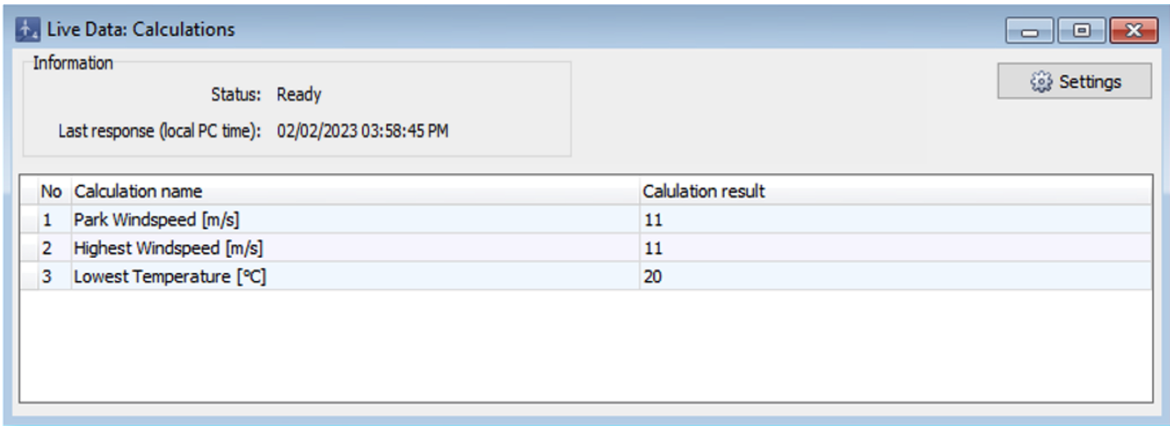
The information, options or buttons are described in the following table

Element	Explanation
Local SMU time	Displays the local time of the SMU.
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing** — The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready** — The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*).
No.	Consecutive number of the external trigger
Trigger Name	Name of the trigger as entered in the **Sensors and IO Signals** window (*Hardware > Sensors and IO Signals*).
Set/Reset	If you click on the box, the **Set External Trigger** window opens, see the following example.  Here you can enter the desired runtime or select it via the arrow keys. Press Start to start the trigger, press Stop to stop it. After the window is closed, the following is displayed:  Trigger is not active (has been stopped or has expired)  Trigger is set until the time specified under **Set to.**
Set until	see above
	If you click on this button, the **Application Settings** window, **Update intervals for live data windows** (*File > Application Settings > Live Data*) input area opens. The interval can be changed there..

4.6.11 Live Data: Calculations

Purpose	Display calculations defined in the project with current calculation result
Path	*Real-time data > Calculations*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	display only
Reference	Project

If you have established an online connection to an SMU (*File > Connect*), you can display the calculations defined in the current project in this window. For more information on calculations, see section Calculations window 252.



Live Data: Calculations

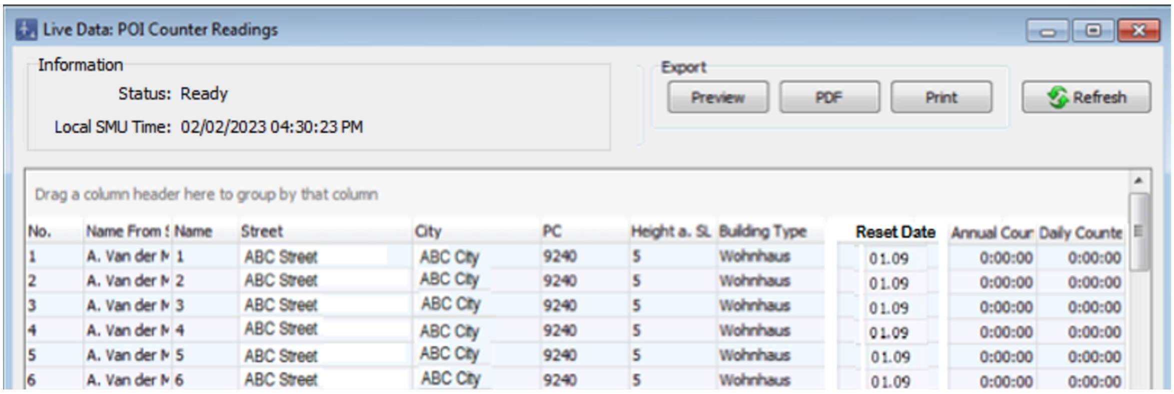
The information, options or buttons are described in the following table

Element	Explanation
Last response (local PC time)	SM4 received its last response from the SMU at the date and time displayed here.
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing** The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready** The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*).
No.	Consecutive number of the calculation
Calculation name	Name of the calculation as defined in the **Calculations** window (*Switching & Measurement > Calculations*).
Calculation result	Current results of the calculations.
	If you click on this button, the **Application Settings** window, **Update intervals for live data windows** (*File > Application Settings > Live Data*) input area opens. The interval can be changed there. The interval can be changed there.

4.6.12 Live Data: POI Counter Readings

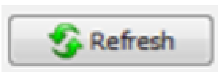
Purpose	Quick overview of current daily and annual counters
Path	*Realtime Data > POI Counter Readings*
Right group	Viewer
Prerequisites	Online connection to the SMU
Type of use	Display + interactive
Reference	Project

If you have established an online connection to a SMU (*File > Connect*), you can use this window to display an overview of the current daily and annual counter readings for the individual places of immission. While other live data windows read out the values automatically, you must manually trigger the reading of the data here by clicking on **Refresh**.



Live Data: POI Counter Readings window (section)

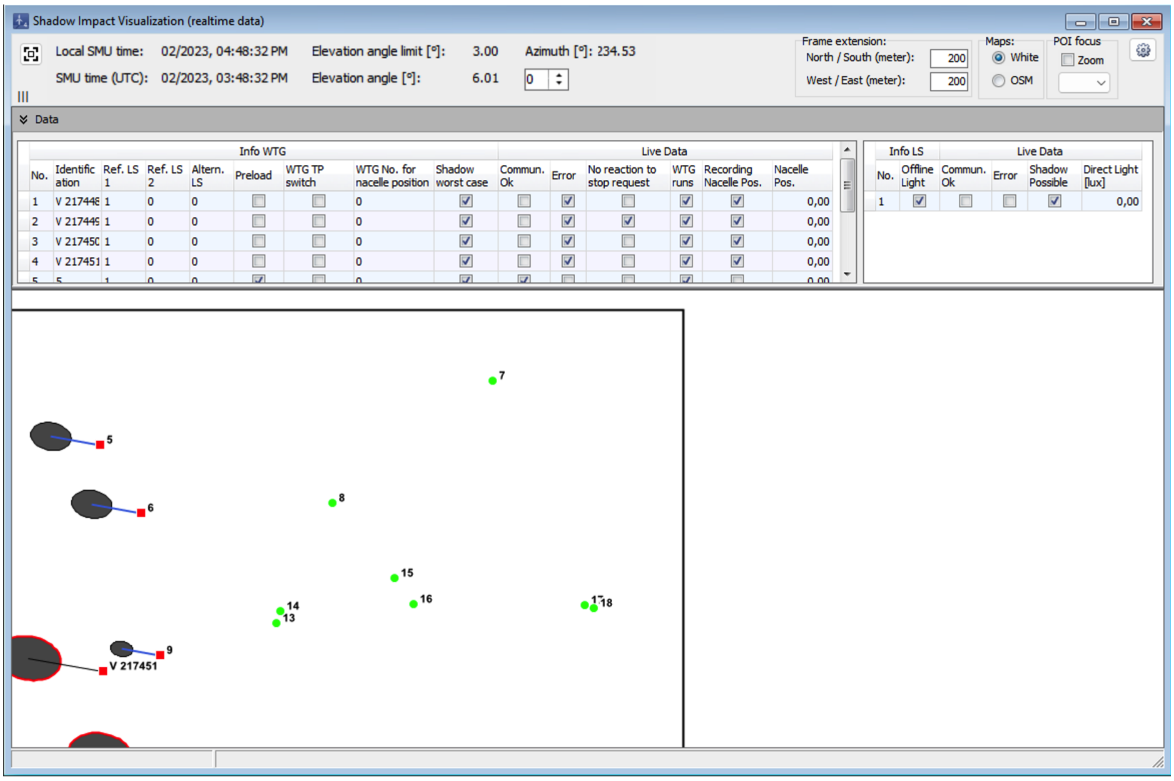
The information, options or buttons are described in the following table

Element	Explanation
Last response (local PC time)	SM4 received its last response from the SMU at the date and time displayed here.
Status	Note: Depending on the status of the live data shown in the list below, the following can be displayed here: **Preparing** – The prerequisites for displaying live data are being created (among other things, a connection to the SMU must exist). **Ready** – The prerequisites for displaying live data are met; the data is retrieved and displayed regularly (interval as specified in *File > Application Settings > Live data*). **Disconnected** – Connection to the SMU has been disconnected, displayed live data are no longer up to date.
	Opens the preview window of the read out counter readings. This button, as well as the **PDF** and **Print** buttons, are only active if the counter readings have been successfully read out by clicking **Refresh**.
	Used to save counter readings in PDF format.
	Used to print the PDF view of the counter readings on paper. There is no language setting for the document to be printed. The document will be printed in the language selected under SM4 (*File > Application Settings -> General -> Language*).
	Reads out the current counter readings from the SMU.

4.6.13 Live Data: Shadow Impact Visualisation

Purpose	Visualize the current shadow impact situation
Path	*Realtime data > Shadow Impact Visualization*
Right group	Viewer
Prerequisites	
Type of use	Display + interactive
Reference	Project

If you have established an online connection to an SMU*(File > Connect*), you can visualize the current shadow impact situation in this window. This window remains open even after the connection to the SMU has been terminated.

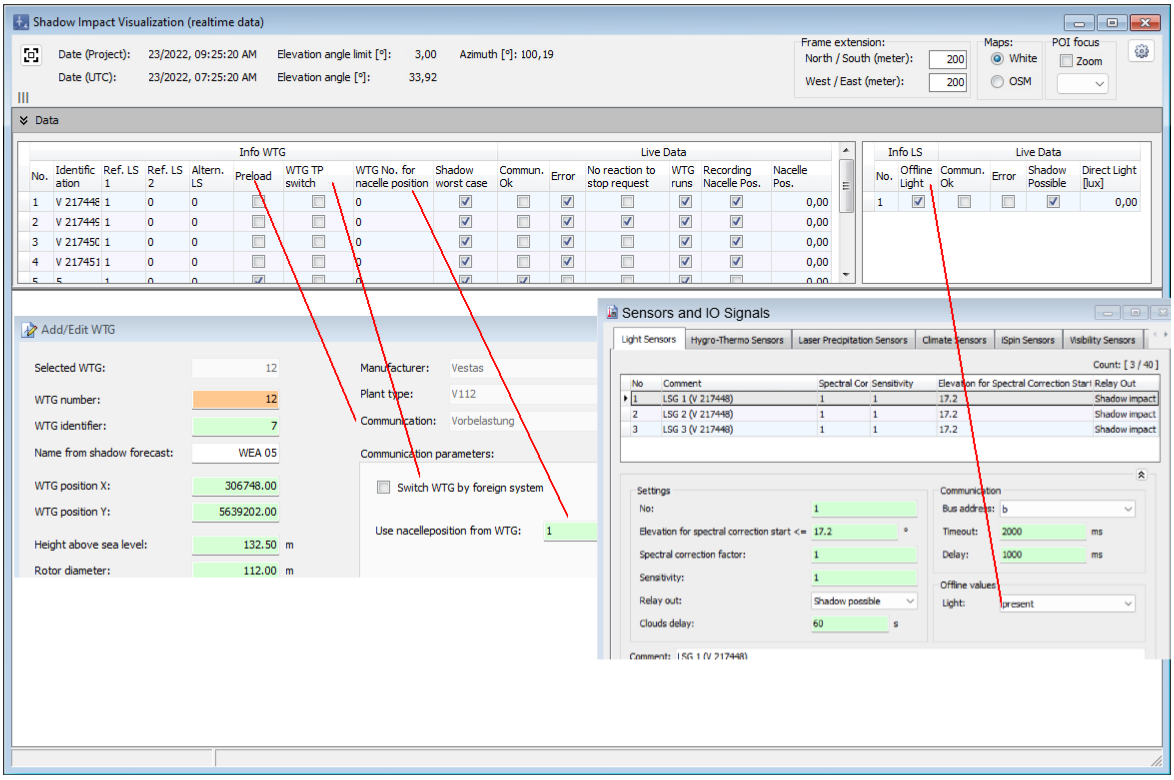


Live Date: **Shadow Impact Visualization** window

You will find an explanation of the symbols (tower shadow blue/black, rotor shadow light/dark etc.) that are used to display the current shadow impact situation in the lower half of the window, in the following section SI visualization symbols 321.

An explanation of the information, options or buttons can be found in the following table.

Element	Explanation
Local SMU time	Local time of the currently displayed shadow impact scenario.
SMU time (UTC)	UTC time of the currently displayed shadow impact scenario.
Elevation angle limit [°]	Value as defined und *Project > Application Settings > Shadow impact calculation > Min. sun elevation*. This parameter defines the minimum elevation angle – below this minimum elevation, shadow impact effects are not deemed possible and will not be visualized here.
Elevation angle [°]	Elevation angle of the sun as calculated by SM4.
Azimuth [°]	Azimuth of the sun as calculated by SM4.
Frame extension	Outside the project frame, the shadow impact ellipses are cut off. Input range 0-10000 m, default 200 m
Maps	**White** – Background is white.
	OSM – Open Street Map is displayed in the background. **NOTE:** To use OSM, the computer must be connected to the Internet.
POI Focus	If you check the **Zoom** box, you can select a POI number in the selection list below to center the map on this particular POI.
	Opens the **Live Data** settings area in at *File > Program Settings > Live Data*, where you can change the interval for updating the display of the shadow impact scenario.
Data: The tables displayed in the **Data** area cannot be edited here (display only).	
Info WTG	Data from the **Add/Edit WTG** window *(Project > Wind Turbine Generators > Add WTG*) is displayed here, please also refer to the screenshot below this table. **Shadow worst case** column Since it is not always possible to tell from the shape of the rotor shadow whether it corresponds to a detected nacelle position or depicts a worst case scenario, a check mark is displayed here whenever the latter applies.
Live Data	Data from the **Real-time data: WTG status** window is displayed here.
Info LS	Data from the **Light Sensors** tab *(Hardware > Sensors and IO Signals*) is displayed here, please also refer to the screenshot below this table.
Live Data (far right)	Data from the **Live Data: Light Sensors** is displayed here.

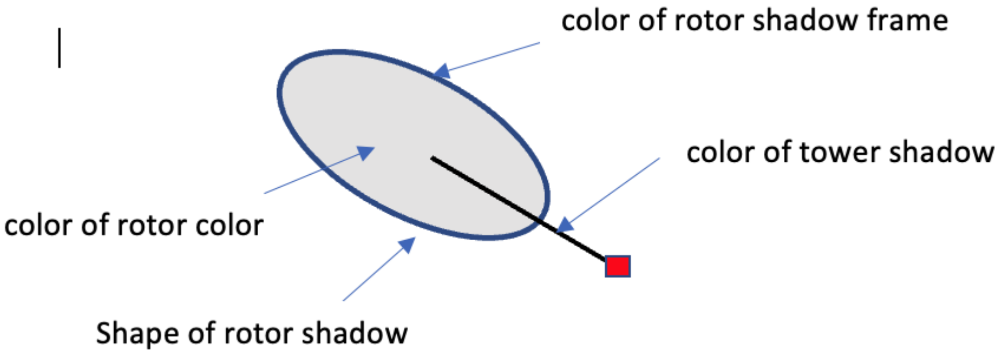


Live Data: Shadow Impact Visualization window, display area **Data**

An explanation of the symbols (tower shadow blue/black, rotor shadow light/dark, etc.) can be found in the next section.

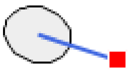
4.6.13.1 SI visualization symbols

The 4 elements shown in the following figure are used in the **Shadow Impact Visualization** window to visualize the current shadow impact situation:



The properties of the elements, which vary depending on the shadow impact situation, are described in the following tables 1 to 4:

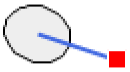
Table 1: Color of the tower shadow

Color	Reason
blue 	WTG is not switchable (WTG type = preload)
black 	WTG is switchable (WTG type ≠ preload)

NOTE

If the WTG is not switchable (WTG type = preload), then no communication with the WTG is possible, i.e. no real-time data can be requested from the WTG and the rotor shadow frame cannot be displayed in red - however, the light sensor data is still taken into account.

Table 2: Color of the rotor shadow

Color	Possible reasons
light 	• Communication with light sensor (LS) ok **And** there is no error at LS – but according to real-time data, shadow is not possible • Communication with LS not ok **Or** there is an error at the LS – offline value: **Light = not present** • WTG is not running (communication ok)
dark 	• Communication with LS ok **And** there is no error at LS – according to real-time data shadow is possible • Communication with LS not ok **Or** there is an error at the LS – offline value. **Light = present** • WTG is running • WTG communication not ok

NOTES

- If the WTG is not running, the light sensor data is not taken into account, because even if the light sensor is ok and shadow is possible, there can be no shadow impact, since the rotor is not turning.
- Even though the WTG is running, the rotor shadow may be displayed in light gray because no shadow is possible according to LS readings or because the offline value of the LS has been set to "not present".

Regarding the visualization of shadow according to the readings reported by light sensors (LS), the following combinations and states of light sensors should be taken into account

faulty *= communication not ok or LS faulty*
n.c. *= not configured*
LS 1 *= reference light sensor 1,* ***LS 2*** *= reference light sensor 2,* ***LS A*** *= alternative light sensor*

One light sensor

LS 1	LS 2	LS A	Visualization according to...
OK	n.c.	n.c.	LS 1
faulty	n.c.	n.c.	LS 1 (offline value)
n.c.	OK	n.c.	LS 2
n.c.	faulty	n.c.	LS 2 (offline value)
n.c.	n.c.	OK	LS A
n.c.	n.c.	faulty	LS A (offline value)

If the LS = OK, the real-time data are evaluated; otherwise, the visualization takes place according to offline values.

Two light sensors

LS 1	LS 2	LS A	Visualization according to...	see
OK	OK	n.c.	LS 1 or LS 2	a)
faulty	OK	n.c.	LS 1 (offline value) or LS 2	a)
OK	faulty	n.c.	LS 1 or LS 2 (offline value)	a)
faulty	faulty	n.c.	LS 1 (offline value) or LS 2 (offline value)	a)
OK	n.c.	OK	LS 1	b)
faulty	n.c.	OK	LS A	b)
OK	n.c.	faulty	LS 1	b)
faulty	n.c.	faulty	LS 1 (offline value)	b)
n.c.	OK	OK	LS 2	b)
n.c.	faulty	OK	LS A	b)
n.c.	OK	faulty	LS 2	b)
n.c.	faulty	faulty	LS 2 (offline value)	b)

a) If two reference LSs are configured, both are evaluated whether faulty or ok – if one of the evaluations results in shadow, then shadow applies.
b) If a reference LS and an alternative LS are configured, then the following applies:
- if both LSs are ok, then the value of the reference LS is evaluated
- if one LS is ok, then the value of the non-faulty LS is evaluated
- if both LSs are faulty, then only the offline value of the reference LS is taken into account

Three light sensors

LS 1	LS 2	LS A	Visualization according to...	see also
OK	OK	OK	LS 1 or LS 2	a)
OK	OK	faulty	LS 1 or LS 2	a)
faulty	OK	OK	LS 2 or LS A	b)
OK	faulty	OK	LS 1 or LS A	b)
faulty	faulty	OK	LS A	-
faulty	OK	faulty	LS 1 (offline value) or LS 2 or LS A (offline value)	c)
OK	faulty	faulty	LS 1 or LS 2 (offline value) or LS A (offline value)	c)
faulty	faulty	faulty	LS 1 (offline value) or LS 2 (offline value) or LS A (offline value)	d)

a) If LS 1 and LS 2 or all LSs are ok, then LS 1 and LS 2 are evaluated – if one of the evaluations results in shadow, then shadow applies

b) If LS1 or LS 2 is faulty, then also LS A is evaluated – if one of the evaluations results in shadow, then shadow applies
c) If LS 1 or LS 2 is faulty and LS A is faulty, then the offline values of the faulty LS and the real-time data of the functional LS are evaluated.
d) If all LSs are faulty, then all offline values are evaluated – if an offline value = light is present, then shadow applies

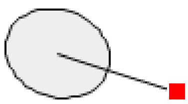
Table 3: Shape of the rotor shadow

Form	Possible reasons
nacelle position 	WTG is **switchable:** • Nacelle position is detected (communication ok) WTG is **not switchable** (preload): • WTG No. for nacelle position is not 0 (exists in the project) and is recorded
worst case 	WTG is **switchable**: • Nacelle position of WTG is not detected • Communication not ok WTG is **not switchable** (preload) : • WTG no. for nacelle position = 0 (WTG no. for nacelle position does not exist in the project) • Nacelle position of the WTG no. is not recorded

NOTE

If WTG type = preload, the values entered in the **Add/Edit WTG** window under **Communication parameters** are checked (since no communication to the WTG and thus no access to the Live Data is possible).

Table 4: Shape of the rotor shadow frame

Color	Possible reasons
black 	• WTG communication ok • No error is present
red 	• WTG communication not ok • An error is present

4.7 Logs menu

The SMU generates the following 4 logs:

- Operation log
- Shadow Impact
- Special Shutdown
- Single Data Recordings

In addition to downloading the desired logs in the **Logs** menu, you can filter them before displaying, exporting or printing.

The following table provides you with an overview of the **Logs** menu.

Menu item	Purpose
Local 326	Opens the **Logs from Local LogPool** window. Here you can, for example, filter, display, export and print logs that have already been downloaded. Here you can also access the sub window for exporting CMDRs, see Cyclic Multi Log sub window 331.
SMU 341	Opens the **Logs from the SMU** window. Here you can download specific logs or all logs from the SMU, see Logs from the SMU 341.

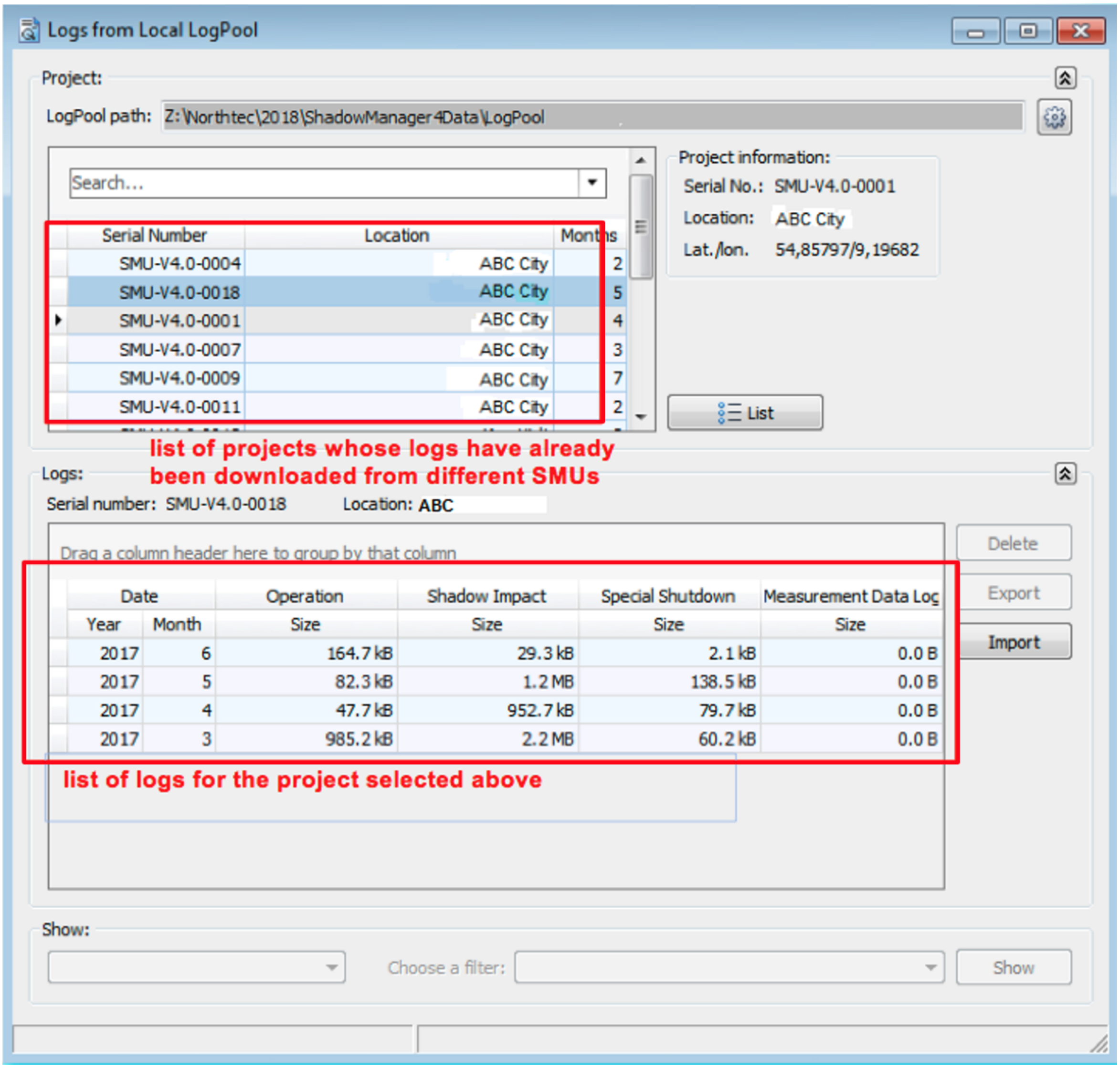
Click on a menu item to jump directly to more information.

4.7.1 Logs from Local LogPool window

Purpose	Filter, display, export and print logs that have already been downloaded
Path	*Logs > Local Log Files*
Right group	Read out logs
Type of use	Display + interactive
Reference	Cross-project

In this window you can

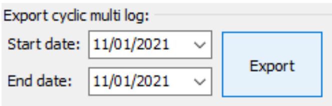
- list logs that have already been downloaded from the SMU
- filter, display, export and print listed logs and
- expand the details of individual logs
- apply pre-defined or user-defined filters before displaying the log in order to reduce the load on the computer

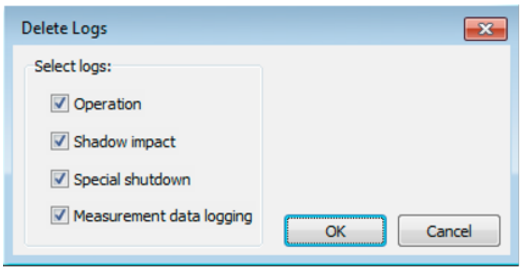
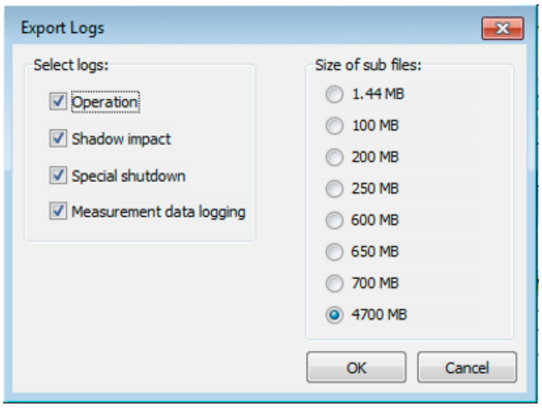


Logs from Local LogPool window

The information, options or buttons are described in the following table

Element	Explanation
Project area	(top window half)
or	This button is located at the right-hand-side window edge. It serves to show or hide the **Project** window area.
LogPool path	The file path to the folder where you stored the .exe file for running SM4 is displayed here. As soon as you run this .exe file, the **ShadowManager4Data\LogPool** folder structure will be created in the same directory, and, once you download logs from the SMU, these will be automatically stored in the **LogPool** folder. It is also possible to change this path, see the next table row.

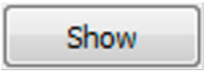
Element	Explanation
	This button is used for calling up the display filter application settings, where you can change the path, amongst other things, see section Display filters 83.
Search...	Here you can search for a specific project by entering free text.
Serial Number	Serial number of the respective SMU
Location	Location of the wind park
Months	Logs are downloaded month by month. Here you can view the number of downloaded logs.
Project Information	Information on the project selected on the left-hand side of the lists window is displayed here. The input of coordinates (lat./lon.) respectively relate to the automatically determined project center.
	For information on this input area, please refer to Cyclic Multi Log sub window 331.
	After you have selected a project from the top left of the window, click on this button to list the corresponding logs in the bottom half of the window. **NOTE:** You can also double-click on a list entry to list the logs.
Logs area	(bottom window half)
 **or** 	This button is located at the right-hand-side window edge. It serves to show or hide the **Logs** window area.
Serial Number	Serial number of the SMU that generated the displayed logs.
Location	Location of the associated wind farm
Drag a column heading here to group according to the heading.	If you have a large number of logs, it may be helpful to drag & drop the columns **Year** or **Month** to this field in order to sort the tables and display the logs for a specific year or month more clearly.
Date/ Operation/ Shadow Impact/ Special Shutdown/ Single Data Recordings (Measurement Data Logging)	You will find the following information under these column headings: **Date**: Information on the year and month of the respective log **Operation**: Size of the available operation log **Shadow Impact**: Size of the available shadow impact log **Special Shutdown**: Size of the available special shutdown logs (bat, bird, sector, noise, external) **Measurement Data Logging**: Size of the available Measurement data logs.

<table>
<tr><th>Element</th><th>Explanation</th></tr>
<tr><td>
</td><td>Is used for deleting a line of logs selected in the Logs area. If you click on Delete, a dialog window will open where you can individually exclude each of the four logs from being deleted.

</td></tr>
<tr><td>
</td><td>It is used to export logs selected in the Logs area. If you click on Export, a dialog window will open where you can individually exclude each of the four logs from being exported. Moreover, you can limit the size of the export file by making the corresponding selection for Size of sub files.

</td></tr>
<tr><td>
</td><td>Used to import a log from a local storage location or an external storage medium to the LogPool.

NOTE: Always use this import function when importing. If you instead simply move the corresponding files to the LogPool in Windows Explorer, the file structure will often be damaged.</td></tr>
<tr><td>Show drop-down list</td><td>Here you can select the log you wish to display.

The SMU generates 4 different logs (operating log, shadow impact log, shutdown log (special shutdown) and measurement data logging). A very large volume of data can be generated depending on the selection. In order not to overload the PC when processing this data, the entries can be pre-filtered using the Display Filter.

Alongside this function, entries from various different types of logs can also be combined. Log entries from an operating log can, e.g., be presented with entries from the shadow impact log in one view.</td></tr>
</table>

Element	Explanation
	The **single data recording** logs are the exception. In this case the values set by the user are recorded. No display filters can be used for this log and its entries cannot be combined with entries from other logs. **NOTE**: Instead of 4 logs, the dropdown list offers 8 logs to choose from. The reason for this is that the shutdown log is divided into the following logs here: **bat protection, bird protection, sector shut-down, noise protection** and **special shutdown**. So, when you select one of these 5 options, you are selecting part of the shut-down log.
Choose a filter drop-down list	If you have set a user-defined filter in the application settings (see Application Settings window, Display filters 83), you can select this filter here in order to further filter the log you have selected in the **Show** dropdown list.
	Click on **Show** and the log you selected will appear in a separate window. The entries displayed here correspond to the display filter you selected. You can find more information on this window in the next chapter. **NOTE**: This button is only active if you selected a log listed in the **Logs** area.

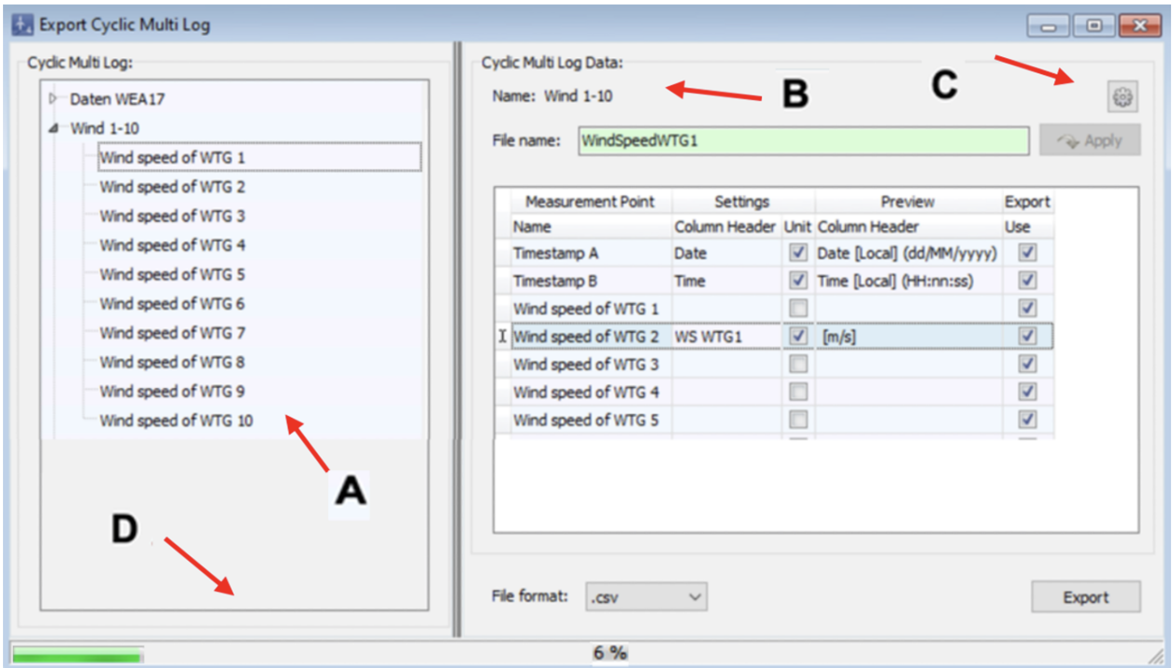
While downloading logs in the **Logs from the SMU** window, the functions of the **Logs from local LogPool** window are blocked.

4.7.1.1 Export Cyclic Multi Log sub window

Purpose	Display logged events of defined cyclic multi data recordings (CMDR), edit their display and export the data to a .csv file
Path	*Logs > Local Log Files > **Export** button* (after selecting project & date range)
Prerequisites	The following steps must have been carried out beforehand: • Define CMDR (see Cyclic Multi Log window 239) • Send project to the SMU (see Check Configuration window 159) • SMU records data • Download log files from the SMU (see Logs from the SMU window 341) • Export recorded data in the **Logs from local LogPool** window (see Cyclic Multi Log sub window 331)
Type of use	Display + interactive
Reference	Project

After the steps listed under **Prerequisites (**see above) have been carried out and you have finally clicked on **Export** in the **Logs from local LogPool** window, the **Export Cyclic Multi Log** window opens. The **combined** CMDRs are displayed here, see example screenshot below.

"Merged" in this context means that the reading points of the current project file/configuration **AS WELL as** the readings points from legends, i.e. older project files/configurations, are taken into account. Thus, reading points that have long been deleted may also be displayed here.



Export Cyclic Multi Log window

The above window is divided into the following sections

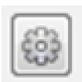
A Tree structure of the combined CMDRs with their reading points

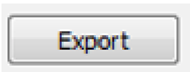
B Data of a CMDR selected on the left with the possibility to change settings

C Opens the relevant settings area in the **Application Settings** window

D Shows the progress of the data summary and the .csv export.

The information, options or buttons are described in the following table

Element	Explanation
Left part of window	
Cyclic Multi Log	In this display of the merged CMDRs, you can show or hide the reading points – otherwise **no editing is** possible. Once you select a recording, its reading points will be displayed in the right area of the window. If you select more than one recording on the left, *<no data to display> will* appear on the right, as it is not possible to display the data from more than *one* recording. **NOTE** It is possible that more reading points are displayed for a CMDR than are currently defined in the **Cyclic Multi Log** window, because the **merged** setups from *several* project files (legends) are displayed here, i.e. possibly also those reading points that were created at some point but later deleted again. When merging, the system checks for upper and lower case so that, e.g., the reading points of a recording called "Data WTG 1" are **not** merged with those of a recording called "data WTG 1".
Right side of window	
Name	Name of the recording as defined in the **Cyclic Multi Log** window. Display only
	Opens the relevant area in the **Application Settings** window where you can specify general settings for the .csv files to which CMDRs are exported. For more information on this settings area, see Application Settings window, Csv-Export, Cycl. Multi Data Recordings 76. **NOTE** The settings you make there in the **Measurement point settings** area are defaults for the fields of the same name in the **Cyclic Multi Log** window. They **only** affect those reading points that are **newly** added; reading points that have already been defined retain their .csv settings.

Element	Explanation
	This button for changing the file name is only active, • if a directory name is selected in the tree structure on the left side of the window (no reading point) AND • the entry in the **File name** field corresponds to the conventions for Windows file names, see next line.
File name	File name of the export file. When merging the data, the file name is taken from the CMDR of the last transferred project file (configurati-on). Note the following for the file name • conventions for Windows file names must be observed (certain characters and names, e.g. " : ; '< > as well as LPT0, COM0 etc. are not allowed), otherwise the field is highlighted in red • all .csv files of all CMDRs are output to the same folder – therefore the file names must be unique so they do **not** overwrite each other (case-insensitive): Filename = fileName
Table	Displays the reading points and two additional items (timestamps: **Da-te** and **Time**). The rows can be dragged and dropped to change the column order in the export file. You will find a detailed explanation be-low this table.
File format	Only the .csv format is currently supported.
	Starts the .csv export; is disabled during an ongoing export.

Measurement Point	Settings		Preview	Export
Name	Column Header	Unit	Column Header	Use
Timestamp A	Date	☑	Date [Local] (dd/MM/yyyy)	☑
Timestamp B	Time	☑	Time [Local] (HH:nn:ss)	☑
Rotor speed of WTG 17	RotSpeed	☑	RotSpeed [1/min]	☑
WTG status of WTG 17	WTG Status	☐	WTG Status	☑
Wind speed of WTG 17	WSpeed	☑	WSpeed [m/s]	☑
External temperature of WTG 17	Temp	☑	Temp [°C]	☑
Power, 10 min. average of WTG 17	PWR	☑	PWR [kW]	☑
Nacelle angle of WTG 17	NacAng	☑	NacAng [°]	☑

Table in the right area of the **Export Cyclic Multi Log** window

Element	Explanation
Name	Name of a reading point that will allow you to recognize it in the tree structure Display only
Column Header	Column title for the export file If you leave this field blank, the corresponding measured value will still be exported, but it will appear in the .csv file in a column without a title, or the title may only contain the respective unit (if activated).
Unit	Determines whether the unit is displayed in the column title. Display only for **Date** and **Time**
Column Header	What you see here will later appear 1:1 in the column title of the export file. Display only
Use	Determines whether the record (column) is exported. Display only for **Date** and **Time**

Notes on the above table

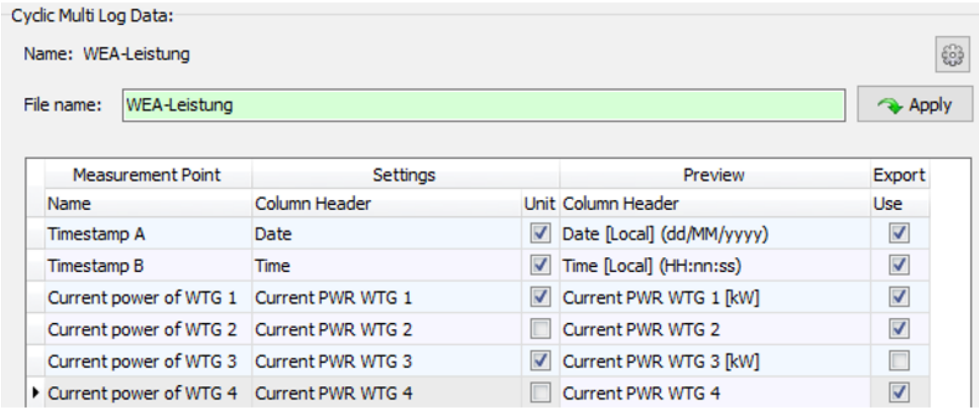
- In the table, you can rename the column titles of the export file; a row corresponds to a "column" in the export file.
- The rows can be dragged and dropped to change the column order in the export file.
- While an export is being executed, data cannot be edited and the drag & drop function is disabled.

The following is an example of an export file.

Export window **Cyclic multiple word recording -** Example of an export file

In this section you will find an example of the preview of a CMDR and the corresponding export file.

The following CMDR has been exported:



If the corresponding export file is opened in Excel, the result will look like this:

	A	B	C	D	E
1	Date [UTC] (dd/MM/yyyy)	Time [UTC] (HH:nn:ss)	Current PWR 1 [kW]	Current PWR 2	Current PWR 4
2	27.07.21	22:00:01	0	0	0
3	27.07.21	22:10:02	0	0	0
4	27.07.21	22:20:00	9999	9999	9999
5	27.07.21	22:30:00	9999	9999	9999
6	27.07.21	22:40:03	9999	9999	9999
7	27.07.21	22:50:02	9999	9999	9999
8	27.07.21	23:00:01	9999	9999	9999
9	27.07.21	23:10:00	9999	9999	9999
10	27.07.21	23:20:02	17326	271,1	
11	27.07.21	23:30:02	16769	133,1	
12	27.07.21	23:40:02	16362	71	
13	27.07.21	23:50:02	13857	23,6	

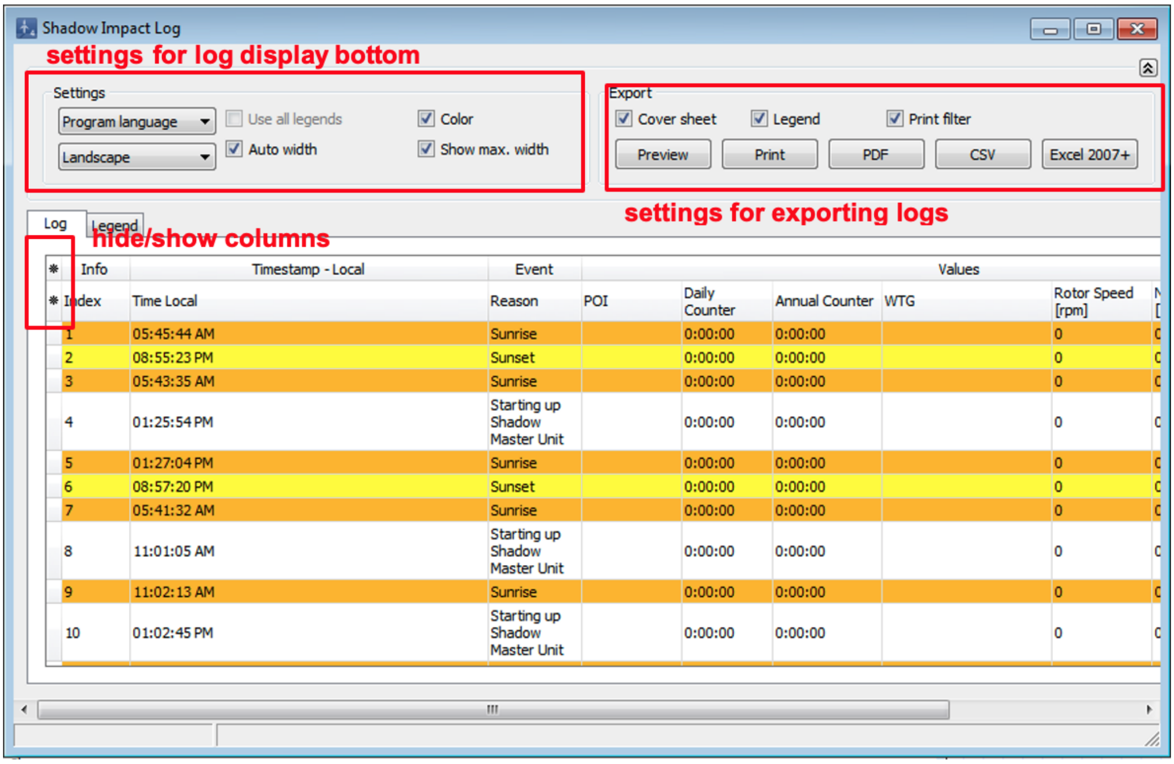
As you can see, the columns, as well as the column order, unit yes/no, etc. correspond to the settings from the screenshot above.

See also Practical example 8: Regular recording of several measured values 46

4.7.1.2 Operation Log/Shadow Impact Log/Shutdown Log sub windows

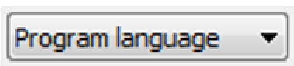
Purpose	Display, print, etc. logs that have already been downloaded from the SMU.
Path	*Logs > Local > **Display** button* (after selecting a log)
Type of use	Display + interactive
Reference	Project

The logs you selected in the **Show** dropdown list of the **Logs from Local LogPool** window are displayed in this window.



Log display window example: **Shadow Impact Log**

The information, options or buttons are described in the following table

Element	Explanation
Settings area	
	In this drop-down list, you can specify in which language the log should be output. In all cases, the **Program language** option (report language = language of the SM4user interface) can be selected. The other languages available depend on the supported languages.

Element	Explanation
Landscape Portrait	Here you can specify whether the log should be displayed/printed in **Landscape** or **Portrait** format.
Use all legends	As the name of a POI/WTG can change over the course of time, there may be several legends for a POI/WTG, as applicable. If this option has been selected, the **Legend** tab will display older legends will be displayed. Otherwise, only the latest legend will be displayed.
Auto width	If you select this option, all hidden columns will be automatically distributed over the available width.
Show max. width	If you a) have not activated the **Auto width** option and b) have so many hidden columns that they cannot easily fit on one page, all the columns moved to the next page will be highlighted in grey on the screen.
Color	When this option is activated, all colors assigned to events *File > Application Settings > Display filters > Operation log/ Shadow impact log /...* are shown (it can be seen in the example window on the previous page that the **Sunset** event has been assigned the color yellow). Information on assigning colors can be found in section Application Settings window, Display filters 83.
Export area	
Cover sheet	When activated, a cover page is generated for the log.
Legend	When activated, an explanation of the abbreviations of the places of immission is provided at the end of the log (address, e.g. 1 ABC Street, 12345 ABC City).
Print filter	When activated, the filter that was used is listed at the end of the log (*File > Settings > Display filter > Operation log/ Shadow impact log*/ ...) see Application Settings for Display filters, section Display filters 83.
Preview	Opens the preview window of the log.
Print	Is used to print the log using a printer connected to SM4.
PDF	Is used to save the log as a PDF.
CSV	For exporting in .csv format; e.g., for external analyses.

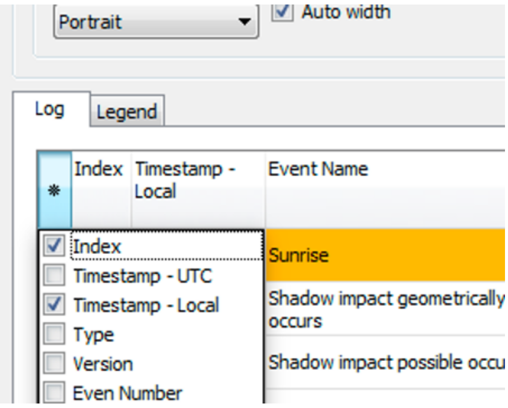
Element	Explanation
Excel 2007+	Exports the log as an .xlsx file that can be opened with Microsoft Offi-ce 2007 and later versions (the colors are also exported).

Notes regarding the log display window (**Operation Log/ Shadow Impact Log/ Shutdown Log**)

- Only the log events that are assigned in the respective filter in the Application Settings (*File > Application Settings> Display filters*) are displayed in the Shutdown log. They are displayed in the log under the same term that is displayed in the **Event** column.
- What you see is what you get: The log is printed out/saved as a PDF exactly as displayed here.
- Move columns: Columns can be moved by drag & drop.
- Sort by column: You can sort a column according to its heading by clicking on it. If you then click again on the same column heading, the sort sequence will change from ascending to descen-ding or vice versa.
  You can also sort by more than one column heading (criteria). To do this, first press and hold the shift key and then click on the desired column headings. The sorting will be carried out according to the order in which you click on the column headings.
- Hide/show columns: Columns can be hidden/shown, see the next page.
- Column filters: Filters can be applied to columns, see section Apply log column filter 339.
- In the **Shutdown Log** window, there are dynamically created columns in addition to the stan-dard columns. This is dscreibte under Dynamically created columns in the Shutdown Log 340.
- If you notice that the font of some entries in the log is not black but colored, they may have been downloaded incorrectly from the SMU.

4.7.1.3 Hide/show log columns

To hide/show columns in the **Operation Log/ Shadow Impact Log/ Shutdown Log** windows, click on the asterisk * at the top left of the **Log** tab. A list of possible column headings will then be shown, see the following figure.



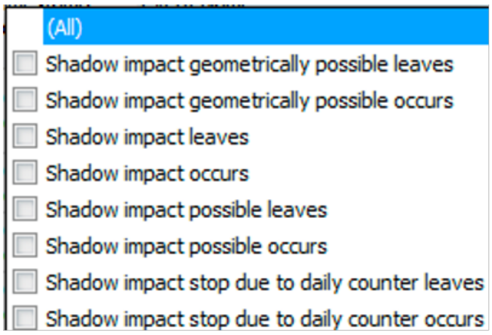
Hide/show log columns

Each column can be hidden/shown as desired by selecting and deselecting the individual column headings.

4.7.1.4 Apply log column filter

The column headings of the log are provided with a filter function, which you can use as follows:

Move the mouse cursor to the top right-hand corner of a column heading until a small filter symbol  appears. Click on the filter symbol. A list of possible entries will then be shown.



Column filter

Now set a checkmark next to the desired events. Only selected events are displayed afterwards.

4.7.1.5 Dynamically created columns in the Shutdown Log

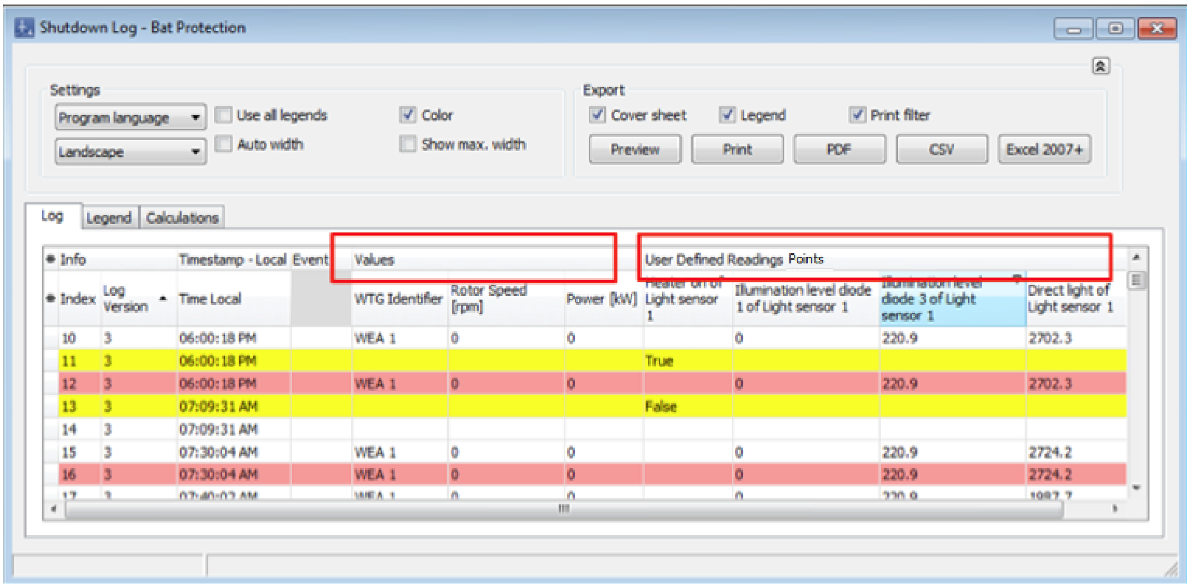
In the case of the **Operating Log** and **Shadow Impact Log**, the SMU determines which values (readings) are logged in connection with an event. In the case of the **Shutdown Log**, on the other hand, further reading points can be recorded in addition to these "standard values" in connection with an event. The following reading points are available:

- Default reading points
  These reading points are permanently stored in SM4 and cannot be changed or deleted by the user. This ensures that the most important reading points are always recorded in the log.

- Condition reading points
  These reading points were used when defining shutdown conditions and can only be edited there. With the help of condition reading points, the log can show why a WTG was switched off at a certain time, e.g. because the hygro-thermo sensor exceeded a certain temperature. This makes much more sense if there are several conditions: the log will then also reveal which of conditions led to the stop (e.g. temperature or humidity or wind speed).

- User-defined reading points
  The user can add these reading points as required. User-defined calculations (*Switching & Measurement > Calculations*) can serve as a reading here. Reading points that are already included in the default or condition reading points cannot be added **again**.

For the standard reading points there are fixed columns in the log display window **Shutdown Log**, which are displayed in the table area **Values**. **Condition reading points** as well as **User-defined reading points** are displayed under **User Defined Reading points**. These columns are created dynamically as required. See the following example:



The columns in the table area **User Defined Reading points** were created dynamically, because

- reading points of the same name are part of a defined special shutdown or night slice shutdown or because they were added as **User-defined reading points** in the **Events** window, and

- values were actually logged in the selected period.

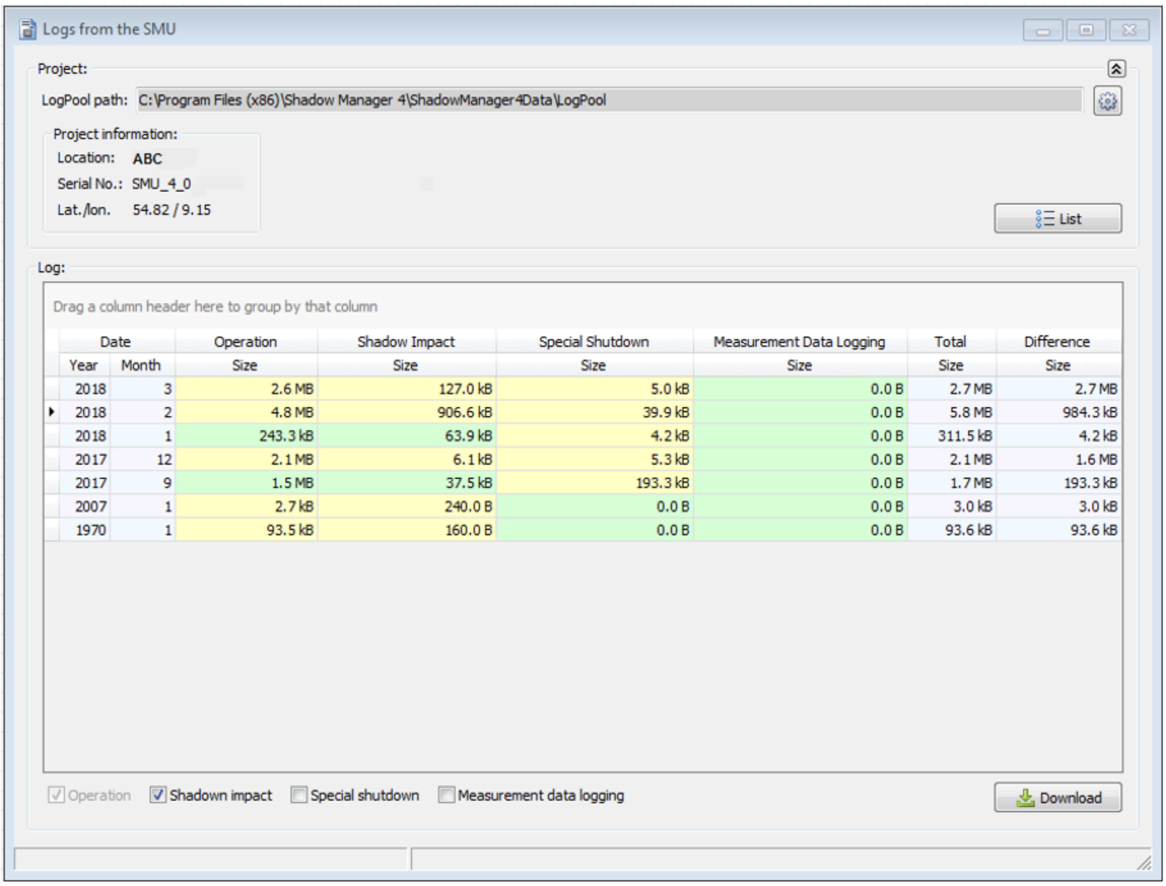
4.7.2 Logs from the SMU window

Purpose	Downloading logs from the SMU
Path	*Logs > SMU*
Right group	Read out logs
Prerequisites	Online connection to the SMU
Type of use	Interactive
Reference	Project

The SMU generates the following 4 logs:

- Operation
- Shadow Impact
- Special Shutdown
- Single Data Recordings

In the **Logs from the SMU** window, you can download specific or all logs from the SMU.



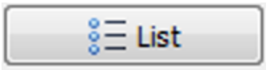
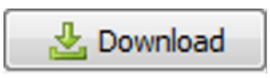
Logs from the SMU window

NOTE

You can only download logs in the window above. Open the **Logs from Local LogPool** window (*Logs > Local Log Files*) to display, filter, print out, etc.

The information, options or buttons are described in the following table

Element	Explanation
 or 	This button is located at the right-hand-side window edge. It serves to show or hide the **Project** window area.
LogPool path	The file path to the folder in which you stored the .exe file for running Shadow Manager 4 is displayed here. As soon as you run this .exe file, the **ShadowManager4Data\LogPool** folder structure will be created in the same directory, and, once you download logs from the SMU, these will be automatically stored in the **LogPool** folder. It is also possible to change this path, see the next table row.

	This button is used for calling up the display filter application settings, where you can change the path, amongst other things, see section Application Settings window, Display filters 83.
Project Information	Information on the currently open project is shown here. Information on the project selected on the left-hand side of the lists window is displayed here. The input of coordinates (lat./lon.) respectively relate to the automatically determined project center.
	When you click on **List**, the SMU will notify SM4 about which logs are available on the SMU and prepare these to send to SM4. The existing logs will not yet be downloaded but merely listed in the bottom half of the window in the **Log** area (this process can take several minutes). After "listing" all logs available in the SMU, all months (lines in the list) and all logs (checkboxes) are automatically selected, so when you click **Download**, all logs are downloaded.
Log	After clicking on **List**, the logs that are available on the SMU will be highlighted in a color here. The colors have the following meaning: green: completely downloaded onto the local computer yellow: incompletely/partly downloaded red: there are more logs locally than exist on the SMU (this should be avoided, and, in this case, it is advisable to delete the entire month and download the logs again) **NOTE** This status is **undesired**; a user may have deleted, e.g., individual files in the local directory. We strongly recommend leaving the local directory untouched. Otherwise, log files could become irretrievably lost, since the SMU automatically cleans up at some point for storage space reasons and deletes older log files permanently.
Operation	Is selected to include the Operation log when downloading.
Shadow impact	Is selected to include the Shadow Impact log when downloading (the Operation log is automatically selected at the same time).
Special shutdown	Is selected to include the Special Shutdown log when downloading.
Measurement data logging	Is selected to include the Single Data Recordings when downloading.
	Click on this button click to start downloading the logs. Following a successful download, a dialog appears, which you must confirm by clicking **OK** before you can continue working.

4.8 Tools menu

The following table provides you with an overview of the **Tools**menu.

Menu item	Purpose
Integrity Check 345	Manually initiate an integrity check (it is checked whether the project is coherent).
Set Plausibility 350	Declare all shutdown conditions that violate the plausibility rules as compliant in one step
Simulation 351	Calculate the worst-case shadow impact scenario over a specific period of time.
Shadow Impact Visualization 356	Visualize shadows impact over time
SMU Connectivity 360	Identify at a glance whether the SMU is ready for a connection
Project Comparison window 362	Clearly juxtapose two projects from different sources
WTG Types 365	List possible WTG types
Window 366	Reset window positions and screen detection

Click on a menu item to jump directly to more information.

4.8.1 Project Integrity window

Purpose	Manually initiate an integrity check
Path	*Tools > Integrity Check*
Prerequisites	-
Type of use	display only
Reference	opened project

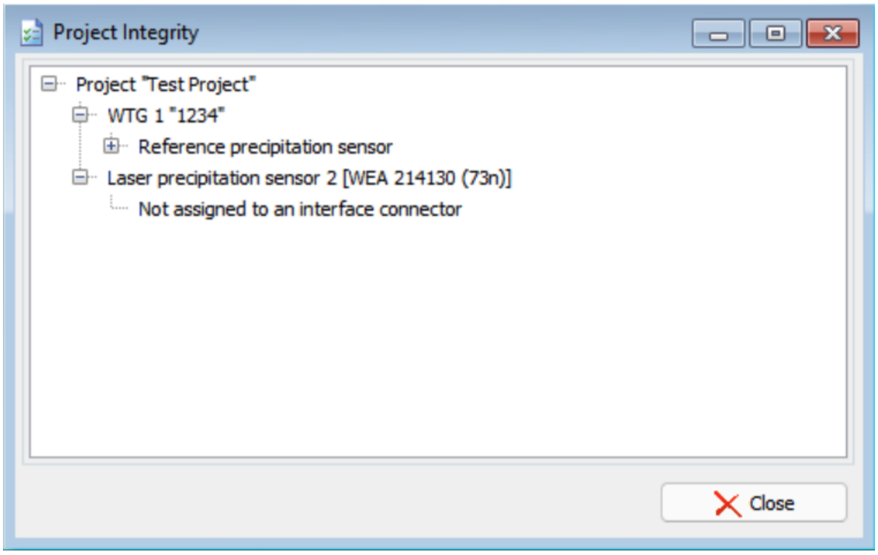
SM4 has an integrity module installed, which is used to test for integrity in a project (incomplete references, missing parameters and other “errors”) prior to uploading to the SMU. The results of the test are displayed in this window.

You can create a project or a project component (e.g. light sensor) in the SM4, even if not all the required parameters are known, in order to prepare the project as far as possible. The following situations are conceivable:

- creating a new project without an IP address being assigned for the SMU
- adding a light sensor that is not yet connected to the hardware
- defining a WTG that refers to sensors that do not yet exist

However, an incomplete project may not be transferred to the SMU (configured). The **Configuration Check** window will open when the user selects *Project > Configuration*. You can click here on **Test Config.** to initiate a test in this window for testing various aspects, including project integrity. All incomplete references will be detected and clearly displayed to the user in the process. The project is only complete when it is no longer possible to detect any unresolved items (only notes on unused objects can be ignored, see below).

An integrity check can be called up manually at any time (*Tools > Integrity Check*) to determine which items still need to be completed. The results will be displayed in the **Project Integrity** window, see the example window below:



Project Integrity window

Notes on the example window above

- A light sensor has been added here and already referenced in a special shutdown for WTG 1. The connection from the light sensor to the hardware (in this case via an interface connector) to enable it to operate on the SMU is missing.
- Moreover, an additional hygro-thermo sensor has been defined. Due to the fact that, however, this is not referenced anywhere else, SM4 simply reports this as an "unused object", which can only be viewed as a note.

4.8.1.1 Dependencies window

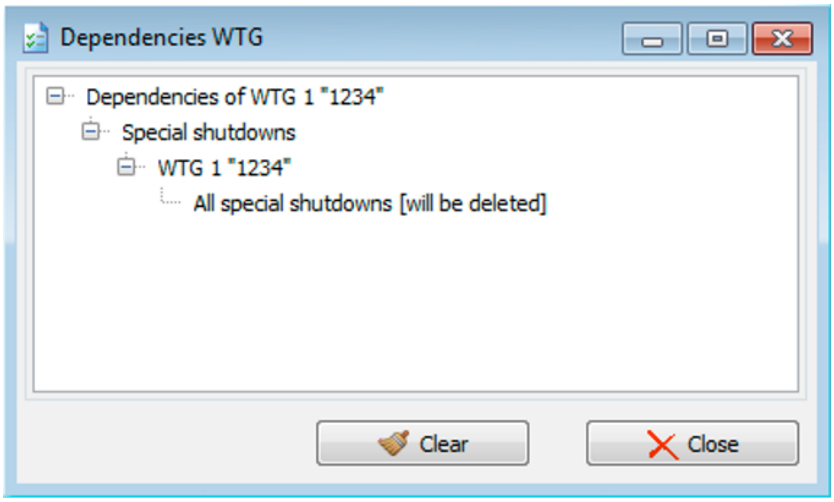
The **Dependencies** window is a part of the integrity module and will always open if a change planned by a user will have consequences for other parts of the project.

Example A: A WTG needs to be removed from the wind park.

Here it is necessary to check where reference has been made to this WTG in the current scenario, for example in the following settings:

- Readings of the WTG in Shutdown conditions of Special and Night Slice Shutdowns
- Special and Night Slice Shutdowns for the WTG itself
- Readings and conditions of this WTG in Single Data Recordings

The user is shown the consequences of removing the WTG in the **Dependencies** window; see the example window below:

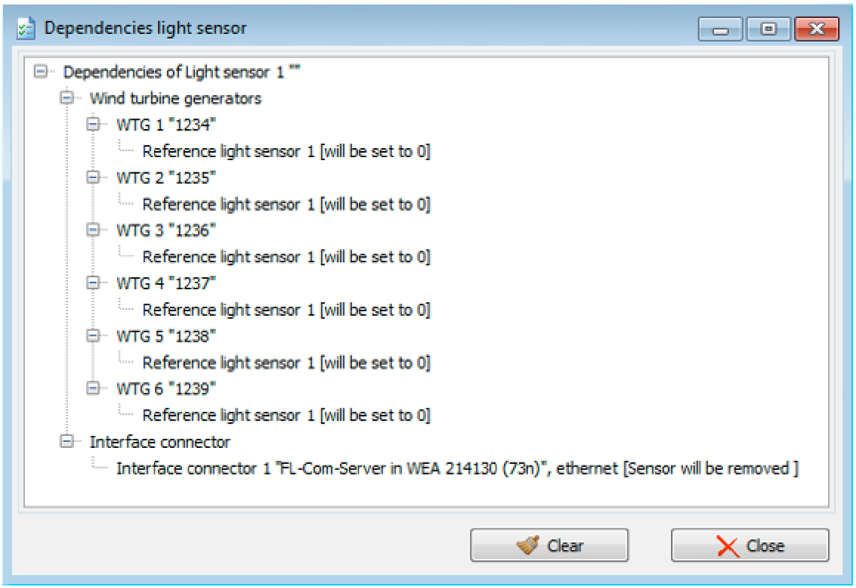


Dependencies window (example A: deleting a WTG)

Notes on the example window above (example A)

- It is apparent that special shutdowns exist for this WTG – none of which will be useful after it has been deleted.
- The **Clear** button is also always available for this type of report from the integrity module. If you click on it, the action that is listed in square brackets after the affected object or objects will be implemented. In this case all special shutdowns that exist for the WTG to be deleted will also be deleted.
- If this window is closed by clicking on **Close**, however, nothing else will happen and the entire process will be cancelled. This means that the planned deletion of the WTG will not take place.

Example B: A light sensor needs to be removed.



Dependencies window (example B: deleting a light sensor)

Notes on the example window above (example B)

- If this sensor is deleted, this will have an impact on other sensors as well, due to the bypass function.
- Furthermore, the light sensor serves as reference sensor for four WTGs.
- And it is assigned to an interface connector.These windows for dependencies are only displayed if an action would have real consequences.

If you attempt to remove a digital input (DI) that is not referenced anywhere, for example, the deleting process will be implemented directly by clicking on the **Remove** button in the **Sensors and IO Signals** window.

The following actions could have consequences for other objects:

- delete WTG/POI
- delete analog/digital inputs/outputs
- delete sensor
- delete interface connectors
- delete interface cards
- new number assignment for /move a WTG/POI
- new number assignment for analog/digital inputs/outputs

- new number assignment for sensors
- new number assignment for interface connectors

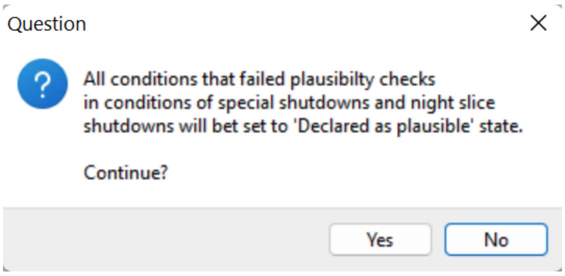
The following objects could be affected by actions:

- conditions for special and night slice shutdowns
- actual special and night slice shutdowns
- conditions for single data recordings
- single data recordings
- shutdown calendars
- interface connectors
- hardware assignments
- bypass sensors

4.8.2 Set Plausibility

Purpose	Declare all shutdown conditions that violate the plausibility rules as compliant in one step
Path	*Tools > Set Plausibility*
Reference	Project

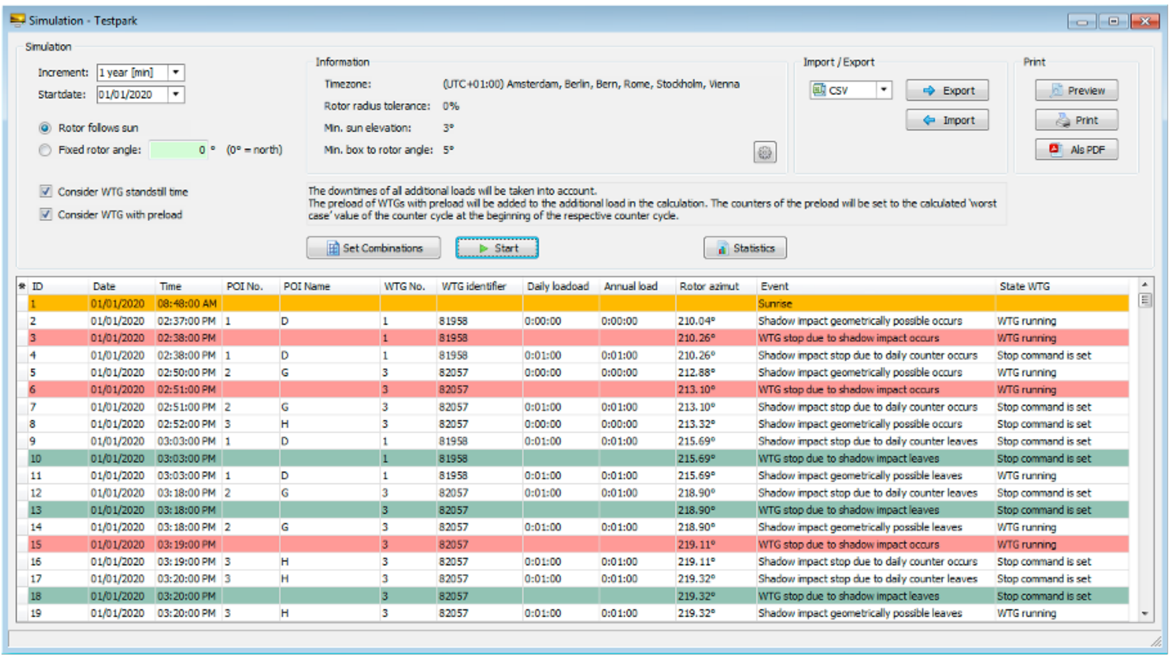
If you select this command, you must answer the following prompt to continue or cancel the operation.



4.8.3 Simulation window

Purpose	• Calculate, display, print, export worst-case shadow impact scenarios over a specified period of time for the entire wind farm or specific combinations of WTGs and POIs • Display, print, export statistics with different perspectives and representations
Path	*Tools > Simulation*
Prerequisites	Dongle
Type of use	Interactive
Reference	Project

The currently loaded shadow impact scenario is calculated over a desired time period (max 1 year) by a simulation. This calculation does not take place in the SMU but within SM4.



Simulation window

General notes regarding the **Simulation** window

- According to the factory default, the system, when simulating a shadow impact scenario, always assumes the worst-case, i.e. there is always enough light during the day to cause shadow impact, and the rotors of the wind turbine generators are always in a 90 °position with respect to the sun.
- Furthermore, it can be determined whether downtimes of the wind park's own WTGs and of the preloading WTGs (WTGs of other wind parks) should be taken into account.
- The same algorithm and the same temporal resolution are used as those used in the SMU. This ensures the simulated results are comparable to the SMU's Shadow impact log.

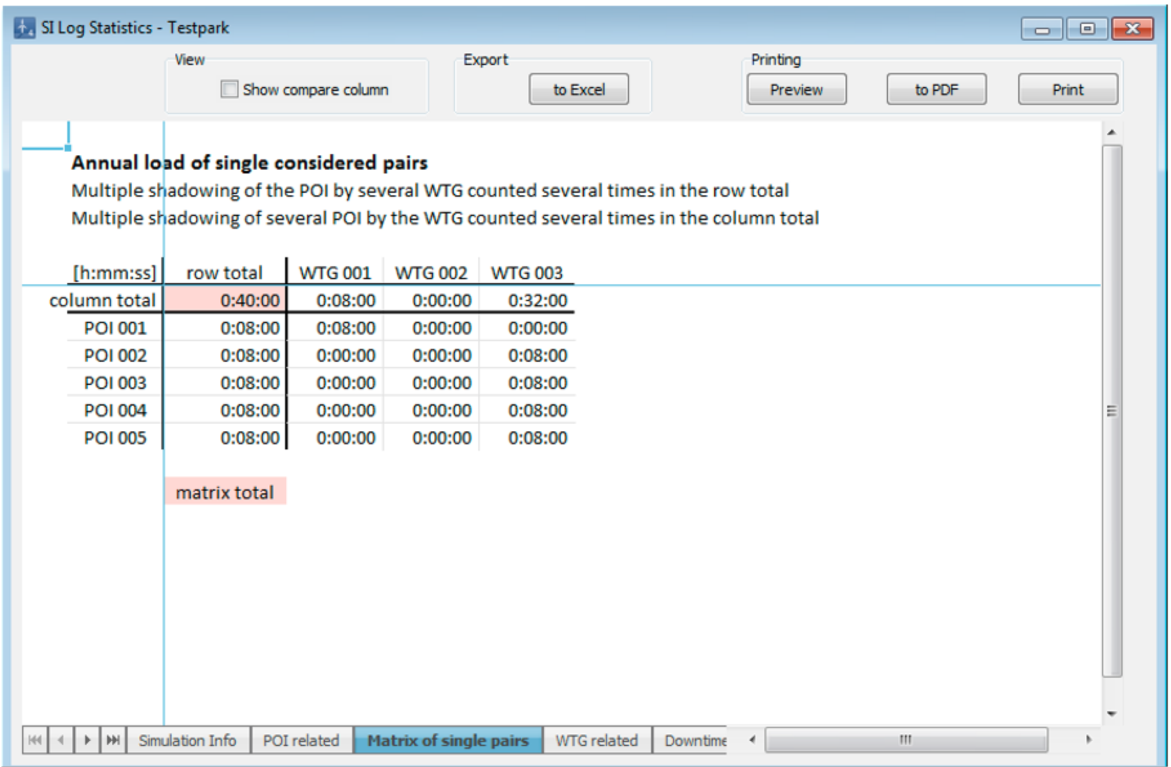
The information, options or buttons are described in the following table

Element	Explanation
Increment	Here you select the simulation period and the resolution – the latter is given in square brackets.
Start date	For example, if you select 01.05.2020 as the start date, the loaded shadow impact scenario is calculated until 30.04.2021. A **Today** button is available in the dropdown list for entering the date, so that you can simulate only the current day with just a few clicks.
Rotor follows sun	If this option is activated, the system assumes that the rotor always remains in a 90 °angle with respect to the sun during the simulation (worst-case).
Fixed rotor angle	If, for example, you want to calculate a scenario that corresponds to the wind direction prevailing in the wind park instead of the worst-case, select the **Fixed rotor angle** option instead of the **Rotor follows sun** option and enter the desired angle: 0° = north, 90° = east, etc.
Consider WTG standstill time	If this option is activated, the daily and annual counters of all additional loads (loads of the POIs caused by WTGs of your own wind park) are considered and in case of an overflow a stop event is generated. If this option is not activated, only the geometrically possible shadow impact will be simulated.
Consider WTG with preload	Here it is determined whether WTGs that cannot be switched by your own wind park (WTGs of another wind park) but still cause immission should be included in the daily and annual counter calculation. You can recognize such "preloads" by the fact that, for example, the first entry of a POI in the column **Daily load** or **Annual load** does not begin with 0:00:00.
Information	The information area displays current settings from the project configuration (*File > Application Settings > SMU > Shadow impact calculation*). These settings are required for the internal calculations of the simulation. Click on the gear symbol to go directly to the setting options.

Set Combinations	With this button you open a selection window in which you can choose the combinations of WTGs to POIs to be simulated. You can select entire columns and rows at once by clicking a column or row title, or set each combination individually by clicking it.
Start	Click here to simulate the selected combination of WTGs and POIs according to the defined settings. A progress bar is displayed at the bottom of the window.
Statistics	Click here to open the statistics window for a calculated simulation. A detailed description of the window is given at the end of this section.
Import / Export	Here you can export the simulation result in CSV, XML, JSON or SM4SIM format. Only the NorthTec proprietary SM4SIM format can be imported.
Print	Here you can display a print preview, print the result or save it as a PDF document.

4.8.3.1 SI Log Statistics sub window

Purpose	Display, print, export simulation statistics with different perspectives and representations
Path	*Tools > Simulation > Statistics*
Prerequisites	Dongle
Type of use	Interactive
Reference	opened project



SI Log Statistik window (using the **Einzelpaarungsmatrix**tab as an example)

General notes regarding the **SI Log Statistics** sub window

- The **Show compare column** option is only relevant for the tabs **POI related** and **WTG related**.
- All tabs can be exported by clicking the **to Excel** button.
- In the **Print** area you can choose between preview, PDF export or direct printing.

The tabs (lower edge of screen) are described in the following table

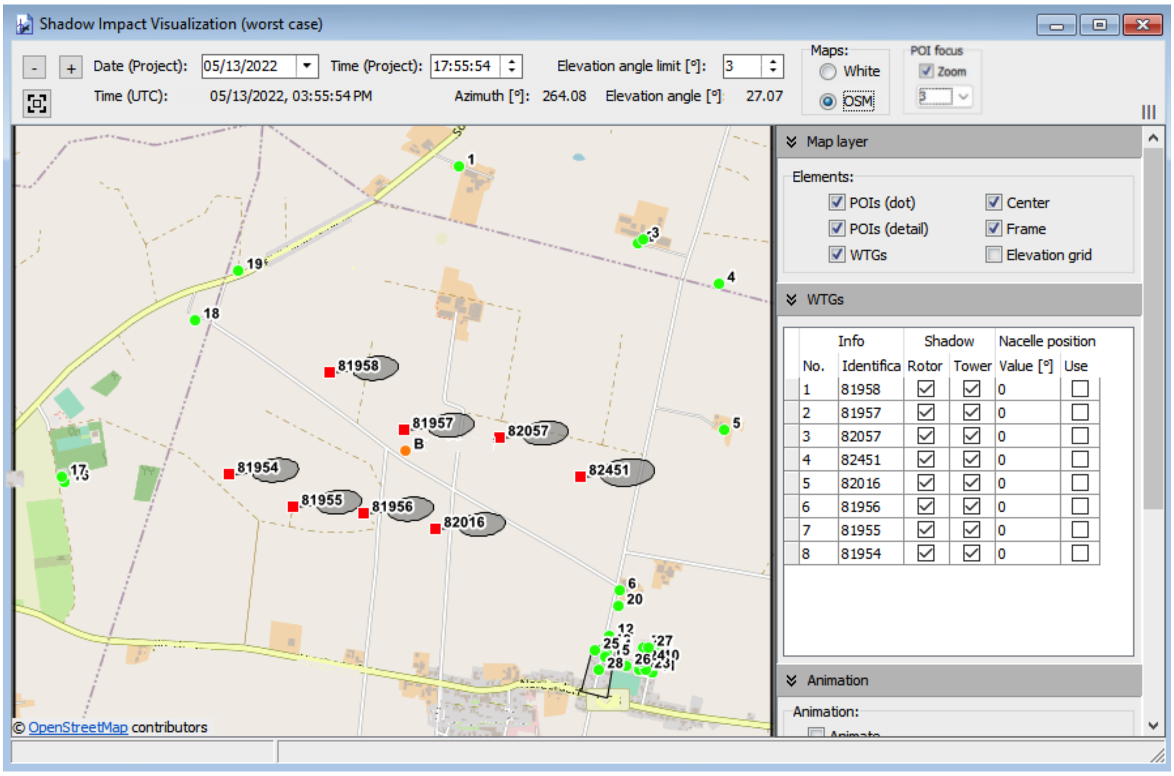
Tab	Explanation
Simulation info	Displays the settings and combination the current simulation is based on.
POI related	Here the shadow impact duration of the POIs is displayed for each POI individually, but also in total, with the following column headings: **Preload** = shadow impact caused by non-switchable WTGs (not belonging to your own wind park) **Additional load** = shadow impact caused by your own WTGs **Total load** = sum of preload and additional load "**counted once**" means that for POIs at which 2 or more WTG cause shadow impact simultaneously (multiple shading), these loads are only considered from the point of view of their effect and are therefore **not** added up. You can use the **Show compare column** option to show a column that displays the **Row total** from the **Matrix of single pairs** tab page, that is, multiple shading is added here (considered from the point of view of the cause).
Matrix of single pairs	Matrix of single pairs tab Matrix of single pairs tabThis is the matrix of the individual pairings of WTGs and POIs. When calculating the shadow impact duration, all other WTGs are hidden here. In the row total per POI, multiple shadings are counted several times (added up, consideration from the point of view of the cause). The arithmetic column sum per WTG counts the shading of several POIs simultaneously several times. The calculated matrix sum corresponds to the park total shadow impact duration if no multiple shading exists. If the option **Consider WTG standstill time** was activated, the shadow events of the other POIs and their counter readings influence the result of the single pairing.
WTG related	Here the duration of shadow impact caused by the WTG is shown. For "overlapping" events from neighboring POIs, the duration from the first immission at the first POI to the last immission at the last POI is added up. You can use the **Show compare column** option to show a column that displays the **Column total** from the **Matrix of single pairs** tab page, that is, multiple shading is added here (considered from the point of view of the cause).
Standstill	If the **Consider WTG standstill time** option was activated, the downtime per WTG caused by an overflow of the annual or daily counter is displayed here. For WTGs with preload, as a rule, no shutdown is assumed. If the option **Consider WTGs with preload** was deactivated, the corresponding WTGs are treated as additional load.
Combinations matrix	This tab shows which combinations of WTGs and POIs were set.

4.8.4 Shadow Impact Visualisation

Purpose	Visualize shadows impact over time
Symbol	
Path	*Tools > Shadow Impact Visualization*
Prerequisites	Dongle
Type of use	Display + interactive
Reference	Project

In the **Shadow Impact Visualization (worst case)** window, you can visualize the shadow impact of the currently open project as it could occur in the worst case, i.e., assuming that the rotor points towards the sun while at the same time the direct sunlight is so strong that shadow impact effects actually can occur. What is depicted here, not only refers to a specific point in time but shows the shadow impact over the course time in user-selectable time steps, always assuming the rotor follows the sun (worst case). In addition, you can make further settings, e.g., exclude individual WTGs from the visualization.

If residents complain about shadow impact, this visualization can be very informative and may contribute to discussions being held based on facts.

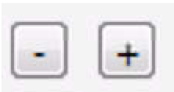
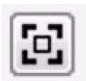
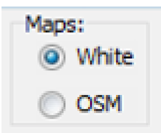


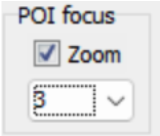
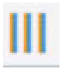
Shadow Impact Visualization window

Notes on the window above

- Click on the map and use the mouse wheel/touchpad or press the plus (+) or minus (-) key to zoom in or out.
- To move the map, hold down the left mouse button and drag the map in the desired direction or use the arrow keys on the keyboard.
- If you zoom in strongly on the map and have selected the POI (detail) option, you can also see the defined walls and areas. The small rectangular line on walls indicates their orientation.

The information, options or buttons are described in the following table

Option/ Button	Explanation
	Use these buttons to adjust the displayed time back or forward by one day with each click.
Date (Project)	Here you can see the date of the currently displayed shadow impact scenario and change it by clicking on the small black arrow to open a drop-down list.
Time (Project)	Here you can see the time of the currently displayed shadow impact scenario and can change it by clicking on the arrow keys or overwriting the current time.
Elevation angle limit [°]	Here you define the minimum elevation angle the sun must have so that shadow impact effects are considered to be possible and are visualized here. Input range 0.1 to 15 degrees, default: depending on project (*Project > Project Settings > Shadow impact calculation*)
	If you click on this button, the map section is moved so that the project center is displayed in the middle of the map.
Time (UTC)	Shows the project time in universal time.
Azimuth [°]	Azimuth of the sun as calculated by SM4.
Elevation angle [°]	Elevation angle of the sun as calculated by SM4.
	If you switch to OSM here, Open Street Map is displayed in the background. **NOTE** The computer must be connected to the internet to use the OSM.

Option/ Button	Explanation
	If you check the **Zoom** box, you can select a POI number in the selection list below to center the map on this particular POI.
	Displays/hides the settings area on the right side of the screen.
Map layer	
POIs (dot)	Used to show/hide defined places of immission. Defined POIs are displayed as green dots:
POIs (detail)	Used to show/hide defined walls and areas. Defined walls and areas are displayed as black lines. The view needs to be greatly enlarged to be able to detect them. The small rectangular line on walls indicates their orientation.
WTGs	Used to show/hide defined wind turbine generators. Defined WTGs are displayed as red squares.
Frame	Used to show/hide a black project frame.
Center	Used to show/hide the project center, i.e. the center of all WTGs according to latitudes and longitudes from the project data. The project center is shown as an orange circle. It is calculated automatically.
WTG	
Zoom to WTG (double-click)	If this field has been activated, you can click on a WTG in the table underneath to make it the center of the map.
Info	The number corresponds to the respective **WTG number** in the **Wind Turbine Generators** window. The identification corresponds to the respective **Name from Shadow Forecast** in the **Wind Turbine Generators** window. Display only
Shadow	You can show or hide rotor shadows and tower shadows of a WTG by placing or removing the respective check mark. If you right-click the right to the left or right of a check mark, a context menu opens in which you can apply the respective setting to all other WTGs.
Nacelle angle	If you check the **Use** box and enter, e.g., 45 at **Value**, the shadow impact visualization will be based on the assumption that the nacelle, and therefore the rotor, are oriented to north east.

Option/ Button	Explanation
	If you do not check the **Use** box, the worst case will be assumed for the shadow impacting visualization. 0° = North, 90° = East, 180° = South, 270° = West **Application example:** In the case of a specific complaint by a resident regarding a defined time period, you could take the corresponding nacelle position from the shadow Impacting log, enter it here and thus visually reconstruct whether there was real shadow Impacting at the time in question. Input range 0–359 degrees, default 0 degrees
Animation	
Animate	If you set a check mark here, the shadow Impact is automatically displayed over time, according to the following settings. If you do not check this box, the settings in the **Animation** section will have no effect.
Skip times without shadowing	If you set a check mark here, times in which real shadows cannot be cast (because the elevation angle has fallen below the limit) are automatically skipped during animation.
Time steps/ Day steps	For animation, you can choose **time steps** OR **day steps**. If you select the **Time Steps** option, these correspond to the setting below (Time Steps (minutes)).
Time steps (minutes)	Setting for above option **Time steps** Input range 1-120 min, default 3
Animation interval (sec.)	Here you select the interval at which the display should change (jump to the next time period or day). Input range 1–60 s, default 1 s
Project framework	
North / South **West / East**	Outside the project frame, the shadow impact ellipses are truncated. Input range 0–10000 m, default 200 m

NOTE

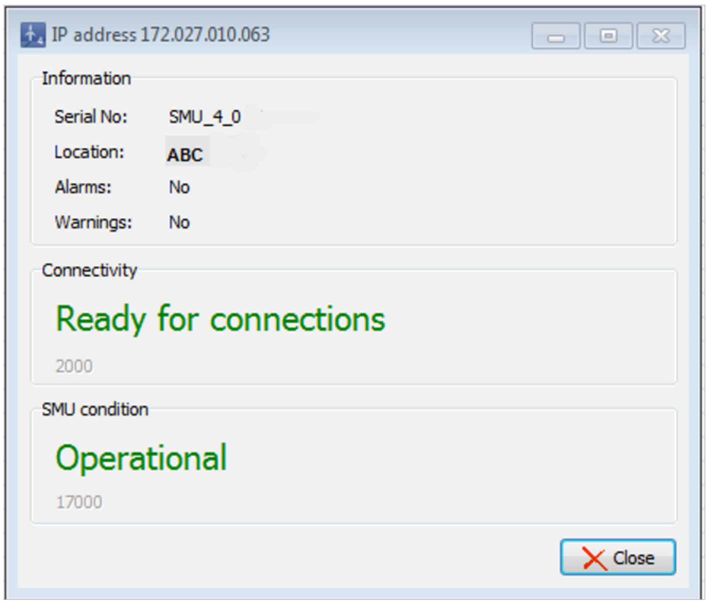
There may be discrepancies between the **visualized** shadow impact (this window) and the **simulated** shadow cast *(Tools > Simulation window)*, as the visualization is only a two-dimensional representation (top view). **Example**: The POI is a house wall with windows from a height of 5 m above the ground. If the shadow hits the area below the windows, it does not yet cause real shadow impact, only when the shadow travels further and finally actually hits the window. For more information, refer to Edit Walls and Areas sub window 135.

4.8.5 SMU Connectivity window

Purpose	Check the availability of the SMU via the SMU's IP address
Path	*Tools > SMU Connectivity*
Type of use	Display only
Reference	Project

If you install a software update or a new project configuration on the SMU, it will automatically restart, if applicable, sometimes twice. Every attempt to connect to the SMU during this period will be unsuccessful. In this window you can identify at a glance whether the SMU is ready for a connection, which avoids unsuccessful connect retries.

The connectivity window, on the other hand, obtains the information via the SMU website, and access to this may be prevented by the park operator for security reasons. So if the website is not accessible, you can also get the information such as serial no., location, version, etc. from the **SMU Information** window (SMU > SMU Information).



SMU Connectivity window

NOTE

HTTP port 80 must be accessible for this window to work. This may apply in particular to routers or firewalls of wind parks.

The following table provides an explanation on the information contained in the **SMU Connectivity** window.

Information in the **SMU Connectivity** window:

Element	Explanation
Serial No.	Serial number of the SMU
Location	Location of the SMU according to the **Project Data** window
Version	Version of the SMU
Alarms	Here, **Yes**/**No** indicates whether alarms are set. If **Yes**, you can check the type of alarm in the **Alarms** window (*SMU > Alarm*).
Warning	**Yes**/**No** indicates whether there are warnings here. If **Yes**, you can also check the type of warning in the **Alarms** window (*SMU > Alarm*).
Connectivity	One of the following connectivity conditions will be displayed here: **Ready for connections** – A connection can now be established. **preparing** – The Shadow Manager interface is being prepared. **Busy** – A connection already exists between a different SM4 installation and the SMU. **SMU not available** – The SMU is currently starting up/ is switched off / cannot be accessed in the network/ faulty, or similar.
SMU Status	One of the following SMU conditions will be displayed here: --- – Status cannot be determined, e.g., because SMU cannot be reached **Operational** – The SMU is ready for operation, an existing shadow project is being processed **preparing** – The SMU is started, e.g., after an update **Stop** – The SMU shuts down, e.g., before an update
	Closes the window.

4.8.6 Project Comparison window

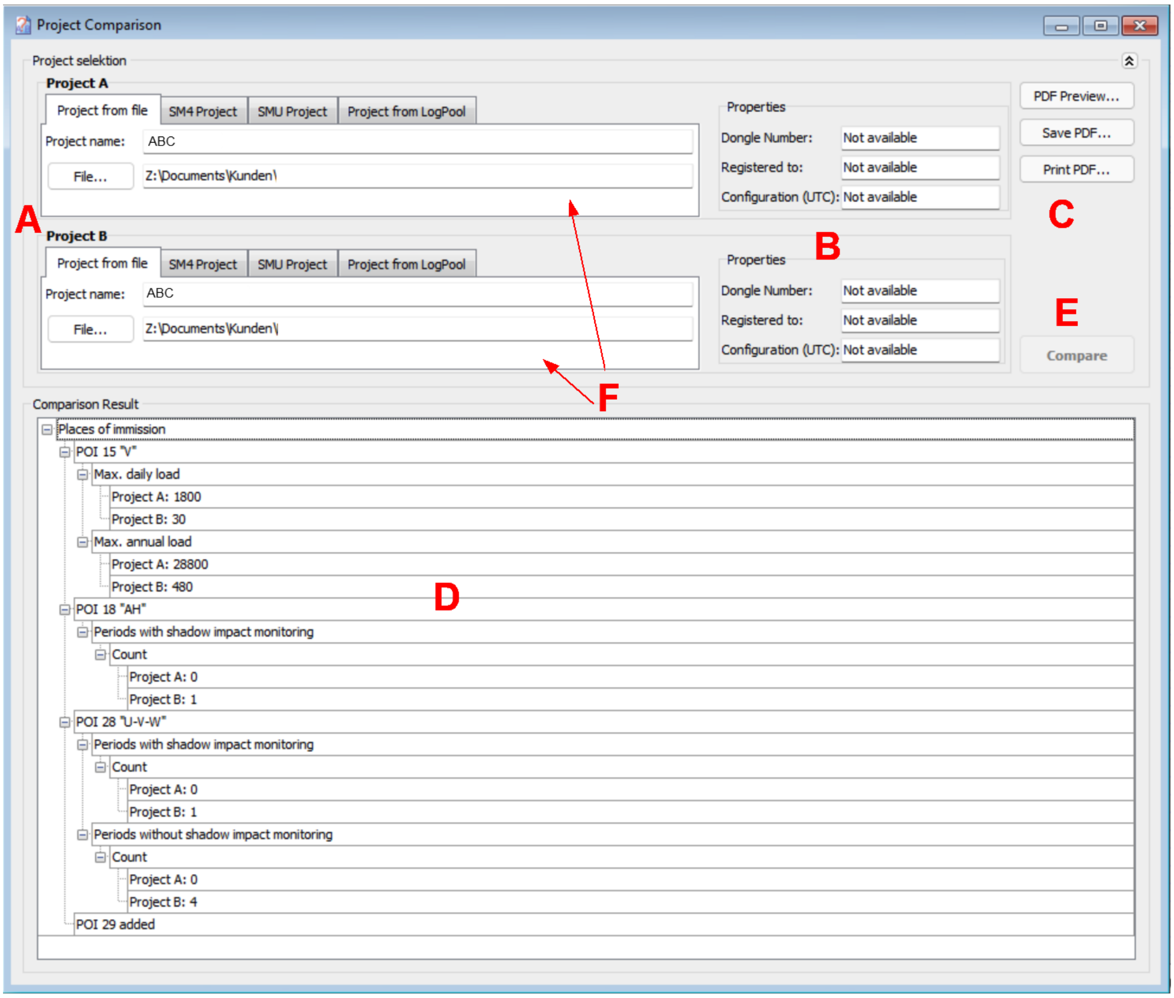
Purpose	To clearly juxtapose two projects (project versions)
Path	*Tools > Project comparison*
Usage type	Dialog + display
Reference	Project

Changes usually occur frequently in every wind farm project, for example because a new POI has come into life that needs to be protected, to name just one example. In this simplest case, the new POI is first added to SM4, then the updated configuration is sent to the SMU. In this way, new versions of one project are created again and again over time, and in the **Project Compare** window, two versions of the same project from different sources (see tabs in the top left of the following screenshot) can be conveniently compared with each other. Depending on the type of change detected in the process, the results area will either only show *that* something has been changed, or also *how* something has been changed.

Practical example: A project was set up by NorthTec and delivered. It was then extended by the customer, but is now to be reset to its original state. A project comparison shows what has been changed at the push of a button, thus facilitating the reset.

NOTE

Please note that a project comparison always involves comparing two versions of one and the same project. Thus, strictly speaking, "project" in this context means "version of a project".



Project Comparison window

Overview of the individual areas of the **Project Comparison** window

A In this area you select the two projects (version A+B) that you want to compare with each other. According to the four tabs, there are four possible sources for A + B respectively:

- **Project from file** – select an .smp4 project file stored on your own computer
- **SM4 Project** – if you select this tab for **project A** or **project B**, the project currently opened in SM4 will become a candidate for comparison. To enable comparison, you must select a different tab for **Project B** or **Project A**, respectively.
- **SMU Project** – If you are connected to a SMU, you can load the current SMU project as the comparison candidate at **Project A** or **Project B**. To enable a comparison, you must select a different register at **Project A** or **Project B**, respectively.
- **Project from LogPool** – Here you can use log data downloaded from a SMU for comparison, since these also contain all data needed for a comparison in the form of a so-called project file (ProjectInfo.dat). If there are several legends for a project (see glossary 371), the desired one can be selected.

B Provided that the corresponding information is available, this area shows WHO (Registered to) created the respective project with which DONGLE (Dongle Number) and then sent it at what TIME **(Configuration (UTC)**) to SMU.

C In this area you can view, save, or print the comparison result as PDF.

D Here the comparison result is displayed as a tree structure. Depending on the type of change detected, the result area will either only show *that* something has changed, or also *how* something was changed.

In the example above, you can see the value by which the **Max. daily** and **annual load** was changed for POI 15. For POIs 18 and 28, on the other hand, you can only see *that* the number of times with shadow impact monitoring have changed, but not *how* they have changed.

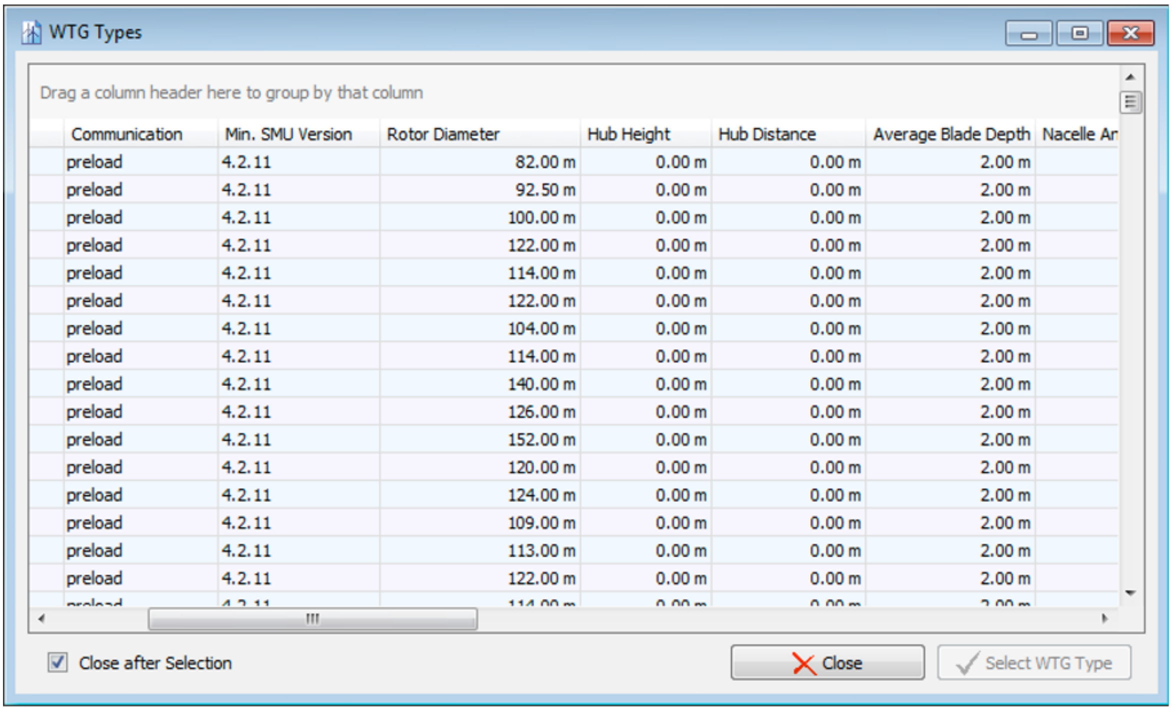
E After you have selected two projects in Area **A**, click this button to run the comparison.

F You can load an SM4 project set as project A or B either into the current SM4 instance or into another instance by right-clicking in one of the white areas.

4.8.7 WTG Types window

Purpose	List possible WTG types
Path	*Tools > WTG Types*
Prerequisites	-
Type of use	Display only
Reference	Project

All WTG types that can be selected in the **Add/Edit WTG** window are listed in this window and can be selected by pressing the corresponding button.



WTG Types window (section)

Notes on the window above

- The same information that is displayed in this window is displayed in the **WTG Types** window that can be called up in the **Add/Edit WTG** window via the WTG Types button.
- The **Select WTG Type** button is shaded in grey here, as this window is only for the purpose of display.
- In the **Add/Edit WTG** window, it is used to quickly select the presets specified for the respective types (values that are always the same for every WTG type).

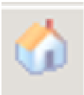
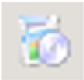
4.8.8 Windows menu item

Purpose	Reset window positions and screen detection
Path	*Tools > Windows*
Reference	Project

The **Window** menu item offers access to both of the following functions:

Function	Explanation
Reset Window Positions	SM4 takes note of the last position of the window when you close windows or the entire application. This means that the next time you open the same window, they will also be displayed in their previous position. This will enable you to permanently arrange your working area the way that is most convenient to you. You should only select **Reset Window Position** if you want to reset the position of all windows to their respective default position.
Reset Screen Detection	SM4 detects the number of monitors used and the set resolution. This thus generates a type of “fingerprint”. The stored window positions are arranged according to this fingerprint. This is an especially interesting SM4 feature if you use the portable version on two different computers. If you work on a computer with one monitor, for example, and on another with two monitors, Shadow Manager will detect this and use the last applied window position for the respective system. The **Reset Screen Detection** menu item deletes all “fingerprints” and the SM4 will then begin the detection process again.

4.9 Help menu

Symbol	Window	Description
	**NorthTec Homepage**	NorthTec Homepage
	**Check for New Version**	When this menu entry is selected, the software will automatically check whether updates for Shadow Manager 4 are available.
	**About Shadow Manager 4**	Display of information on the software version, on NorthTec (telephone number, address etc.) and on the operating system used.

5 Appendix

The appendix contains information relating to the entire software or respectively entire manual/online help.

5.1 Troubleshooting

Should you encounter any problems when using Shadow Manager, please read the information in this chapter. You will probably find the cause and solution for your problem right here.

Problem/ error message	Possible cause and solution
The SMU cannot be accessed once a project has been transferred. (under **SMU Connectivity** (*Tools > SMU Connectivity*) the system indicates "SMU not available")	The SMU is starting up, is switched off/not available in the network etc. If this lasts longer than a few minutes, the IP address stored in the SMU might have (accidentally) been altered. In this event, a NorthTec service technician will have to determine the IP address of the SMU on site.
SM4 indicates an incorrect user name and/or password when trying to connect to the SMU (*File > Connect*).	User name and/or password were not entered correctly. Entries are case-sensitive: User name "John Doe" is different from "john doe".
A menu item has not been activated, although I have established a connection to the SMU and been assigned the access rights to the menu item.	For activities involving editing rights, e.g. **SMU update**, you are required to log on with a dongle.
The input window for the menu item I selected is not displayed.	The size of the SM4 main window has possibly been reduced and the input window has opened outside of the visible part. Check whether a scroll-bar has appeared on the right or at the bottom of the SM4 screen that allows you to move the visible part.
The background remains white when I select **OSM** on the overview map.	To use the **OSM** (Open Street Map) function, your computer must be connected to the Internet.
Although I can see the active alarms in the **Alarms** window, I can't click on the buttons.	The buttons only function if you have been assigned the **Alarm** rights group and you logged on using a dongle. If this is not the case, you may only view the alarms. (**Observer** rights group).

Problem/ error message	Possible cause and solution
Send Configuration The **Send Configuration** button is not available (grayed out).	You have to purchase a dongle from us in order to be able to configure an SMU with SM4.
Edit Walls and Areas When I enter the coordinates for the length of a wall or the side of an area in the **Edit Walls and Areas** window, the field in which these coordinates are shown in meters is highlighted in yellow.	If the field **Length** of a wall or area in meters (last field of the line) is highlighted in yellow (instead of green), the entered values are not plausible or the maximum length of a wall or side of an area according to the warning limit (*File > Application Settings > Warning limits*) has been exceeded. Check that you have entered the coordinates correctly. For further information, please refer to the Warning limits 74 section.
Edit Walls and Areas The coordinates I entered in the **Edit Walls and Areas** window to define the length of a wall or an area side are not plausible.	The coordinates of all WTGs and POIs must be defined using the same metric coordinate system. You may have used figures based on different coordinate systems. For further information refer to the Edit Walls and Areas sub window 135 section .
SM4 is not functioning as expected (data is not shown, values cannot be entered etc.)	If SM4 does not operate as expected, consider whether the reason for this could be the application settings (*File > Application Settings*) or the project settings (*Project > Project Settings*). **EXAMPLE** You enter the value “3.0” for the “Hub distance” in the **Add/Edit WTG** window but SM4 does not accept the value (the field remains highlighted in red). You have probably selected the **decimal separator** “,” (decimal comma) under the **Country-specific settings** in the **Application Settings**.
“Internal Error:...” or **“Error: ...”**	Error messages starting with these words are fatal errors that you cannot resolve yourself: In this case, please contact NorthTec.
„Internal Error: Unknown Response-ID by command”	This is a fatal error. Please note down the two numbers (x, y) and contact NorthTec.
“The registered user does not have the authorization required”	After this error message the connection to the SMU will be disconnected. You should ask your administrator to assign you the required right group.

Problem/ error message	Possible cause and solution
The **Wind Turbine Generators** window (*Project > Wind Turbine Generators*) displays more WTGs than the **Live Data: WTG Status** window (*Realtime Data > WTG Status*).	In the **Wind Turbine Generators** window, WTGs that do not belong to the project's wind park may have been created in the project (*Project > Wind Turbine Generators*), as there are places of immission in the project at which these "foreign" WTGs may cause shadow impact. They therefore represent a so-called "preload. However, the **Live Data: WTG Status** window only displays the number of these "foreign" WTGs (see **WTGs with pre-load that are not displayed**), because the SMU cannot communicate with these foreign WTGs.

5.2 Glossary

Configuration

SM4 derives the configuration data for the SMU from the project created by the user (for one or more WTGs or a wind park). The configuration therefore contains processed data from a project, which the system for shadow impact monitoring and species conservation needs to carry out its monitoring functions. When preparing the project data for configuration, unneeded telephone numbers and addresses, for example, are removed and some data are converted.

The project file and the SMU configuration contain the same information for the shadow impact scenario.

External triggers

“External triggers” were introduced in SM4 as a way of allowing users to remotely control shutdowns or other processes in a convenient yet IT-safe manner. In simple terms, external triggers are software versions of digital inputs (hardware), as they perform the same function. They are, therefore, also located in the same place in SM4 (*Hardware > Sensors and IO Signals*). The best application example is the so-called mowing shutdown where farmers can use a smartphone app to independently shut down WTGs during harvesting work that attracts large birds. For this purpose, defined triggers are assigned user rights in SM4 and then included as shutdown triggers in special shutdowns.

Legend

To be able to interpret log data correctly, SM4 also always requires the respective SM4 project file. This file contains, for example, street names, comments, and other information about a POI. The information contained is not relevant to the SMU for calculating the shadow impact scenario but is supplied to the SMU with every configuration process, nonetheless. The SMU does not touch the SM4 project file but stores it as a file with the current timestamp, where the timestamp prevents older project files from being overwritten. When logs are downloaded, these project files are automatically included. They are called "legends" in SM4 and can be exported or printed together with the log data if required (see also Operation Log/Shadow Impact Log/Shutdown Log sub windows 336).

Power Threshold

One of several ways to reduce revenue losses in SM4 is by defining a **power threshold** for every combination consisting of a WTG and the surrounding buildings (places of immission). If a WTG is operated below this power threshold while causing shadow impact in a place of immission, the respective WTG is shut down immediately. While a WTG is running above the power threshold, the permitted periods of shadow impact will be exploited. Thus, the shadow impact budget will be reserved for times when the WTG can operate at a higher power output. See WTG Combinations sub window.

Place of Immission (POI)

Places of immission are buildings on which a wind turbine generator causes shadow impact; these can be defined in Shadow Manager using co-ordinates.

Project

To ensure the system for shadow impact monitoring and species conservation can fulfill its most important task, namely shutting down wind turbine generators because of shadow impact or bat protection etc., it is necessary that data specific to the project is first created in SM4.

To do so, a project is created or an existing one is opened in SM4. The project contains all data and settings relevant to a specific wind park or its SMU and the connected sensors (e.g., the SMU's port number/IP address, coordinates of the WTGs/POIs, shutdown periods). If a project is complete and inherently consistent, SM4 is then able to derive the configuration data for the SMU. The project and the configuration data are then encrypted and transferred to the SMU. Once it is there, the SMU stores the project as a file and is then configured according to the configuration data. Only then is it possible for it to fulfill its main task: shutting down and (restarting) WTGs according to the specifications of the authorities and other factors (e.g., yield optimization).

Shadow range

The shadow range is the distance between a WTG and a POI up to which perceptible shadow impact is deemed possible. If the distance between a WTG and a POI is greater than this range, it is assumed that any shadow impact caused at the POI will not be perceived (as disturbing). When determining shadow range, SM4 uses the blade data provided by the respective WTG manufacturer to calculate the point at which 20% of the face of the sun will be obscured (German 20% obscuration criterion). According to the German guideline, the arithmetic mean between the maximum blade depth and the blade depth at 90% of the rotor radius is used as the mean blade depth, since the blade depth decreases towards the rotor tip. As an alternative, a rectangular rotor blade with a mean blade depth is calculated as follows:

Average blade depth = ½ (max. blade depth + min. blade depth at 0.9*rotor radius)

Shadow Impact Budget

Approving authorities usually require that daily and annual shadow impact limits are complied with for buildings located in the vicinity of wind parks.

Shadow Master Unit (SMU)

The SMU is located in the WTG or in the hand-over station; it logs the calculated as well as the actual shadow impact caused at the monitored buildings and also the shutdown periods of the WTGs. The logs can be read out via a network interface. The SMU takes over the following tasks:

- calculates shadow impact periods on the buildings to be monitored
- retrieves light sensor data
- communicates with wind turbine generators (WTG)

- stops the relevant WTG if the shadow impact limit has been exceeded
- automatically shuts down WTGs according to specified time periods and meteorological conditions (protection of bats)
- records all shadow impact and WTG shutdown events forecasts possible shadow impact

Watchdog

Time relay for external error notification. The watchdog is generally triggered by the master unit and subsequently sends feedback signalizing that everything is ok. If, for example, the master unit determines that a light sensor is defect, i.e., if it is not sending any data, it doesn’t trigger the watchdog and subsequently this can externally signalize a defect. An entry is made to the log and a red light flashes in the SMU cabinet. The following errors can be registered using this system:

- sensor defect
- WTG does not react to stop commands
- WTG is not sending any data
- the SMU is in a non-definable operating status (crashed) the SMU has been switched off by an unauthorized party

Worst case

With regard to the NorthTec system for shadow impact monitoring & species conservation, "worst case" means that the rotor points towards the sun, or, when considering a time course, always follows the sun, while the direct sunlight is so strong that shadow impact effects can occur.

- A -

- C -

- D -

- E -

- F -

- H -

- I -

- L -

- M -

- N -

- O -

- P -

- R -

- S -

- V -

- W -