

Release Information – PSS®SINCAL Platform 17.0

This document describes the most important enhancements and changes to the new program version. See the product manuals for a more detailed description.

General Remarks	3
Licensing	3
System Requirements	3
Dokumentation	4
Example Networks	4
Models	5
PSS®SINCAL	6
User Interface	6
General Improvements	6
Tabular View	10
Diagram View	10
Scenario Files	14
Model Management and Import Interfaces	16
Multi-User Master Database (PM)	16
Excel Import	19
Extended Import Functions for Electrical Networks	20
Electrical Networks	22
General Improvements	22
BOSL Models	27
Grid Code Compliance Renewables (EEG)	29
Protection Coordination (OC, SZ)	35
Protection Analysis (PSA)	40
Pipe Networks (Gas, Heating/Cooling, Water)	43
Route Calculation	43
Automation (Programming Interfaces)	43
Automation of the User Interface	43
Automation of the Calculation Methods	45
PSS®NETOMAC	48
User Interface	48
General Improvements	48
Model Editor	48
Calculation Methods	50

General Improvements	50
New BOSL Functions	51

General Remarks

Licensing

To operate the PSS SINCAL Platform 17.0, new license files are required. Once the program is installed, these can be requested at the **PSS SINCAL Platform Support** (phone +43 699 12364435, email sincal@simtec.cc).

The product is already delivered with a special license file, which allows the use of almost all modules with 50 node limit on any computer. This license is limited in time, i.e. the use is possible for 6 months after the release of the product version in April or October. This is to ensure that the product can be used immediately after installation and to make testing of the various modules easy and uncomplicated.

System Requirements

The following hardware and software requirements include the minimum requirements to operate an application of the PSS SINCAL Platform 17.0.

Hardware Requirements

PC or notebook

CPU: x64, >= 2 GHz, MultiCore

RAM: >= 8 GB

Hard disk: >= 20 GB

Graphics card: >= 1920 x 1200, True Color

Mouse: 3 buttons (wheel mouse)

Operating Systems Supported

Windows 8

Windows 10

Windows Server 2008 R2

Windows Server 2012 R2

Windows Server 2016

Windows Server 2019

Database Systems Supported

SQLite 3.x

Microsoft Access

Oracle 9i

Oracle 10g

Oracle 11g

SQL Server 2008, SQL Server Express 2008

SQL Server 2008 R2, SQL Server Express 2008 R2

SQL Server 2012, SQL Server Express 2012

SQL Server 2014, SQL Server Express 2014

SQL Server 2016, SQL Server Express 2016

SQL Server 2017

SQL Server 2019

Dokumentation

General Improvements

The documentation in the PSS SINCAL Platform has been extensively revised and improved in many places. Based on support requests and feedback from training courses, the descriptions have been continuously improved and made more detailed in those places where the most questions/unclearities occurred.

Documentation for Application Example SAVNW

In PSS SINCAL, the "Example SAVNW" application example is available. This network model is a well-known example from the field of transmission networks that shows the basic functions of power flow, short circuit, stability and eigenvalue calculations. Now a comprehensive documentation is available, which shows step by step how to use the stability and eigenvalue calculation with this network model.

Network State/Network Graphic/Scenario as XML File

In the manual "Database Description" the new chapter "Network State/Network Graphic/Scenario as XML File" is available. In this chapter the complete structure of the XML file is described. This is intended to enable the use of this simply structured file, which can map all essential parameters of the network, also for external applications.

Grid Code Compliance Renewables (EEG)

For this calculation method a new documentation is available in the "Power Flow" manual. It describes in detail the input data and provides the essential basics of the checks performed in this calculation method to assess whether the connection of the generating plant is permissible.

Model Editor (GMB)

The documentation of the graphical model editor has been extensively extended. All available blocks have been documented to match the input screen forms in the Model Editor. The new documentation is available in the PSS NETOMAC "System Manual" in the chapter "Model Editor".

Example Networks

PSS SINCAL

The following new or enhanced sample networks are available:

Network	Description
Example EEG	New example network for the calculation method Grid Code Compliance Renewables
Example NST	New example network for the calculation method Network Stress Test
Example ST CGMES	Updated example with variants for different calculations in stability, stability limit and electromagnetic transients
ZuverTypen_DE	Updated network with German standard type data for the reliability calculation
ZuverTypes_INT	Updated network with international standard type data for reliability calculation

Models

New Models

The following new XMAC models, including the documentation, are provided:

Model	Description
PVD1.xmac	Aggregated model of decentralized generators without time constants of control

Modified Models

The following models were updated and documented:

Model	Description
DER_A.xmac	Simplified parameter handling in model binding
GovSteam1.xmac	Corrected model implemented in GMB
GovSteamEU.xmac	Improved model initialization

Removed Models

The following models were removed:

Modell	Beschreibung
GovSteam1.mac	Replaced by new GMB model

PSS®SINCAL

User Interface

General Improvements

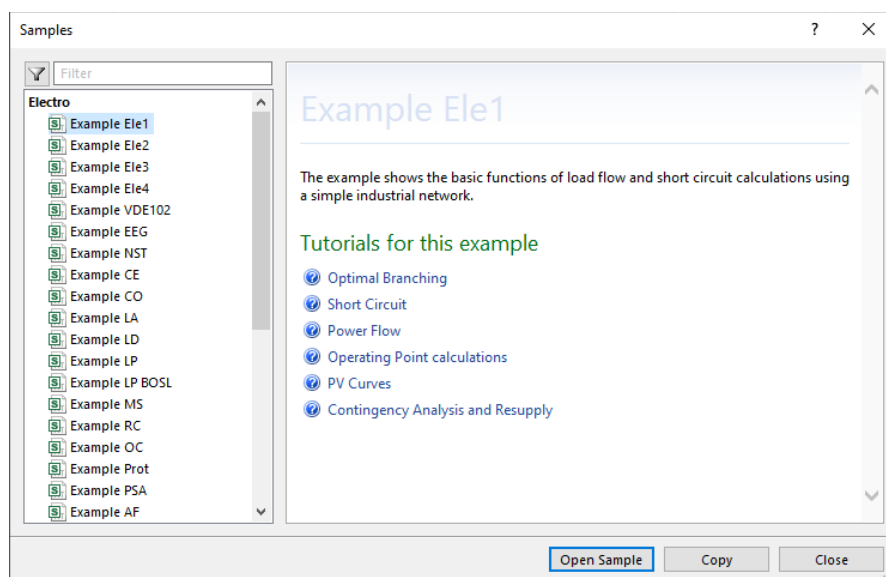
This section describes general improvements in the user interface. Most of these extensions and improvements are based on user requests.

Enhanced Dialog Box for Examples

The dialog box can now, in addition to the start page, also be opened in the main menu via the menu item **File – Open Samples**.

The display of the examples in the dialog box has been made clearer and a new function for copying an example is also available. This is useful if an example was modified to test the functionality and then the original state is to be restored.

Also new is that the dialog box can be opened even if the examples are not available in the user directory. In this case, the **Copy** function can be used to selectively copy individual examples to the user directory.



Invert Selection

A new function for inverting the selection is available in the graphics editor. The function is available in the main menu under **Edit – Select – Invert Selection** and in the toolbar via the drop-down menu.

Improved Diagrams for Table Input Dialog Boxes

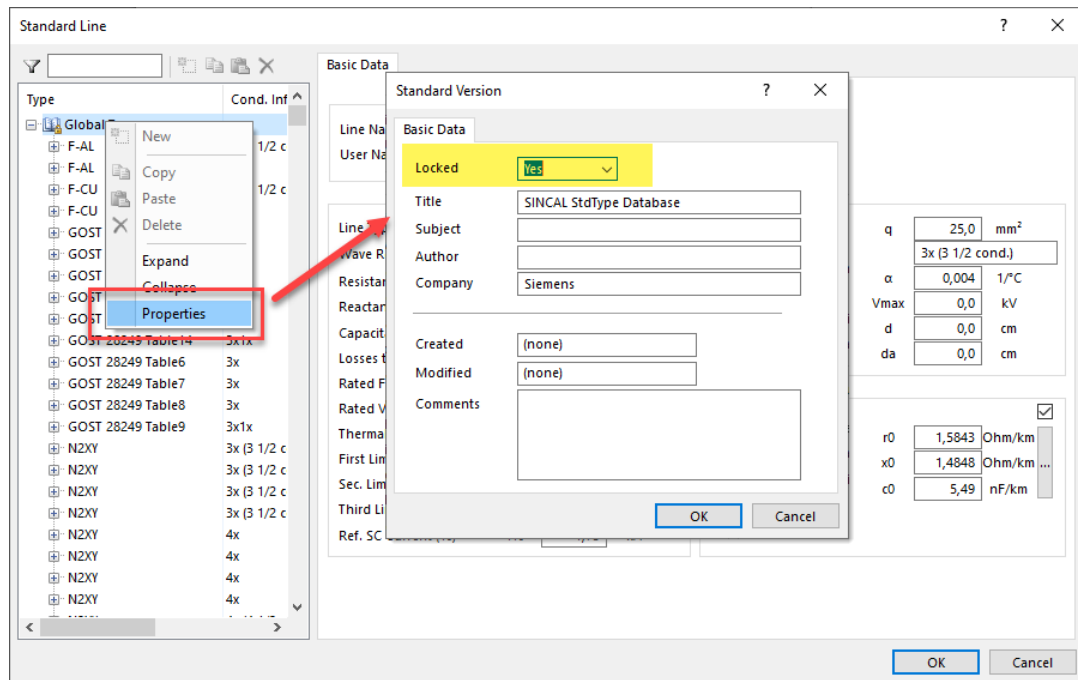
The display of the diagrams in the table input dialog boxes has been enhanced. A new display mode for the power factor is available and an extended labeling for the characteristic curves has been provided for the power limits.

Standard Databases

PSS SINCAL supports global and local standard databases for network elements and protection

devices. Previously, only the contents in the local standard databases could be changed. This has been made more flexible. You can now define directly in the version table of the standard database whether it can be changed or not.

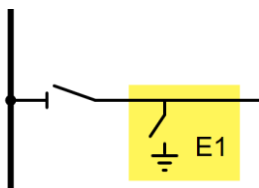
This setting is also available in the dialog boxes for editing standard types. The following screen form can be opened via the pop-up menu of the browser using the menu item **Properties**.



The screen form contains general information about the database as well as the new selection field **Locked**, which defines if a processing is allowed.

Breaker

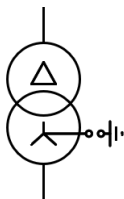
There is a new breaker type, the **Earthing Disconnecter**. This allows the connection of the network element (phased or three-phase) to ground. The earthing disconnector becomes effective in the calculation if the corresponding network element is disconnected from the rest of the network.



The screen forms of the switches now display the assigned master resources on the **Additional Data** tab in the same way as the network elements.

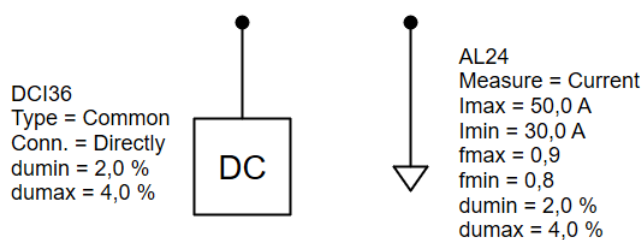
Extended Grounding Symbol Display

The display of the grounding symbols has been extended. When neutral point data is disabled, the symbol now indicates that grounding is not active.



Display of Measured Values in the Network Graphic Inscription

The display of input data in the network graphic has been extended for **DC Infeeder** and **Loads**. The data entered in the **Measured Values** tab can now also be displayed.

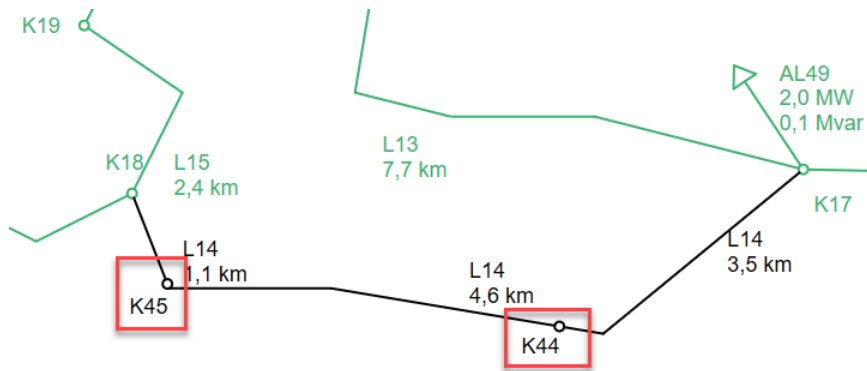


Reconstitute Line from Segments

With this new function, a line containing several line segments can be converted back into individual lines.

The following picture shows the line L14 which contains 3 segments.

Using the new **Reconstitute from segments** function is available in the line's pop-up menu, this line can be converted back into three individual lines. In this case, nodes are inserted at the appropriate places and then the new lines are connected to them. In the following example these are the marked nodes K44 and K45.



Replace Network Data

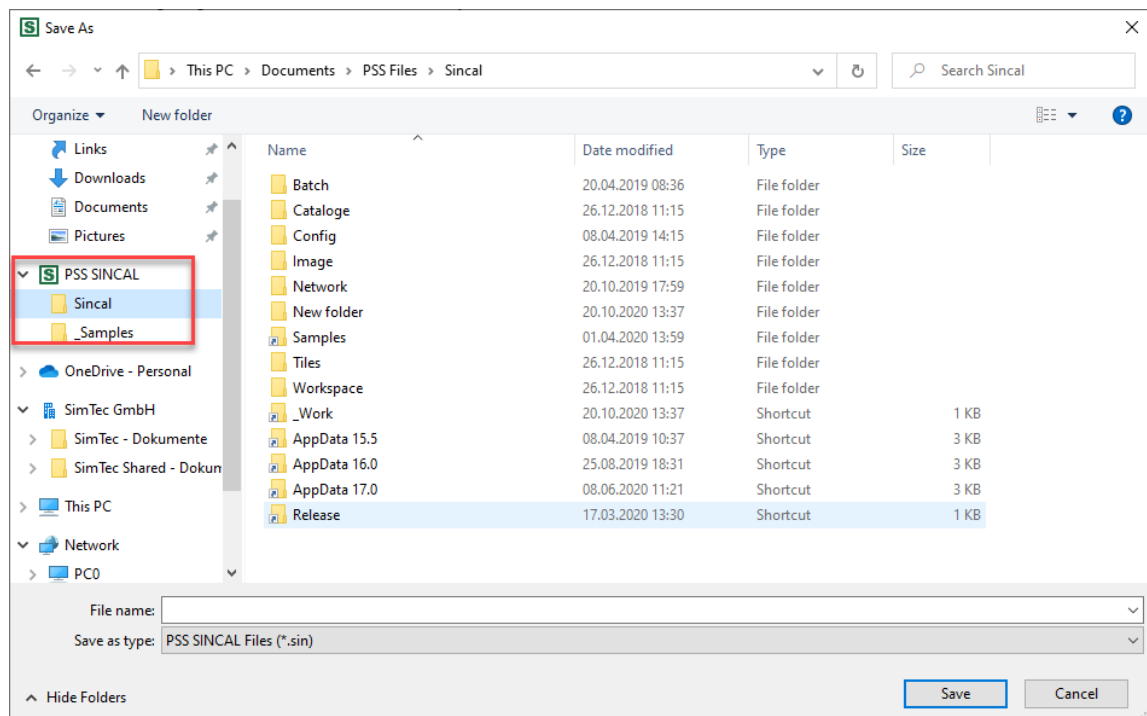
The **Replace Network Data** dialog box has been enhanced. The dialog box displays the network element data organized by categories. The pop-up menu provides new functions for activating or deactivating all attributes of a category.

Network Archive

The function for creating the network archive has been enhanced. Now also those models, which are assigned via search paths, are stored in the newly created archive.

Improved File Dialog Boxes

The file dialog boxes for saving were improved. PSS SINCAL Places are now available here, as in the dialog boxes for opening. These contain the path to the user specific Sincal directory and the directory in which the currently open network is located.

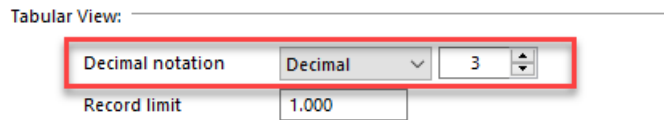


Tabular View

Based on user requests, some new functions are available in the Tabular View.

Setting Decimal Places

The display option for decimal numbers has been extended. The number of decimal places to be displayed can now be defined in the Options dialog box under **Application – Common – Forms and Views**.



Improved Data Editing for Selection Fields

A new function is available for topology and/or data selection fields. The screen form can now be opened directly through the pop-up menu of the selection field in the table. This is useful if you want to open an assigned manipulator or profile for a network element.

Node 1	Element ...	Network ...	fEP	fEQ	Mpl	Profile 1	Profile 2	OP	Z0/Z1 [pu]
Node_11	Load_01	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	OP Series: Fac...	
Node_14	Load_02	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F7 Fac...	
Node_09	Load_03	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_15	Load_05	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_01	Load_07	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_16	Load_08	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_06	Load_09	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_17	Load_10	0.4kV	1,000	1,000	(none)	168h: H0_12.0...	(none)	F8 Fac...	
Node_07	Load_15	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_04	Load_18	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_29	Load_19	0.4kV	2,500	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_26	Load_20	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_25	Load_21	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_22	Load_22	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_21	Load_23	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_36	Load_16	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_34	Load_11	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_35	Load_04	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_39	Load_13	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_02	Load_12	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_10	Load_06	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_12	Load_14	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	
Node_08	Load_17	0.4kV	1,000	1,000	(none)	24h: H0_12.0...	(none)	F8 Fac...	

Diagram View

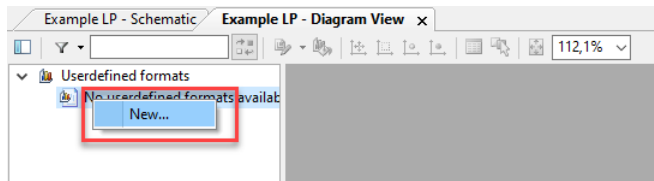
The Diagram View in PSS SINCAL is a very flexible tool for evaluating and analyzing input data and results from a wide range of calculation methods. In this version, too, many enhancements have been made to further increase usability and flexibility.

Format Editor for Diagram Templates

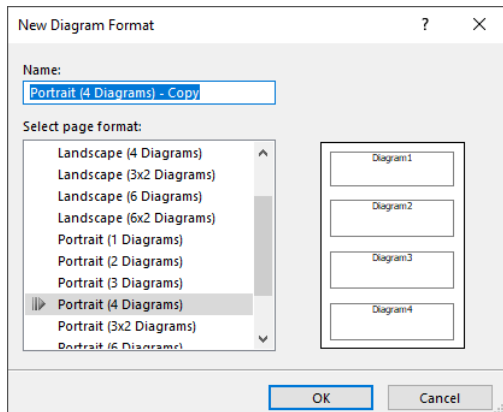
The new Format Editor allows you to create your own templates for user-defined diagrams. These templates are then available in the **New Diagram Page** dialog box for user-defined diagrams. To enter the edit mode for creating diagram templates, switch to the edit mode in the Diagram View using the menu item **Diagram – Format Editor**.

As soon as the edit mode is active, a new layout can be created for editing in the diagram browser.

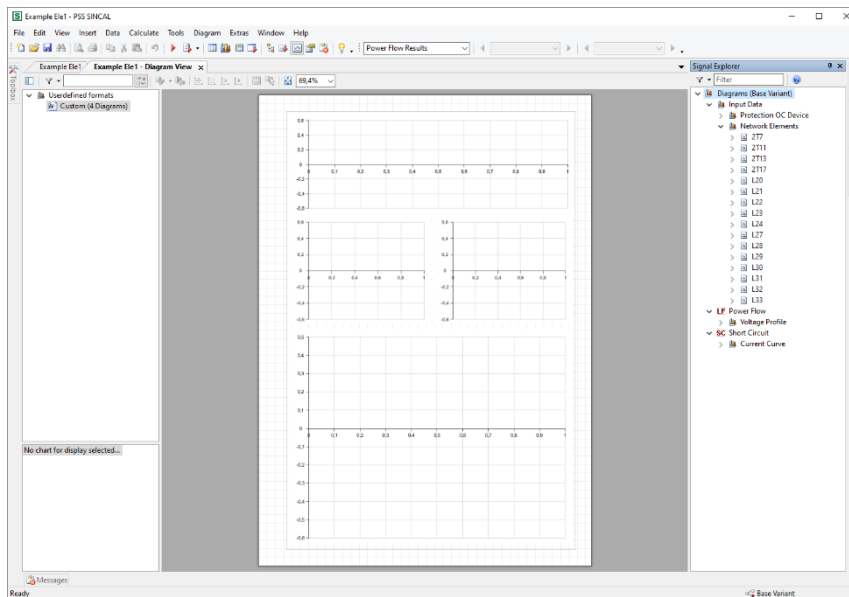
This is done via the pop-up menu with the menu item **New**.



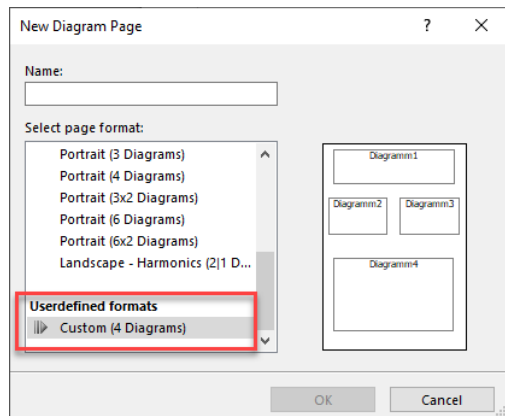
Then the dialog box with the available diagram formats is opened, from which one can be selected as template.



The selected format can then be adjusted as desired. I.e. the pre-defined diagrams can be adjusted as desired on the diagram page to create an individual layout.



As soon as the edit mode is exited, the layout is saved in the diagram file. It is then available as a template when creating new diagrams. The user-defined diagram formats are listed in a separate section of the **New Diagram Page** dialog box.

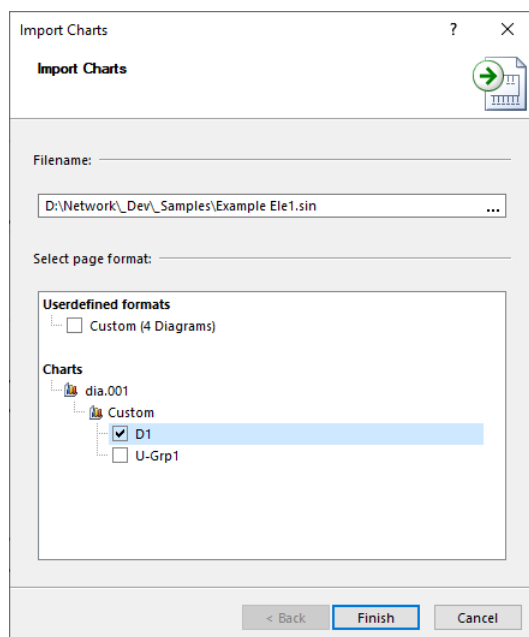


Wizards in the new Diagram System

In the signal explorer for the new diagrams, new wizards are available in the pop-up menu, with which predefined diagram pages for electrical and pipe networks can be created. This then creates predefined diagram pages from the data, which can be further processed and supplemented with additional data as required.

Import of Diagram Definitions

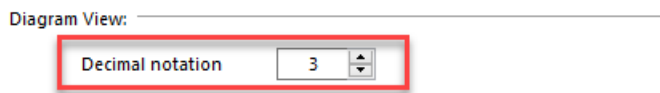
With the menu item **File – Import – Diagram pages and templates** a new wizard can be opened, with which diagrams and diagram templates can be imported from other PSS SINCAL files.



A PSS SINCAL file is selected in the wizard. All user-defined diagram formats and diagrams for this file are then listed. You can use checkboxes to select which data should be transferred to the current PSS SINCAL file.

Setting Decimal Places

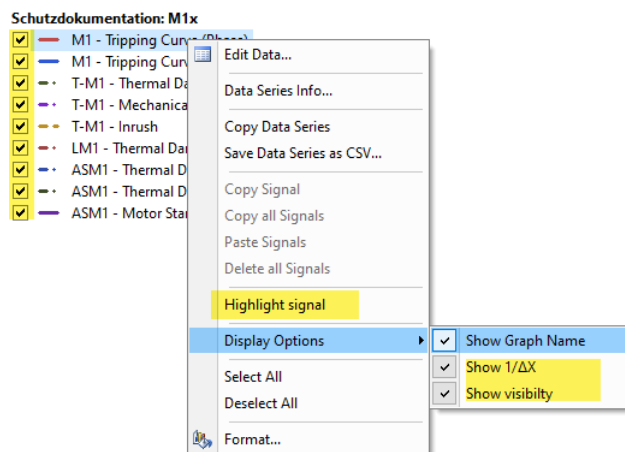
For the representation of decimal numbers in the Diagram View, the decimal places can now be preset. This is done in the **Options** dialog box under **Application – Common – Forms and Views**.



Advanced Functions in the Legend Window

In the legend window of the diagram view new functions are available in the pop-up menu:

- Highlight signal
- Extended visibility for signals
- $1/\Delta X$ display



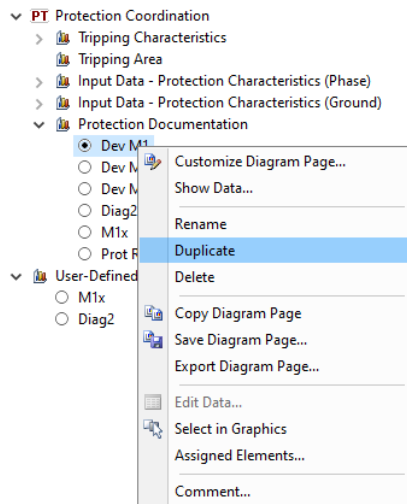
The **Highlight Signal** function can be used to visualize the signal selected from the legend using a colored background. This is intended to improve the association of legend lines to the signal displayed on the diagram.

The extended visibility control for signals in the diagram via the legend is also new. This can be activated via the **Display Options** submenu using the menu item **Show Visibility**. Then a checkbox is displayed in front of each legend line to enable or disable the signal in the diagram.

The new **Show $1/\Delta X$** function for difference values can also be activated through the **Display Options** submenu. When displaying the signal positions in the legend, the $1/\Delta X$ value is also displayed. This is especially useful for dynamic simulation diagrams as it allows easy frequency measurements.

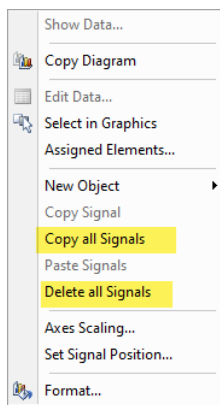
Duplicate Diagram Page in Browser

The new function **Duplicate** is available in the pop-up menu of the browser for user-defined diagrams. This function allows the duplication of the selected diagram page with all assigned signals and format settings.



New Functions in the Pop-Up Menu of the Diagram

Two new functions are available in the pop-up menu of user-defined diagrams, which have been implemented based on user requests.



With the menu item **Copy all Signals** all signals assigned in the current diagram are copied to the clipboard. These signals can then be transferred to another diagram using the menu **Paste Signals**.

Also new is the function **Delete all Signals**. This function removes all signals assigned to the current diagram.

Order of the Signals in the Format Dialog Box

In the **Format Diagram** dialog box, the **Data Series** tab has been provided for the possibility to change the order of the signals. The selected signal can be moved with the key combinations Shift + CursorUp or Shift + CursorDown.

Scenario Files

With the scenarios, PSS SINCAL allows you to save the network status in an external scenario file. These scenario files can be used in many ways, for example, to map switching states, change parameters of network elements or control settings, vary calculation parameters and much more. Also, the combination of different scenario files is possible. In this product version, the already very flexible scenarios have been extended, especially to simplify data exchange with external systems.

Extended Functions for Identification

In the scenario file a new identification method "Master Resource" is available. This allows network elements in PSS SINCAL to be identified using an assigned Master Resource. This is particularly practical for interfacing solutions because Master Resources are often used here to enable unique identification of network elements in different systems. The following snippet shows a scenario file in which the network elements are identified using Master Resources:

```
<NetworkData>
  <Node id="N1" objid="1" type="Node">
    <Name>N1</Name>
    <ShortName>N1</ShortName>
    <MRID category="SinNode">BC4F6ED2-371E-4660-ACC1-A031D776D072</MRID>
  </Node>
  <Element id="E3" objid="3" type="Infeeder" node1="N1">
    <Name>I3</Name>
    <ShortName>I3</ShortName>
    <MRID category="SinElement">7AEDFFEA-8DA6-468D-A92E-5470EBA1EBDE</MRID>
    <State>1</State>
    <InputState>3</InputState>
  </Element>
  <Breaker id="" objid="1" type="Breaker">
    <Name>Breaker</Name>
    <ShortName/>
    <MRID category="SinBreaker">5826F950-4823-4239-B089-06CC5FFFD2F1</MRID>
    <Flag_Typ>1</Flag_Typ>
    <I_n>0.1</I_n>
  </Breaker>
</NetworkData>
```

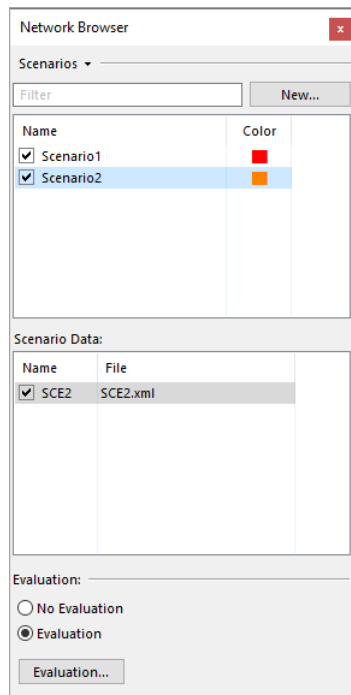
The identification is done here with the XML tag "MRID". The master resource is stored here. The tag has the optional attribute "Category". If this is used, only those Master Resources that also have this category stored in PSS SINCAL are considered.

Support for Protection Devices and other Additional Data

The installation locations of protection devices (ProtLocation) as well as the input data of breakers and fault observations can now also be used in the scenarios.

Extended Integration of the Scenarios in the Network Browser

The display of scenarios in the network browser has been improved. In the upper list of the scenarios, there are now checkboxes for activating/deactivating the scenario.



The pop-up menu in the lower selection list with the scenario files has also been extended. Here the function **View with default program** is available to open the selected scenario file in XML editor.

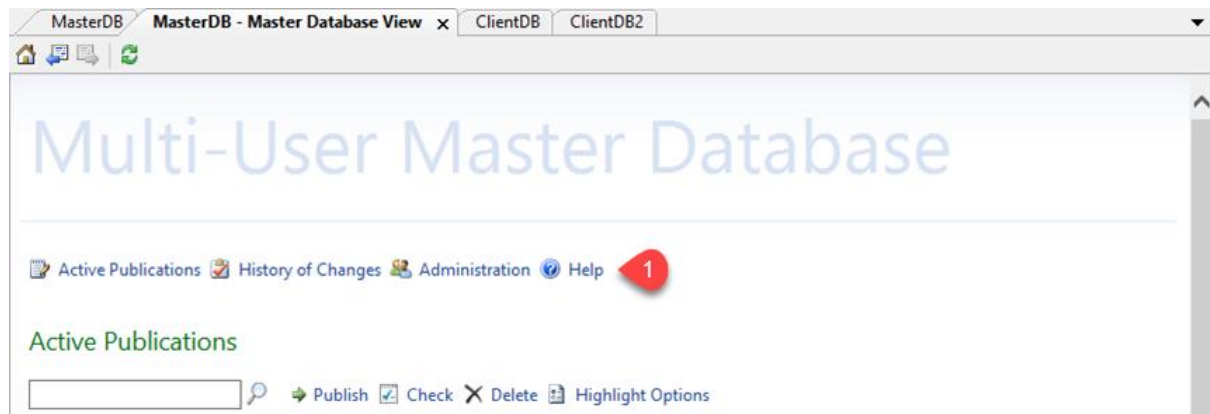
Model Management and Import Interfaces

Multi-User Master Database (PM)

The Multi-User Master Database has been extensively revised and improved. The objective here was to make the administration of changes easier and to extend the range of functions.

General Redesign of the Administration View

Working with the Multi-User Master Database has been fundamentally changed. Now when opening a master database, the administration view is opened directly. Neither network data nor network graphics are loaded from the database, i.e. the display of the view works without delay even in very large networks.


















In the title area of the view there are links (#1) that allow you to switch between the following pages:

- Active Publications
- History of Changes
- Administration

The **Active Publications** page lists the status of the master database as well as all publications of the client users that have not yet been released. This is the central view where the administrator can check the changes of the users and publish them. The editing functions for this are available in the row with the publication in the **Actions** column.

Active Publications

  Publish  Check  Delete  Highlight Options

	Name	Date	Task Type	User	Actions
	Master view (preview active)	23.10.2020, 10:13:09	Preview	Admin	  
Active Publications					
<input type="checkbox"/>	Data Change	23.10.2020, 10:12:12	Publish	User1	   
<input type="checkbox"/>	New node name	23.10.2020, 10:12:34	Publish	User2	  

The **History of Changes** page shows all changes made to the master database so far. On this page the details of changes can be displayed and discarding of changes is possible here.





History of Changes

Label

	Name	Date	Task Type	User	Task User	Actions
	Data Change	23.10.2020, 10:14:33	Publish all	Admin	User1	
	Label Origin	23.10.2020, 10:14:18	Label	Admin		
	New node name	23.10.2020, 10:12:34	Refused	Admin	User2	

The **Administration** page is divided into two sections, User Administration and Connected Databases. With the **User Administration**, users can be created, edited and deleted.

User Administration

  Add  Edit  Delete

	User Name	Role
<input type="checkbox"/>	Admin	Administrator
<input type="checkbox"/>	User1	User
<input type="checkbox"/>	User2	User

The **Connected Databases** section lists all connected client databases. For each client database that is connected to the master database, a data row is displayed. This row indicates which user established the connection, when the data was last updated or published, or whether the master database was locked exclusively for the client.





Connected Databases







Connect GUID	User	Refresh Data	Publish Data	Actions
13DE2C6BA9974FB9A8F8EB8FBBD84CB4	Admin	23.10.2020, 10:10:08	23.10.2020, 10:14:35	
354402083C394FADA045EC7E46B5CB87	User2	23.10.2020, 10:11:34	23.10.2020, 10:12:34	
510BA4280E6243A8AE4B64FCE27F70C5	User1	23.10.2020, 10:11:11	23.10.2020, 10:12:12	

Display of Changes in the Network Diagram

This new feature allows to visualize the changes in the network graphic by highlighting them. This also allows the administrator to graphically identify in which areas of the network modifications have been made during a publication. Highlighting can be activated on the **Active Publications** page if the preview in the network graphic is active.

Active Publications

  Publish ☒ Check  Delete  Highlight Options

	Name	Date	Task Type	User	Actions
	Master view (preview active)	23.10.2020, 10:13:09	Preview	Admin	  
Active Publications					
<input type="checkbox"/>	Data Change	23.10.2020, 10:12:12	Publish	User1	 <input checked="" type="checkbox"/>  

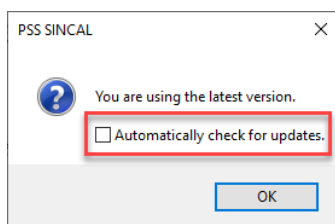
Improved Password Administration for Client Users

The administration of passwords for client users has been changed. Clicking the menu item **File – Multi-User Master Database – Change Password** now displays a dialog box where the user can change the password after entering the old and the new password.

Improved Update Check for Client Users

The function **File – Multi-User Master Database – Check for updates** checks whether changes have been made in the master database since the last update or reload.

In the information message, which is displayed after the check, a checkbox is available to activate an automatic check.



If the automatic check is enabled, it will be executed every time a client database is opened. If there are changes in the master database, this is indicated with an information message and optionally the changes can be applied to the client database by using **Refresh**.

General Improvements

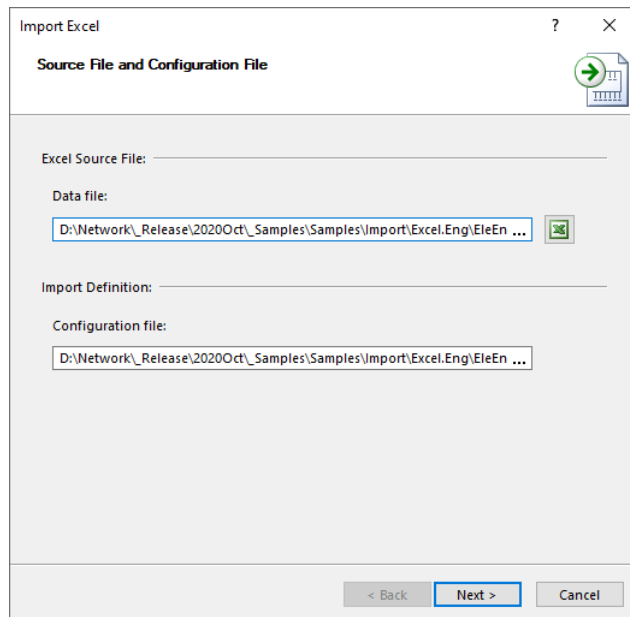
The Multi-User Master Database has also been functionally enhanced. A "hidden" variant is now used in the client databases to better track user changes. This makes it more efficient to update the master database when publishing and makes it easier to identify changes.

Excel Import

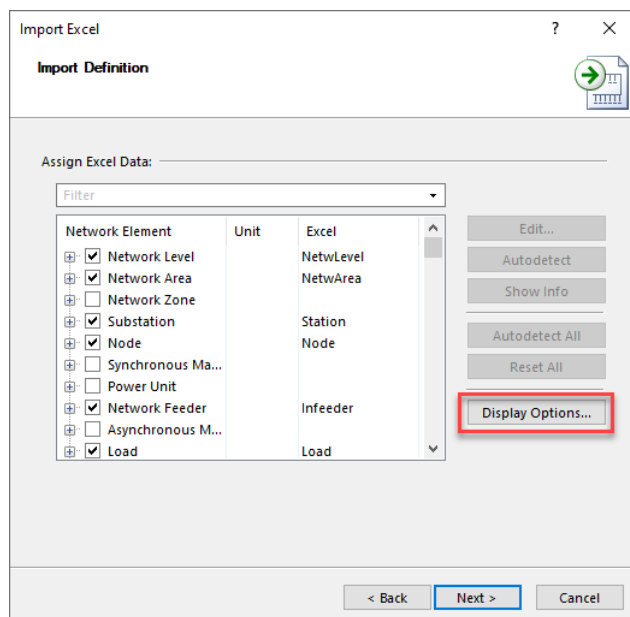
The Excel import in PSS SINCAL has been extensively improved and extended. The aim is to make this frequently used data import function even easier to use.

The import has been completely redesigned. As before, the function is started via the menu item **File – Import – Excel**, but now a wizard is used, which is based on the usual workflows when importing data.

On the first page of the wizard, you can select the Excel source file with the data to be imported and an optional configuration file with import settings.

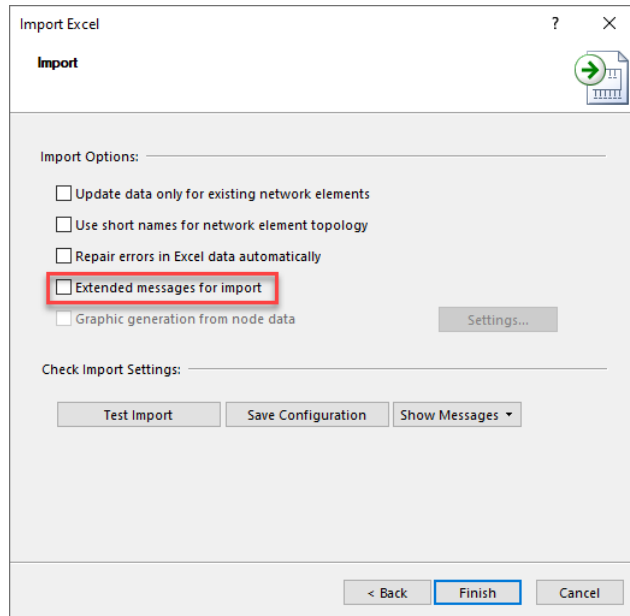


The actual import definition is done on the second page of the wizard. Here, the attributes in the Excel worksheets are assigned to the PSS SINCAL data structures.



The control of the **Display Options** is also directly integrated on this page, i.e. it can be set to display only those tables and fields that are necessary for the calculation methods activated in the current network.

The third and last page contains the control options for the import procedure.



The option **Extended messages for import** is new. If it is activated, extended messages are generated during import. It is then documented which data was inserted or updated. Problems are reported with messages.

On this page, you can also check the data before import by clicking the **Test Import** button. No data will be imported but the complete import logic will be processed. Existing problems with the data or the assignment are then documented by messages.

Extended Import Functions for Electrical Networks

CYMDIST Import

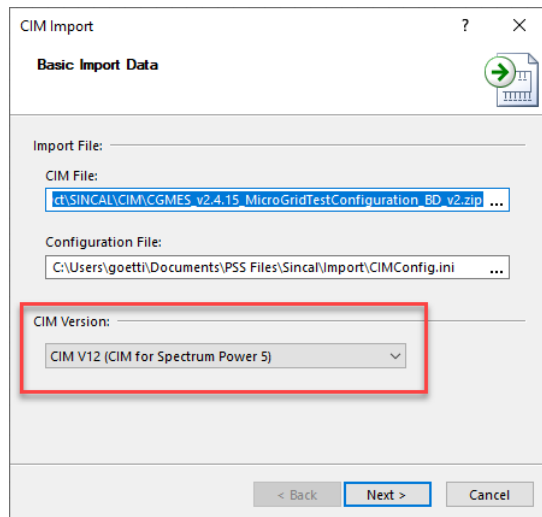
The CYMDIST import has been enhanced. Now CYMDIST data of version 9.0 can be imported in addition to the already supported versions 5.0, 7.2 and 8.0.

In addition, the following data structures are now also processed:

- User defined voltages for transformers
- PhotoVoltaic records
- Sectionalizer records
- RegulatorByPhaseSetting records

CIM V12 Import (Spectrum Power 5)

CIM V12 (CIM for Spectrum Power 5) format is now supported. This is an adapted variant of CIM V12, which contains specific extensions for the import of network data (without network graphic) based on the data model of Spectrum Power 5.



CIM V16 Import (CGEMES 2.4.15)

When importing CIM V16 (CGEMES 2.4.15) the following extensions were implemented:

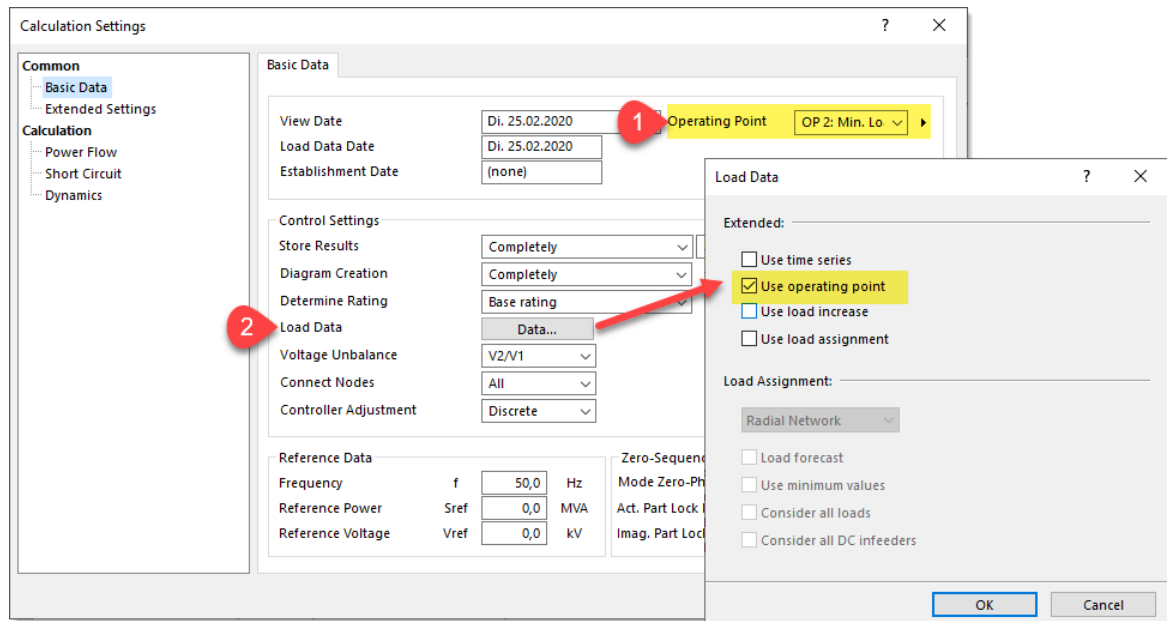
- The attributes CurrentLimit and CurrentLimit.value are now imported from the EQ profile.
- When importing transformer settings, the value TapChanger.step from the SSH profile is now preferred. If not available, the value TapChanger.normalStep from EQ profile is used as before.

Electrical Networks

General Improvements

Operating Points as a Basis for Further Calculations

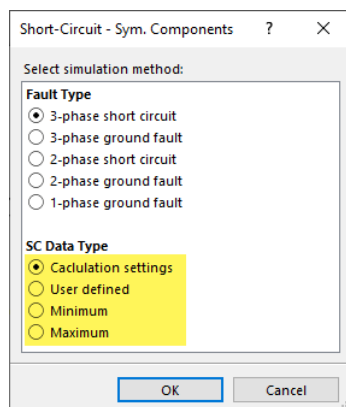
In PSS SINCAL, a selected operating point can now be used as the basis for further calculations (power flow, short circuit, etc.). The principle of operation is the same as for the View Date, i.e. in the calculation settings, the **Operating Point** can be selected in the **Basic Data** (#1).



The operating point is then used in the calculation methods if the corresponding option in **Load Data** (#2) is activated.

Short Circuit Calculation

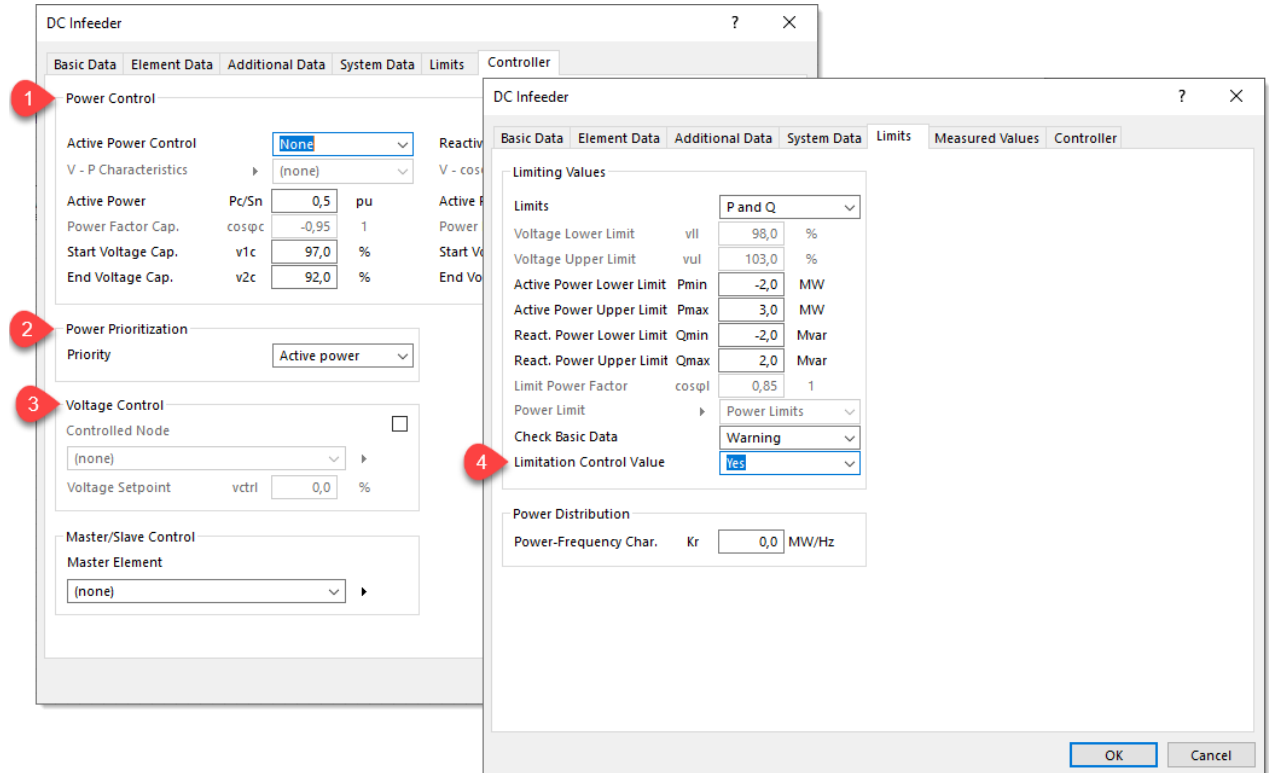
The dialog box for starting the short circuit calculation has been extended. Now you can select directly in the dialog box which short circuit data should be used for the calculation.



With the **Calculation settings** option everything works as before, i.e. the default settings from the short circuit settings are used.

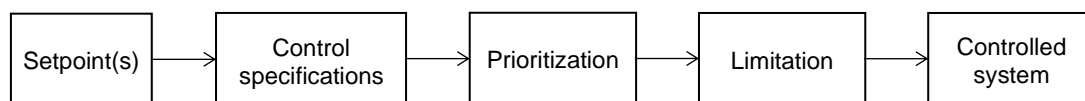
Element Controller (Active and Reactive Power Control, Prioritization, Limit Values)

The functionality of the control as well as the consideration of limit values was again extended in this product version. The new functionality is available for **DC Infeeder**, **Synchronous Machine**, **Power Unit** and **Network Feeder**.



Power Control (#1), **Power Prioritization** (#2) and **Voltage Control** (#3) are now arranged in separate sections and can be used individually or in combination. In addition, **Limiting Values** (#4) defined in the **Limits** tab can now also be considered.

The simple flow chart shows the basic principle of operation:



- **Setpoint(s):** The setpoint or setpoints for the control are specified by the user in the input data of the element.
- **Control specifications:** Depending on the element, a control specification can be a characteristic curve, an upper and lower limit, a constant voltage, etc.
- **Prioritization:** If there are several setpoints, one setpoint can be preferred.
- **Limitation:** To achieve control specifications, it is possible that technical specifications are violated by the element (minimum and maximum position tap changer, minimum and maximum active power, etc.). If limited, the result remains within these technical limits.
- **Controlled system:** The controlled system is an iteration on the way to solve the power flow problem.

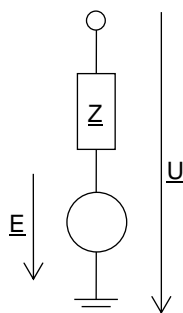
DC Infeeder – New Model Type

A new **Power Flow Type** is available for the DC infeeder "Model V (P and Q)".

An assigned BOSL model can be used to specify the real and imaginary part of the voltage behind an impedance ($R_{lf} + jX_{lf}$). This BOSL model is processed in the PSS SINCAL power flow calculation in each iteration and must provide absolute values for the real and imaginary part of the voltage:

$$\underline{U} = U_r(BOSL) + jU_i(BOSL)$$

In the dynamic simulation the voltage is also injected behind an impedance. The impedance is to be specified via the screen form in the fields R_{lf} and X_{lf} . The impedance is also available for models in the variables for dynamics ($\#R_{lf}$ and $\#X_{lf}$). The design apparent power of the element is available in the variable for dynamics ($\#S_n$). The source voltage E is determined in models from the default for power and reactance, e.g. for $R_{lf} = 0$.



$$U = |U| \times e^{j\varphi U}$$

$$Ed = |U| - \frac{Q}{|U|} \times X_{lf} \times \frac{\#UNN^2}{\#S_n}$$

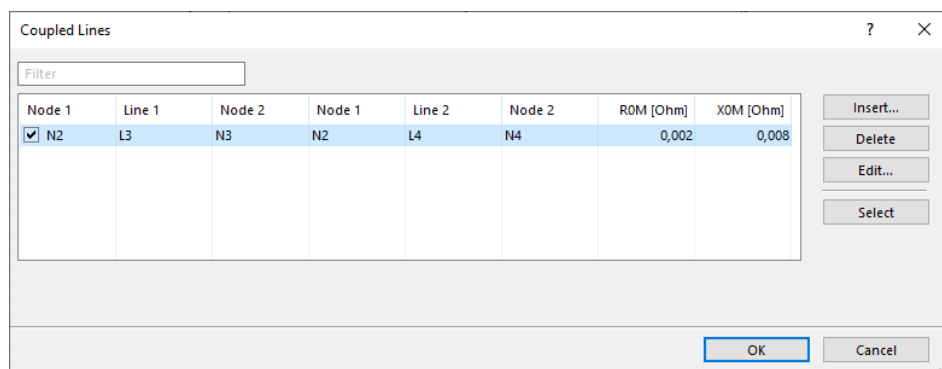
$$Eq = \frac{P}{|U|} \times X_{lf} \times \frac{\#UNN^2}{\#Sn}$$

$$E = (Ed + jEq) \times e^{j\varphi U}$$

$$\underline{Z} = R_{lf} + jX_{lf}$$

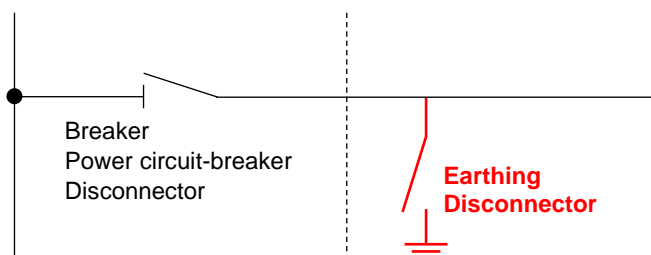
Extensions for Coupled Lines

The handling of coupled lines in the user interface has been improved. The **Coupled Lines** dialog box now displays the complete topology of the lines (Node1 – Line(s) – Node2). Also new is the checkbox, which allows direct activation and deactivation of couplings.



Selecting the network elements of coupled lines is now also possible via the **Tabular View**.

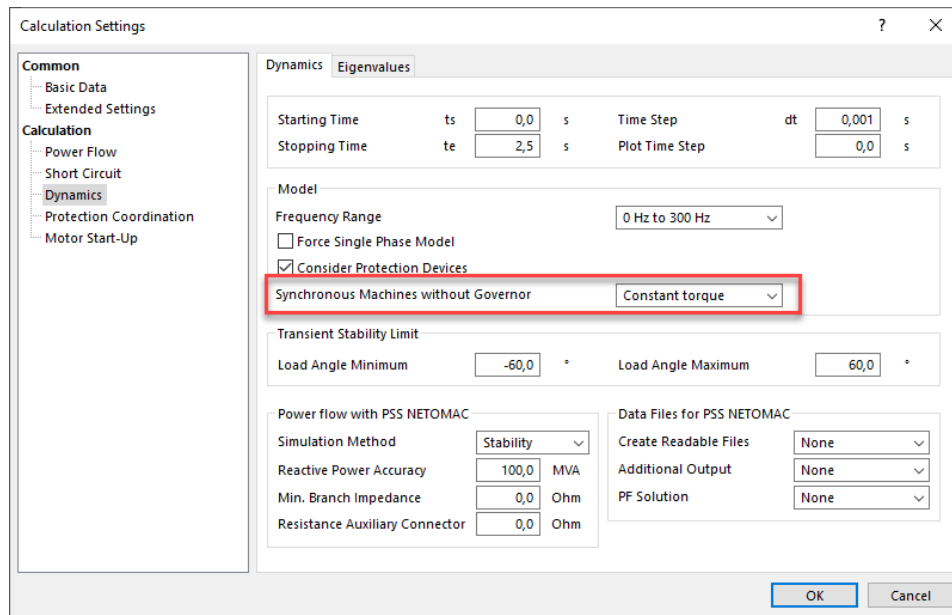
Previously, all lines that are not connected to active power supplies were eliminated in power flow calculations and short circuit calculations. However, in order to take into account, the voltage drop due to couplings of active lines (by zero-system coupling or complete coupling data), these coupled lines can now also be used in the calculation. For this purpose, an **Earthing Disconnecter** must be assigned to the isolated coupled lines. This is a new type of breaker which emulates a switch at the connection between element and ground:



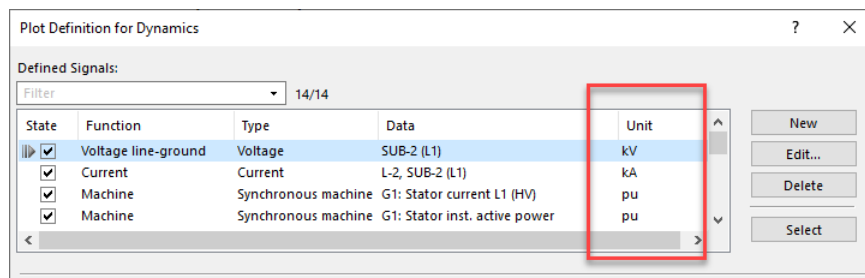
Dynamic Simulation

The control parameters for dynamics simulation have been made more transparent. These changes include a new option for **Synchronous Machines without Governor** that allows the following to be defined for cases where a synchronous machine is not assigned a speed or power controller:

- Constant torque:
The synchronous machine has the same torque in all time steps as at the start time.
- Constant power:
The synchronous machine has the same power in all time steps as at the start time.



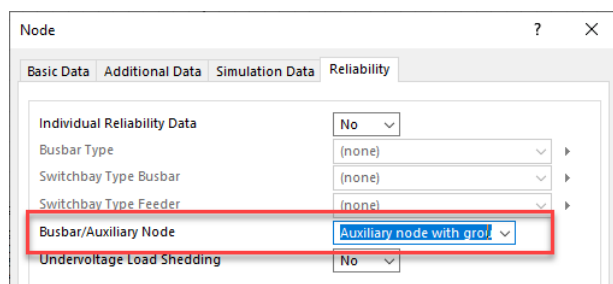
Another new feature is available in the **Plot Definition for Dynamics** dialog box. Here the unit of the signals is now displayed in a separate column.



Also new is that after a dynamics simulation (stability or electromagnetic transients) the **results of the dynamic power flow are now automatically displayed in the network diagram**. If this is not desired, this behavior can be deactivated with an extended calculation setting (Netomac.DynLFResult = OFF).

Reliability Calculation

A new functionality for the automatic creation of function groups has been provided for the reliability calculation. For this purpose, there is a new selection value in the reliability data of nodes/busbars: "Auxiliary node with group formation".

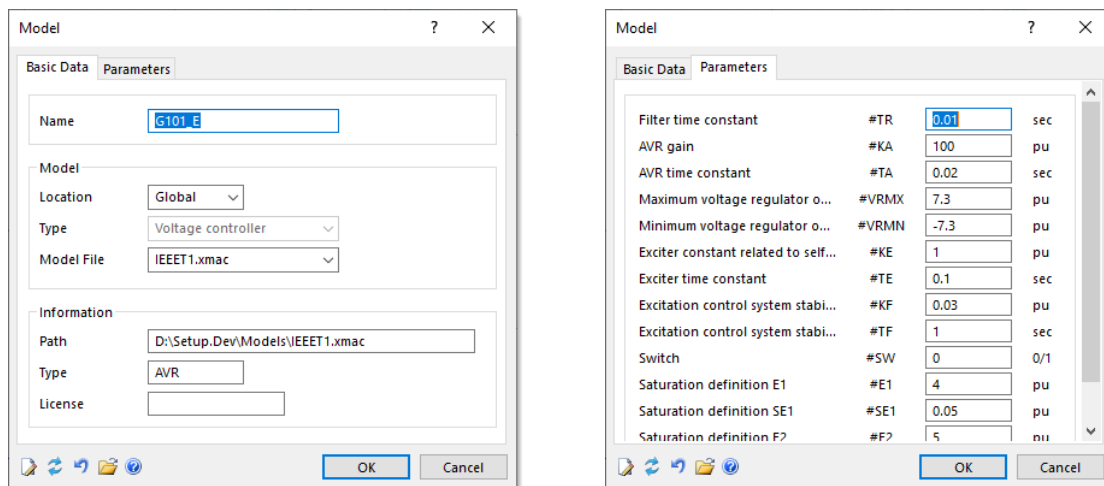


This means that all connected network elements are automatically assigned to a function group and are only in operation together in case of malfunctions.

BOSL Models

Redesigned Model Dialog Box

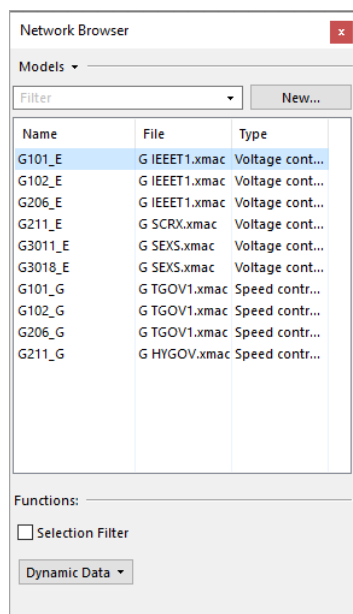
The dialog box for editing models has been redesigned. The general data of the model are now displayed even more clearly in the **Basic Data** tab and the parameters can be edited in the second tab as before.



The toolbar with the most important editing functions is now always available within the dialog box. Thus, the functions can be called at any time, no matter which tab is displayed. The functions for updating and resetting the model parameters have also been improved.

Improved Display of the Models in the Network Browser

The display of the models in the network browser has been made clearer. Now the name of the model, the model file and the model type are displayed in separate columns.



Extended BOSL Models

The use of BOSL models in PSS SINCAL has been made even more flexible. Now it is also possible

to use variables of models assigned to other network elements. This allows you to emulate interdependent controller models that are updated in each power flow iteration.

For this purpose, a new 030000 input (INPUT) is available in the BOSL models, which is supplied with special parameters to identify the variable in the remote model. The following example shows a GNE-P/Q model where a variable is taken from a remote model:

```

$*****
$ NAME: VARPQ.mac
$*****
[LINK]
@PSS@ ModTyp = 500
  GNE-P/Q      #NAME      N

[PSS_Options]
@PSS@ OutOpt = 0          ! In Integration + Powerflow
@PSS@ OutFac = 2          ! y = y0 * Output

[Data]
@DEFAULT@ #Get.T='GNE-P/Q'
@DEFAULT@ #Get.U='L03'
@DEFAULT@ #Get.O='R'
$
[End]
$1.....12.....23.....3AA1....12....23....34....45....56....67...78...89...9ZZ
Get      BOSL      INPUT      030000
R=Get
I=Get

      PRINT      R      I
      OUTPUT
      ENDE

$
$*****

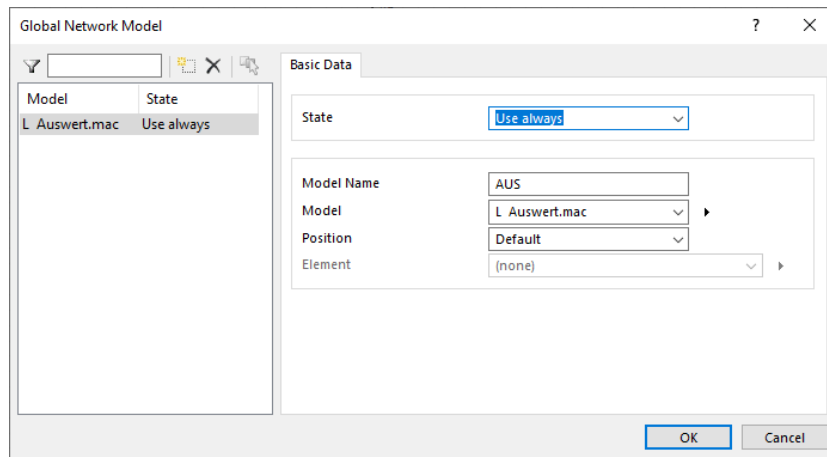
```

The INPUT block in the example shows the new 030000 input. Here the connection to the remote model is established via the parameters in the [Data] section. To do this, the model type, model name and output variable must be defined. This is done via a suffix which is assigned to the block output name:

- #Get.T: Type of the remote model (output block)
- #Get.U: Name of the remote model (normally this is the element name)
- #Get.O: Variable of the remote model

Enhanced Global Network Models

The implementation of global models in PSS SINCAL has also been improved. These models can be defined using the menu item **Data – Dynamics – Global Network Model**. Usually, these models are used to define evaluation and termination models that must perform global processing in the network.



So far, such models have only been used in dynamic power flow and dynamic simulation. But now these models can also be used in PSS SINCAL power flow. Use the **State** selection field to define when the model should be used. The following options are available here:

- Ignore: The global network model is not used.
- Use always: The global network model is always used.
- Use in dynamic: The global network model is only used in dynamics. Operating point models of elements, which take signals from the global network model, are also only used in dynamics.

Also new here is the **Model Name**. This allows to assign a unique name to the global network model. This name is needed if several global network models are used and of course if variables of the model are to be accessed via 030000 input.

Grid Code Compliance Renewables (EEG)

With this calculation method, the connection conditions for a generation plant (EZA) are checked based on predefined guidelines.

In PSS SINCAL 17.0, this calculation method has been extensively expanded and the integration in the user interface has also been optimized in close cooperation with users.

Redesign of the Control Dialog Box

The dialog box for parameterization of the calculation method has been completely redesigned. The input of the parameters is now even better oriented to the usual workflow when these checks are executed.

The general data, which applies to all guidelines, is now available in the following three tabs:

- Technical Data
- Network State
- Connection Rule

The network element with the generating plant to be connected is selected on the **Technical Data** tab. Here, individual parameters can also be taken over from the network model for checking and extended or adjusted if necessary.

Grid Code Compliance Renewables - Technical Data

General

- Technical Data
- Network State
- Connection Rule

VDE-AR-N

- Compliance
- Equipment Dimensioning
- Voltage Change
- Flicker
- Harmonics

Documentation

- Project Data

Technical Data

Generating Plant

Network element: DCI20

Max. terminal apparent power: 15,000 kVA

Max. terminal active power: 10,000 kW

Power factor $\cos\phi$: -0,97

Rated current: 0,022 A

Num. of generating units: 1

Max. gen. unit active power: 10,0 kW

Converter

Manufacturer: Siemens

Model: Line commutated

Type: Typo A

Calculate Save Close

In the new **Network State** tab, you define how the network should be configured to check the connection conditions. New here is the possibility to select an operating point which is to be used for the consideration of the network in the power flow calculation (e.g. to simulate the high load case).

Grid Code Compliance Renewables - Network State

General

- Technical Data
- Network State
- Connection Rule

VDE-AR-N

- Compliance
- Equipment Dimensioning
- Voltage Change
- Flicker
- Harmonics

Documentation

- Project Data

Network State

Operating point: High_Load

Identification of existing generation plant in network area

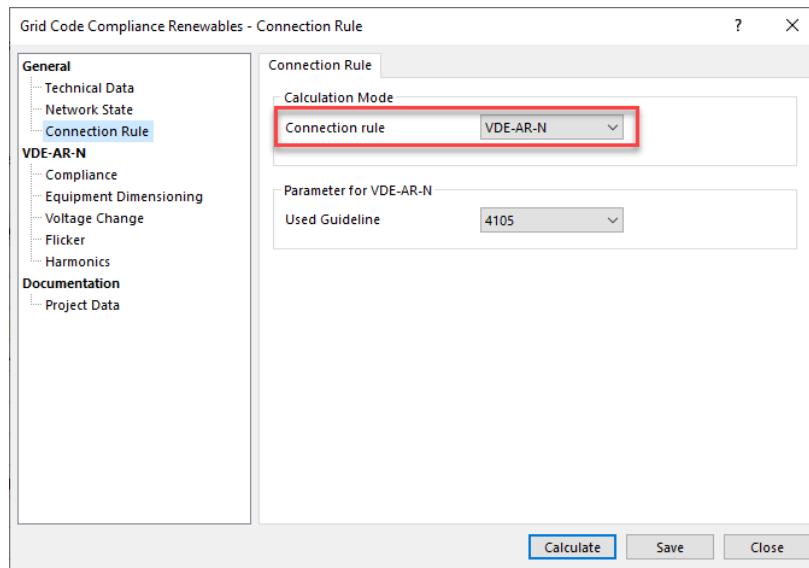
Gen. plants with sep. transformers: Consider

Gen. plants function groups: Consider

Calculate Save Close

The **Connection Rule** tab is used to specify the method by which the connection conditions are checked. At present, the test can be performed according to the following guidelines:

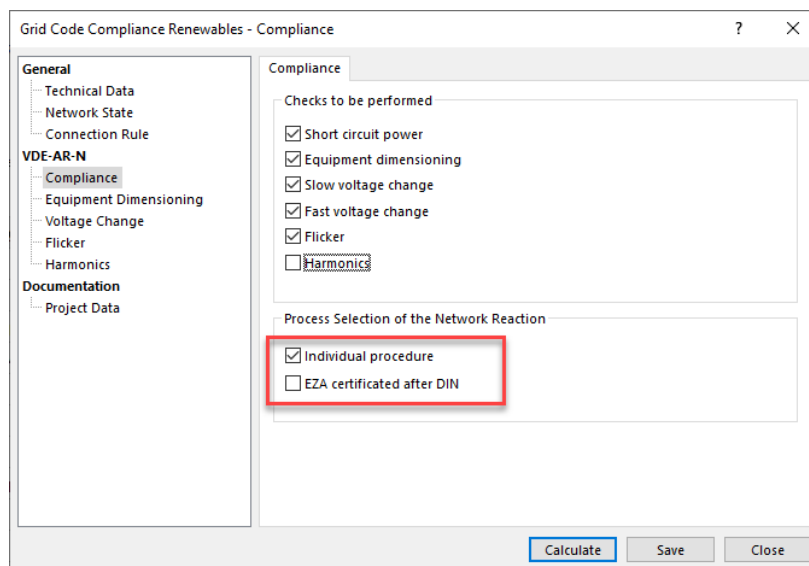
- VDE-AR-N 4105, 2018
- VDE-AR-N 4110, 2018
- NER Australia based on IEC 61000-3-6/-7
- IEEE 1547-2018



Depending on the selected connection rule, different parameters are available in this tab and the input options in the browser are then adjusted accordingly.

Revised Verification according to VDE-AR-N 4110/4105

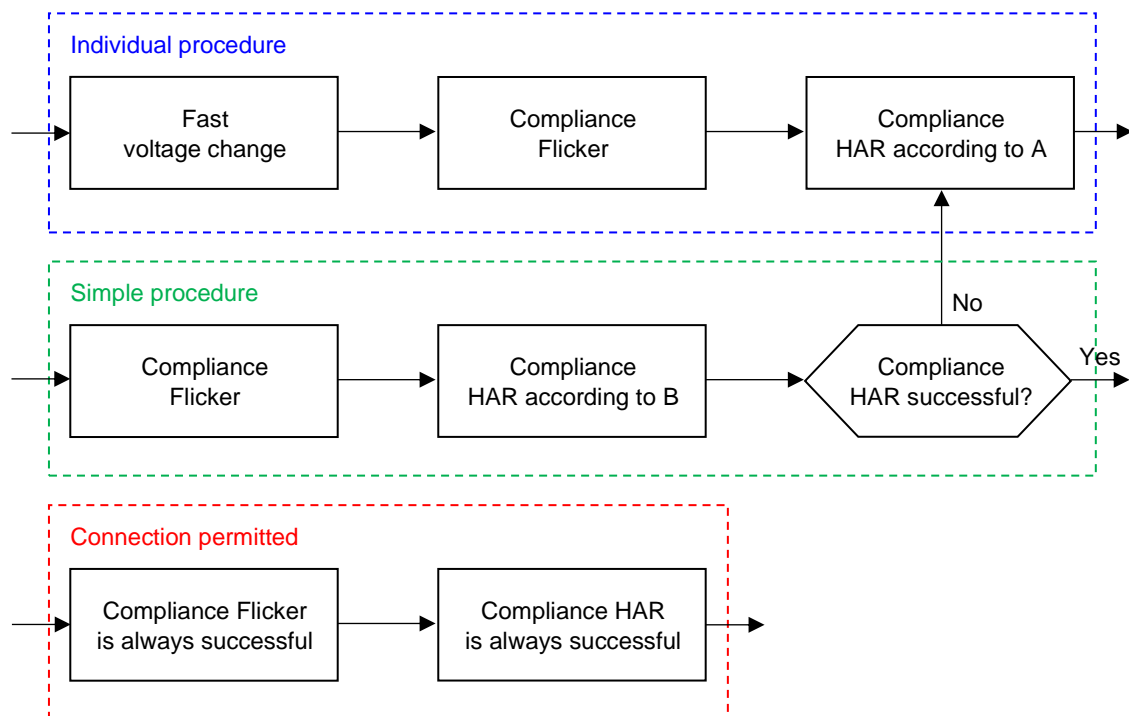
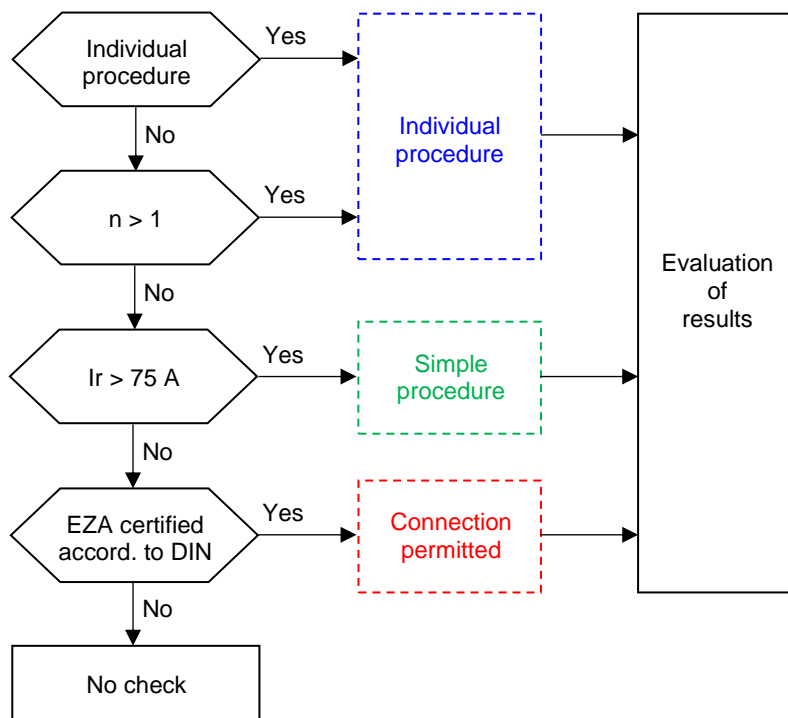
The verifications for the connection rule VDE-AR-N 4110/4105 have been extensively revised. The following figure shows the new tab **Compliance** in which the checks to be performed can be activated.



The **Individual procedure** option can be activated to use the individual procedure directly without using the automatic evaluations of the number of generating units and input current.

The **EZA certificated after DIN** option can be selected for the evaluation of devices with an input current ≤ 75 A if the plant meets the requirements specified in the standard. If the standards are met, no mathematical check of the system perturbations is necessary, and the evaluation of the Compliance Flicker and Harmonics is evaluated as successful.

The following flowchart shows the processing logic for the network reactions with the individual checks.



New Result View

The display of input data and results of the calculation method in the result view has been completely redesigned.

The new result view is divided into the following three segments:

- Settings
- Results
- Result Charts

In the **Settings** section the most important parameters of the project are displayed. After that, a table with network data of the generating plant and network data of the considered subnetwork follows. There are also links available to mark the listed network elements directly in the network diagram or display them in the tabular view.

Settings

Project: EEG Test **Connection rule:** VDE-AR-N
Title: Test of EEG module **Used Guideline:** 4105
Date: 17.10.2020

Network Data: Generating Plant	
Network Element	DCI20
Connection point	N10
Max. apparent connection power	15,0 kVA
Max. active connection power	10,0 kW
Power factor	-0,97
Rated current	0,02 kA
Number of generator units	1
Highest active connection power of generator unit	10,0 kW
Converter manufacturer	Siemens
Converter model	Pulse modulated
Converter type	Typo A
Network Data: Considered Subnetwork	
8 generating plants in the subnetwork	DCI4 , DCI9 , DCI21 ,...
10 nodes	N1 , N2 , N3 ,...
23 elements	G1 , L2 , DCI4 ,...

The **Results** section displays the results of the various tests. At the beginning a table with the different test criteria and the test status is displayed. This makes it easy to determine whether all tests were successful and whether the connection of the generating plant is allowed.

Results

Last calculation: 2020-10-22 19:54:25, **Input data:** 2020-10-22 19:54:25

Criteria	State
Short Circuit Power	Not performed
Equipment dimensioning	Not passed
Slow voltage change	OK
Fast voltage change	OK
Flicker	OK
Harmonics	Not performed

The following tables contain information about the check area and network changes.

Network Data: Plants by type in subnetwork (network area)

Type	Machines	Total Sr
Type 1 machines	G1, G8	0,180 MVA
Type 2 machines	DCI4, DCI9, DCI16,...	0,182 MVA
Reference machines	LO6, LO10, LO11	0,066 MVA
Generating machines	G1, G8, DCI4,...	0,180 MVA
Storage machines	DCI9, DCI21	0,012 MVA

Network modifications

Type	Value
Regulated transformers	2T26
Disabled elements	G1, G8, DCI4,...

Afterwards, further tables are provided containing the results of the checks performed. Usually the network element, the determined check value, the limits for the check value and the check result are shown here.

Short Circuit Power (MIN)

Type		Name		Value	Limit	Remark
Short-circuit power at connection point Sk''		N10		0,43 MVA		
Short-circuit angle at connection point		N10		-28,06 °		
Transformer	R+jX	Node	Description	Value	Limit	Remark
-	-	-	-	-	-	Not performed

Equipment Dimensioning

Type	Name	Value	Limit	Remark
Continuous current load				
Max. continuous current load - Transformer	2T26	25,56 %	< 100,0 %	OK
Max. continuous current load - Line	L24	5,7 %	< 100,0 %	OK
Max. continuous current load - Cable	L2	67,98 %	< 100,0 %	OK
Continuous current short circuit (MAX)				
Max. short circuit utilization	N8	101,97 %	< 100,0 %	Not passed
Max. clearing time cable/line	L22	0,59 s	> 0,5 s	OK

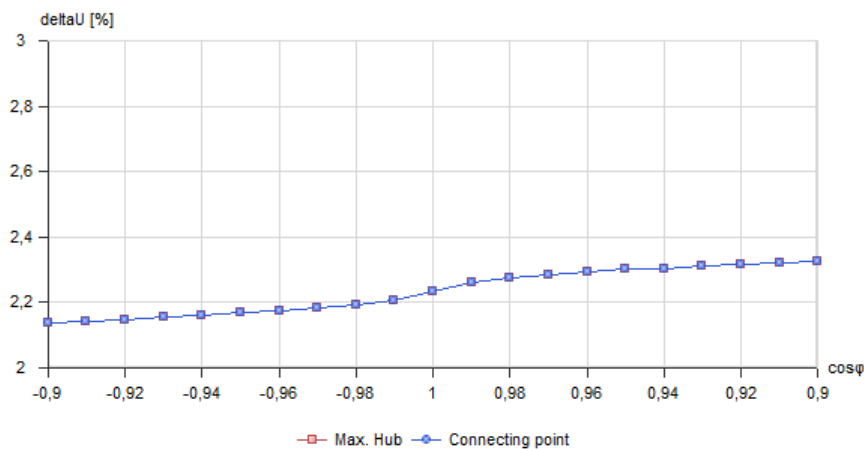
Voltage change

Type	Name	Value	Limit	Remark
Slow voltage change				
Connection point	N10	2,02 %	<= 3,0 %	OK
Connection point max. rise	N1	2,19 %	<= 3,0 %	OK
Fast voltage change				
Voltage change at the connection point (connect)	N10	1,25 %	<= 2,0 %	OK
Voltage change at the connection point (disconnect)	N10	1,25 %	<= 2,0 %	OK

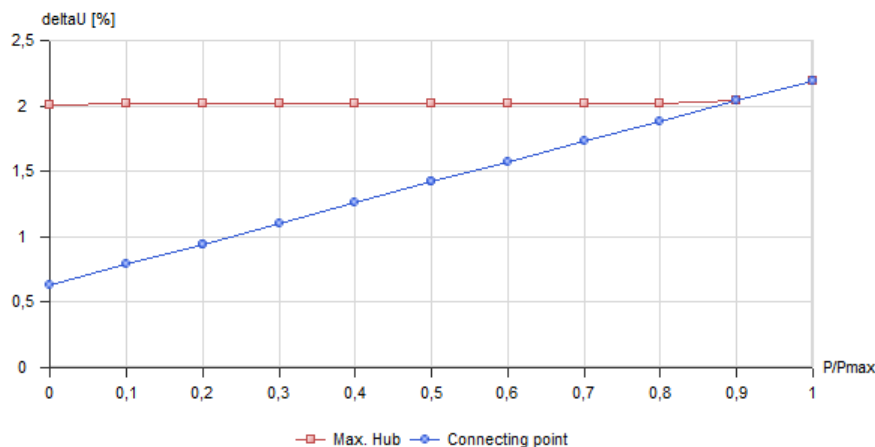
The last section in the result view contains the **Result Charts**. This section is only displayed if the check of slow voltage changes is activated. The charts show the voltage change with a variation of the power factor and with a variation of the feed-in power of the generating plant.

Result Charts

Slow voltage change at variation $\cos\varphi$



Slow voltage change at variation P/P_{\max}



Documentation

A new documentation is available in the Power Flow manual for checking the Grid Code Compliance Renewables (EEG). It describes in detail the input data and also explains the essential procedural steps of the tests according to VDE-AR-N 4105 and 4110, which are carried out in this calculation procedure to assess whether the connection of a generating plant is permissible.

Protection Coordination (OC, SZ)

Various extensions and improvements for the various functions of protection coordination have been implemented.

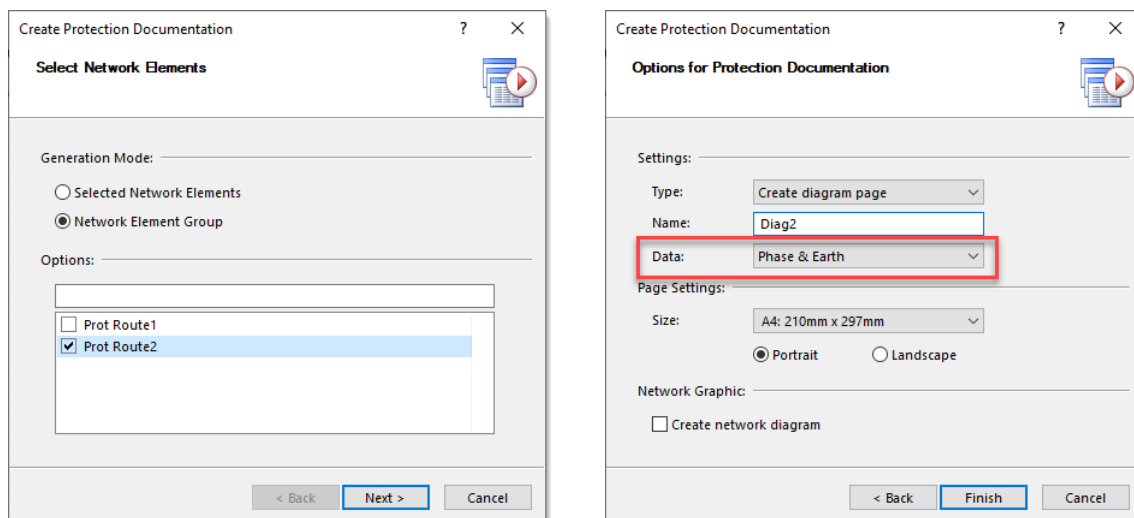
Voltage Protection, Frequency Protection and Earth Fault Detection Values in Tabular View

The setting values for voltage protection, frequency protection and earth fault detection are now also available in the tabular view. Within the table, the setting values of all protection devices in the network are clearly listed and can be edited directly.

Dev. Name	State	Name	Settings	Measurin...	Tripping ...	Uv. Step 1	v< [%]	t< [s]	Uv. Step 2
ES 7	On	Spgs.schutz	Primary	Phase-phase	Individual	Yes	80,000	1,000	Yes
ES 8	On	Spgs.schutz	Primary	Phase-phase	Individual	Yes	80,000	1,000	Yes
ES 100	On	Spgs.schutz	Primary	Phase-phase	Individual	Yes	80,000	1,000	Yes
ES 102	On	Spgs.schutz	Primary	Phase-phase	Individual	Yes	80,000	1,000	Yes
ES 101	On	Spgs.schutz	Primary	Phase-phase	Individual	Yes	80,000	1,000	Yes
ES 21	On	Spgs.schutz	Primary	Phase-phase	Individual	Yes	80,000	1,000	Yes

Protection Documentation

The wizard for creating protection documentation has been extended. Now in the options, the generation of diagrams with the phase and/or earth stages of the protection devices can be activated.



New Legend for Protection Devices

A new legend for protection devices is available. It visualizes the color coding of the different states of the protection devices and fault observations as well as the symbol overlays, which are displayed for protection devices.

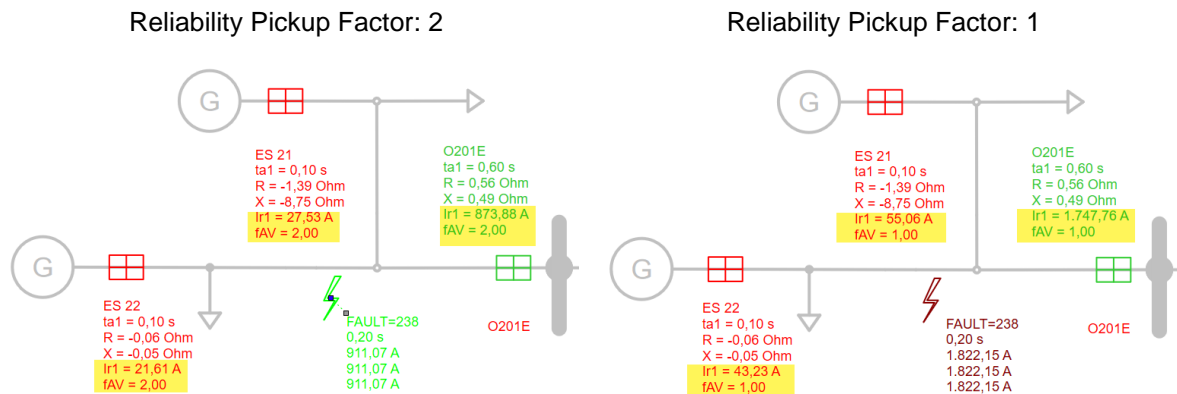
Protection Device - State	
—	Not started
—	Not time-selective
—	Pickup
—	Tripping
—	Active (fault observation)
—	Switched off (fault observation)
—	Tripping switching sequence
—	Before reclosing switching sequence
—	Breaker malfunction
—	Ground fault detected
—	Directional ground fault
Protection device:	
<input type="checkbox"/>	Valid for tripping
<input checked="" type="checkbox"/>	Unauthorized tripping

Enhancements for Reliability Pickup Factor

For the **Additional Fault Data**, the factor f_l for the current has been changed to the Reliability Pickup Factor $f_{rel} = 1/f_l$. This allows the pickup reliability to be checked, i.e. the current calculated in the simulation is divided by the value specified here. If, for example, a reliability of 2.0 is specified, it can

be checked whether half of the current occurring in the simulation also leads to a protection trip. The check can be carried out for overcurrent time protection devices and distance protection devices with current pickup

The pickup reliability factor used in the protection simulation can also be displayed in the network graphic annotation at the protection results to show which currents are used.



IEEE Curves for OC Protection Devices

For OC protection devices the following IEEE curves are now available as standard:

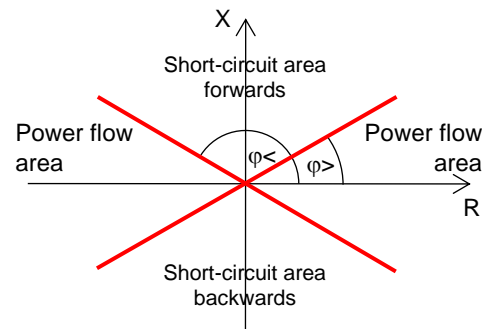
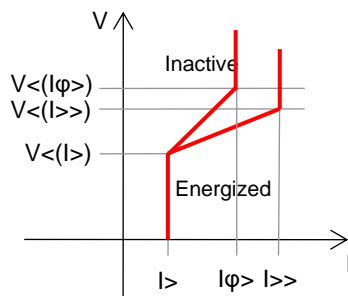
- IEEE Moderately Inverse: $0.0515 / (I_{lp}^{0.02} - 1.0) + 0.114$
- IEEE Very Inverse: $19.61 / (I_{lp}^2 - 1.0) + 0.491$
- IEEE Extremely Inverse: $28.2 / (I_{lp}^2 - 1.0) + 0.1217$

Voltage Restrained Current Pickup

The angle-dependent voltage-dependent current pickup ($U/I/\varphi$ pickup) has been extended.

Several conditions must be fulfilled before there is voltage restrained current pickup:

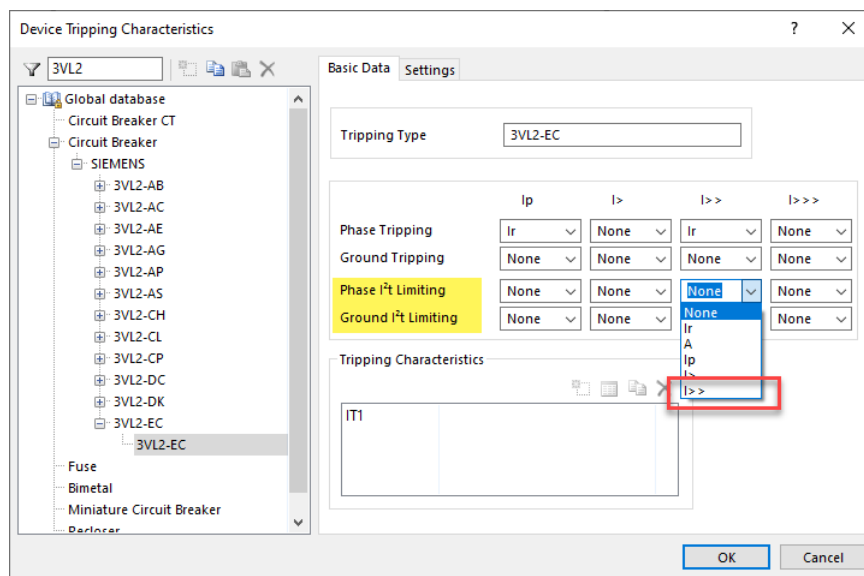
- Exceeding the limits of minimum current $I_{>}$ and
- being below the voltages $V_{<}(I_{>})$ until $V_{<}(I_{>>})$ or $V_{<}(I\varphi_{>})$ at a current of between $I_{>}$ and $I_{>>}$ or $I\varphi_{>}$ or
- Exceeding the current $I_{>>}$ or $I\varphi_{>}$ in all lines of the impedance loop
- Consideration of the angle of the loop impedance:
 If the angle of the loop impedance is between the angles $\varphi_{<}$ and $\varphi_{>}$, the error is forward in the short circuit area. If the angle of the loop impedance is between the angles $180.0 + \varphi_{<}$ and $180.0 + \varphi_{>}$, the error is backward in the short-circuit area. Outside this area, the error is in the power flow area.



In the forward or backward short circuit area, the characteristic curve is drawn via the points $V<(I>)/I>$ and $V<(I\phi>)/I\phi>$, in the power flow area via the points $V<(I>)/I>$ and $V<(I>>)/I>>$.

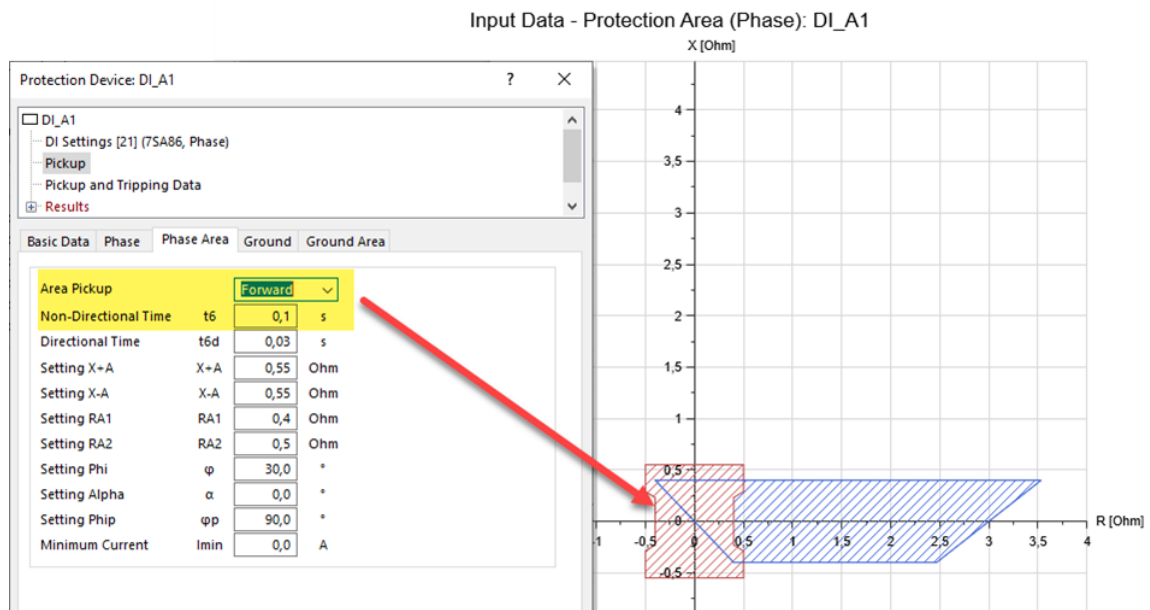
Extension of the I²t-Additional Characteristics

The possibility of defining the I²t additional characteristic of the OC protection devices has been extended. Now this characteristic can be related to the corresponding tripping zone for phase and ground.



Extended Display of the Impedance Pickup Areas in the Diagram

The display of pickup impedance area in the diagrams has been improved. Selecting **Area Pickup Forward** to get a directional and non-directional end time now displays an undirected area in the diagram view.

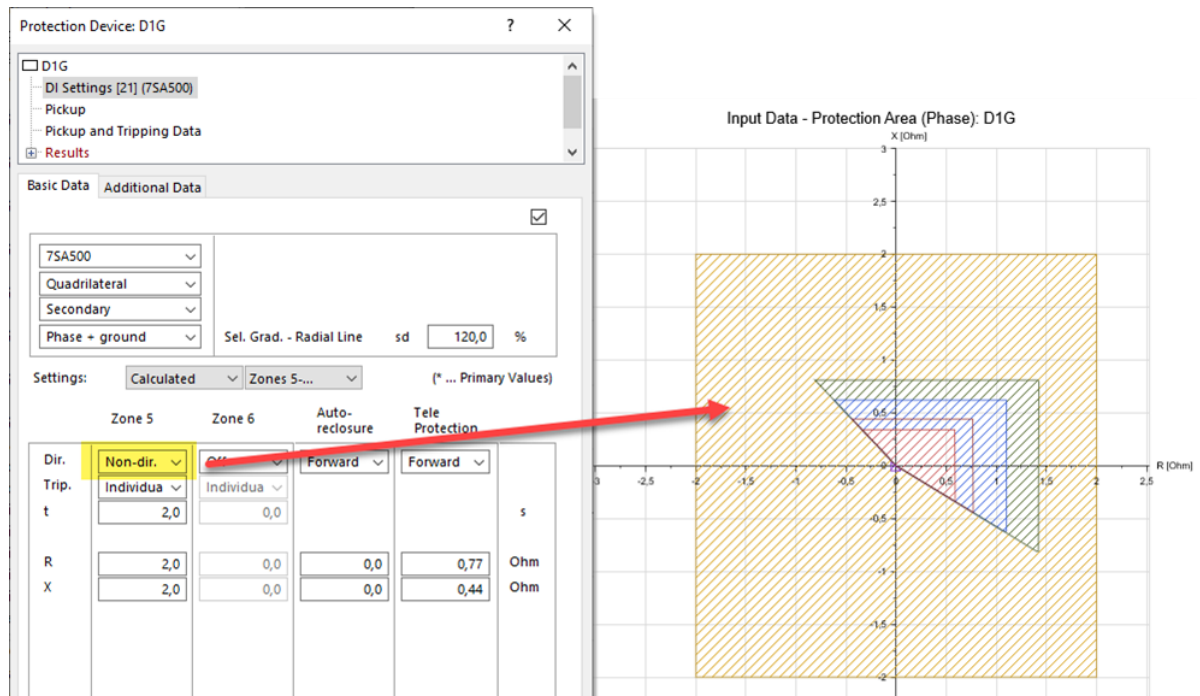


A change has also been made to the display of the **impedance areas of the tripping zones of DI protection devices**. The non-directional tripping zones are now no longer clipped by the settings made in the directional element.

In the following example, the following angle is set in the directional element:

- Forward: from -30° to 135°
- Reverse: from 150° to 315°

The impedance areas of the directional DI zones 1 - 4 are trimmed according to the angle setting, but the non-directional zone 5 is displayed untrimmed.



Protection Analysis (PSA)

In this product version, the protection analysis has again been extended by new functionalities, so that this calculation module can now cover all essential aspects for checking the network protection.

Checking the Pickup Security

The pickup security describes the distance between the current set in the protection device and the maximum occurring load current. The criteria overload, transient starting currents, measuring errors, drop-out ratio of the protection relay and a security factor are included in the factor for the pickup security.

The maximum permissible load current is defined by the thermal limit current (I_{th}) of the line or the rated current from the measurement transformer. The actual current occurring depends on many factors, i.e. simply using the currents of a power flow calculation here is not appropriate. For this reason, the input option of a **Maximum Operating Current** has been provided for the protection device in the **Additional Data** tab. If this value is filled with 0.0 A, then the rated current of the measurement transformer is used instead. This also represents a limit for the maximum permissible operating current.

The screenshot shows the 'Protection Device: W07_SSE' dialog box with the 'Additional Data' tab selected. The 'Extended Settings' section contains the following data:

Parameter	Value	Unit
One-Second SC Current I1sec	5,0	kA
Max. Operating Current Iopmax	0,1	kA
Switch Costs Sc	0,0	€
Show at Grading Diagram	Yes	

The 'Circuit Breaker Times' section contains the following data:

Parameter	Value	Unit
Switch On ton	0,0	s
Switch Off toff	0,0	s

The new pickup security check is enabled in the **Protection Analysis Wizard** on the **Extended Settings** page. Here you can also define the **Pickup Security Factor**. The maximum load current is multiplied by the security factor in the protection analysis. The non-directional and directional current pickup must not respond at the applied current.

The screenshot shows the 'Protection Analysis' dialog box with the 'Extended Settings' page. The 'Checks to be performed:' section contains the following data:

Check	Value
Coordination time:	None
Clearing time:	None
Pickup Dependability:	None
Pickup Security:	Pickup security 1,50
Malfunction:	None
Destruction:	None

The results of the new check are visualized in the result view. Each line in the table visualizes a protection route that was checked. A protection area consists of one or several protection routes. A three-end protection route with for example two protection devices is made up of three protection routes. However, all the protection routes belong to the primary protection area of the individual devices.

The first column of the table contains information on the protection area. In the two other columns, the protection device at the start of the route and the one at the end of the route is shown. The calculated fault locations are visualized along the protection route. The color indicates the result of the protection analysis.

Results

Options

19/26 Routes, 0 Selective, 2 Not cleared, 3 Underfunction, 10 Overfunction, 4 Pickup security viol., 0 Not Calculable, tclear [s]

Zones	Start	End	Start	10 %	20 %	30 %	40 %	50 %	60 %	70 %	80 %	90 %	End
Zone 1	W07_SSE	E12_SSW	0,4	0,4	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,4	0,51
Zone 2	E09_SSB	N35	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,4	0,4	0,7
Zone 2	E09_SSB	B05_SSE	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,4	0,4
Zone 2	B05_SSE	N35	0,4	0,11	0,11	0,11	0,11	0,11	0,11	0,4	0,4	0,4	0,7
Zone 3	E10_SSO	O01_SSE	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,4	0,4	0,4
Zone 4	E11_SSW	W06_SSE	0,51	0,4	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,4	0,4
Zone 5	E04_SSL	L01_SSE	0,51	0,51	0,11	0,11	0,11	0,11	0,11	0,31	0,31	0,6	0,6
Zone 5	E04_SSL	N11	0,51	0,51	0,51	0,51	0,51	0,51	0,4	0,4	0,4	0,4	0,2
Zone 5	E04_SSL	N15	0,51	0,51	0,4	0,11	0,11	0,11	0,11	0,22	0,22	0,22	0,22
Zone 5	L01_SSE	N11	0,6	0,6	0,6	0,31	0,31	0,11	0,11	0,11	0,11	0,11	0,2
Zone 5	L01_SSE	N15	0,6	0,6	0,31	0,31	0,31	0,11	0,11	0,11	0,22	0,22	0,22
Zone 6	E05_SSL	L02_SSE	0,51	0,4	0,4	0,11	0,11	0,11	0,11	0,4	0,4	0,4	0,4
Zone 6	E05_SSL	N15	0,51	0,51	0,4	0,4	0,4	0,11	0,11	0,11	0,11	0,11	0,11
Zone 6	L02_SSE	N15	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,11	0,11	0,11	0,11
Zone 7	DL_Tr. 101	SSE 40MVA	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Zone 8	DL_Tr. 102	SSE 40MVA	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Zone 9	E110_SSO	O101_SSE	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,6	0,6	0,6
Zone 10	O201E	N42	0,11	0,11	0,11	0,11	0,11	0,11	0,4	0,4	0,4	0,6	0,6
Zone 10	O201E	N43	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11

1 - 19 (19)



Selective:
All protection devices selective, fault was cleared.

Not cleared

Underfunction:
Not all devices that are expected to trip actually do trip, but the fault is nevertheless cleared.

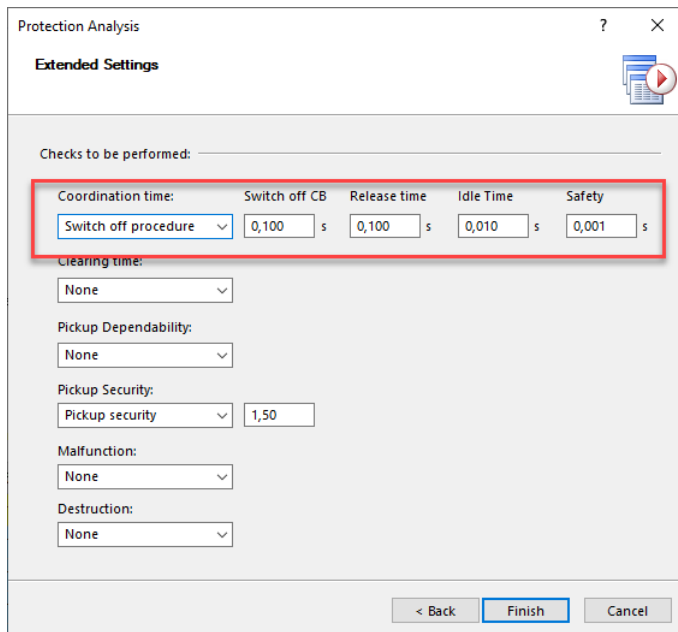
Overfunction:
The fault is cleared by the primary protection but at least another protection device trips although it should not.

Pickup security violation:
A pickup security violation occurs in the start and/or end device of the route.

-  **Not calculable:**
This indicates that the selected fault type could not be calculated at the fault location shown (e.g. a three-phase short circuit on a network element with only one conductor).
-  **Display in table:**
The value displayed in the table and selected in the options is specified here with the short name.

Consideration of the Idle Time in the Protection Analysis

The check of the **Coordination Time** in the protection analysis was extended by the **Idle Time** of the protection devices. This check is enabled in the **Protection Analysis Wizard** on the **Extended Settings** page.



Protection Analysis

Extended Settings

Checks to be performed:

Coordination time:	Switch off CB	Release time	Idle Time	Safety
Switch off procedure	0,100 s	0,100 s	0,010 s	0,001 s

Clearing time:

None

Pickup Dependability:

None

Pickup Security:

Pickup security 1,50

Malfunction:

None

Destruction:

None

< Back Finish Cancel

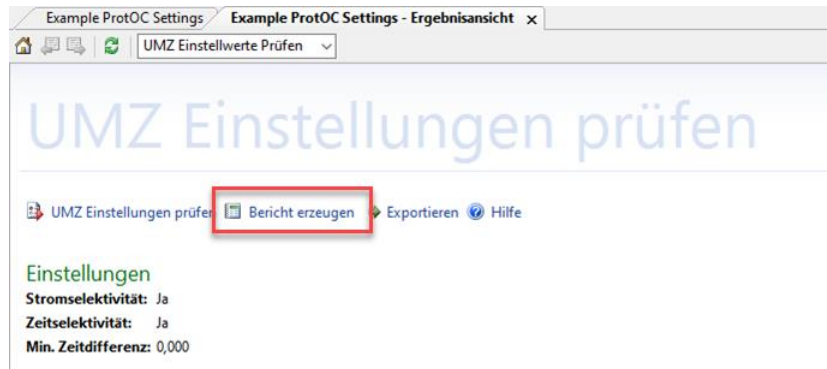
The following options can be selected in the **Coordination time** selection list:

- **None:**
No additional check is carried out.
- **Switch off procedure:**
The **Switch off CB** is the circuit breaker opening time. The **Reset time** is the time required for the pickup of a protection device to drop out after a power interruption. The **Idle Time** is the time required by the protection device after a fault has occurred to detect the fault. With **Safety** a safety margin can be considered. These values are transferred to the corresponding values in **Additional Data – Protection Location** in the section **Switch Time**. The grading time in the Protection Coordination – Calculation Settings is set to 0.0. Shutdown and release times specified locally in the protection device are treated as dominant, which means that shutdown and release times specific to the protection device can be taken into account.
- **Grading time:**
The **Grading time** is applied to the **Coordination time** in the Protection Coordination – Calculation Settings and taken into account accordingly in the simulation.

New Report for OC Settings Check

A PDF report is now available for checking the OC settings, which contains the results displayed in the

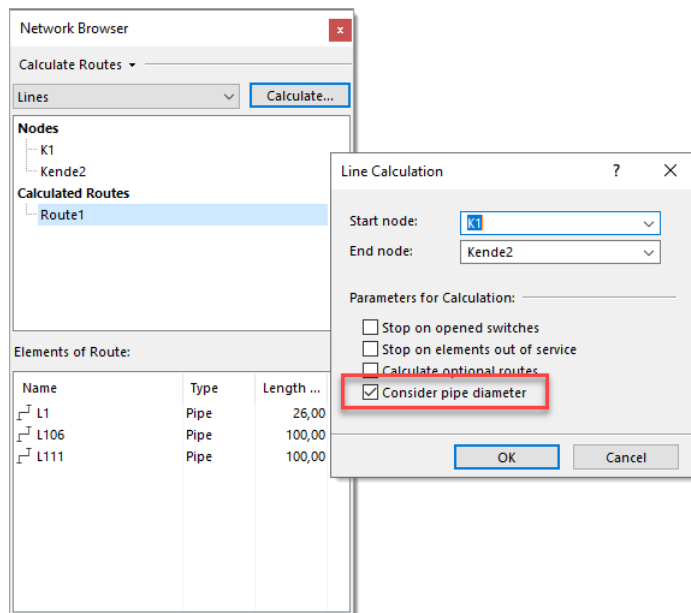
result view. The report can be easily created from the toolbar of the result view with the **Create Report** button.



Pipe Networks (Gas, Heating/Cooling, Water)

Route Calculation

The function for routing in the user interface has been extended. For pipe networks there is a new option to determine the routes based on the largest pipe diameter instead of the pipe length.



Automation (Programming Interfaces)

In this product version, the automation functions of PSS SINCAL have been expanded primarily for interface solutions to external systems. New automation functions are available in the user interface for creating the network diagram and the calculation methods now allow you to completely build the network model using automation functions.

Automation of the User Interface

A detailed documentation of the new functions is available in the "Automation" manual, chapter

"Automation of the User Interface".

Supplement/Create Graphic Elements

New functions are available in the user interface to automate the supplement network element graphics. Analogous to the interactive supplement, the nodes are positioned here and the network elements are generated automatically.

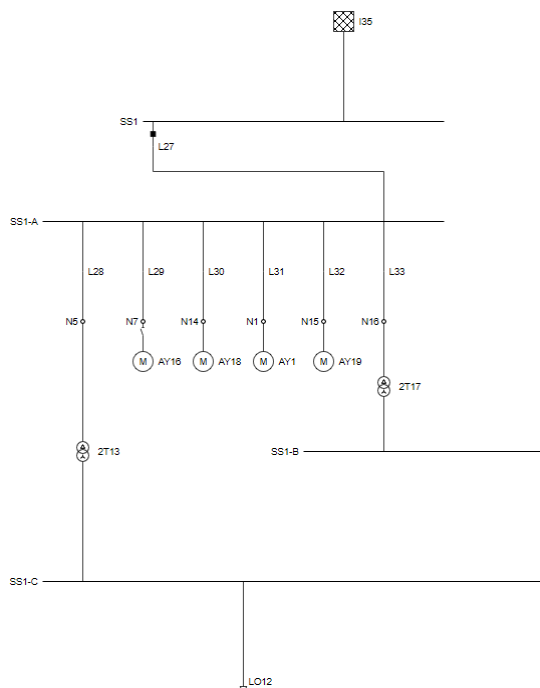
The following Python snippet shows how to use the new functions **CreateGraphicNode** and **CreateGraphicElement**

```
# Create Nodes
SincalDoc.CreateGraphicNode("N5", 0.070, 0.230)
SincalDoc.CreateGraphicNode("N7", 0.100, 0.230)
SincalDoc.CreateGraphicNode("N16", 0.220, 0.230)

# Create Busbars
SincalDoc.CreateGraphicNode("SS1", 0.100, 0.330, 0.250, 0.330)
SincalDoc.CreateGraphicNode("SS1-A", 0.050, 0.280, 0.250, 0.280)
SincalDoc.CreateGraphicNode("SS1-B", 0.180, 0.165, 0.300, 0.165)
SincalDoc.CreateGraphicNode("SS1-C", 0.050, 0.100, 0.300, 0.100)

# Create Elements
SincalDoc.SetParameter("GraphicElement.Node1", "0.200, 0.330")
SincalDoc.SetParameter("GraphicElement.SymbolPos", "0.200, 0.380")
SincalDoc.CreateGraphicElement("SS1", "I35")
...
```

The complete example code is available in the automation samples in "GuiAutoSincal.py" and is intended for use with the network "Example Ele1". This will generate the following network graphic in a new empty view.



Archiving the Network Model as Network Archive

Also new is the automation function for creating a network archive. This is especially useful if individual options are to be defined when creating the archive.

The following Python snippet shows the use of the **ExportNetworkArchive** function:

```

# Export network archive using binary mask for export options
ExportNetworkArchive_XML           = 0x0001
ExportNetworkArchive_GlobalStandardDB = 0x0002
ExportNetworkArchive_LocalStandardDB  = 0x0004
ExportNetworkArchive_GlobalProtectionDB = 0x0008
ExportNetworkArchive_LocalProtectionDB = 0x0010
ExportNetworkArchive_GlobalModels     = 0x0020
ExportNetworkArchive_LocalModels      = 0x0040
ExportNetworkArchive_ModelsSearch     = 0x0080
ExportNetworkArchive_ModelsPath       = 0x0100
ExportNetworkArchive_DataDir          = 0x0200

iOptions = ExportNetworkArchive_XML
          | ExportNetworkArchive_LocalStandardDB
          | ExportNetworkArchive_LocalProtectionDB

SincalDoc.ExportNetworkArchive(r"C:\PSS Files\Sincal\Example Ele1.sinx", iOptions)

```

Delete the Results in the Database

Another new automation function of the user interface is **Compact**. This deletes all result tables in the database and then compresses the database.

```

# Compact network database, delete all results.
SincalDoc.Compact()

```

Automation of the Calculation Methods

A detailed documentation of the new functions is available in the "Automation" manual in the chapter "Automation of Calculation Methods".

Automation of Network Modelling

New automation functions are available in the calculation methods, which allow to build the network model directly in the database. These new functions are designed in such a way that the network model can be generated object-oriented without requiring detailed knowledge about the structures of the data model.

The following Python snippet shows how to use the new automation functions to create the network model:

```

# Open database for processing
iState = SimulationDB.OpenEx()

# Get existing node and network level from it
objNodeSS1C = SimulationDB.GetCommonObject("Node", "SS1-C")
lNetworkLevelID = objNodeSS1C.GetValue("VoltLevel_ID")

# Preselect network level for new created elements
SimulationDB.SetParameter("NetworkLevel", lNetworkLevelID)

print("Adding new node SS1-D")

# Create a new node
objNodeSS1D = SimulationDB.CreateNode("SS1-D")
if not SUCCEEDED(objNodeSS1D):
    SimulationDB = None
    return

print("Adding new line L1*")

# Add line
objLine1 = SimulationDB.CreateElement("Line", "L1*", "SS1-C", "SS1-D")
#objLine1 = SimulationDB.CreateElement("Line", "L1*", objNodeSS1C, objNodeSS1D)

```

```

if not SUCCEEDED(objLine1):
    SimulationDB = None
    return

objLine1.SetValue("Line.1", 0.3)
objLine1.Update()

objLoad1 = SimulationDB.CreateElement("Load", "LO1*", 20)
if not SUCCEEDED(objLoad1):
    SimulationDB = None
    return

objLoad1.SetValue("P", 0.1)
objLoad1.SetValue("Q", 0.05)
objLoad1.Update()

print("Creating graphics for new network elements")

# Create graphic for newly inserted nodes and elements.
objNodeSS1D.SetValue("GraphicNode.FrgndColor", 0x00FF0000)
objNodeSS1D.CreateGraphic(0.0975, 0.06, 0.1325, 0.06)

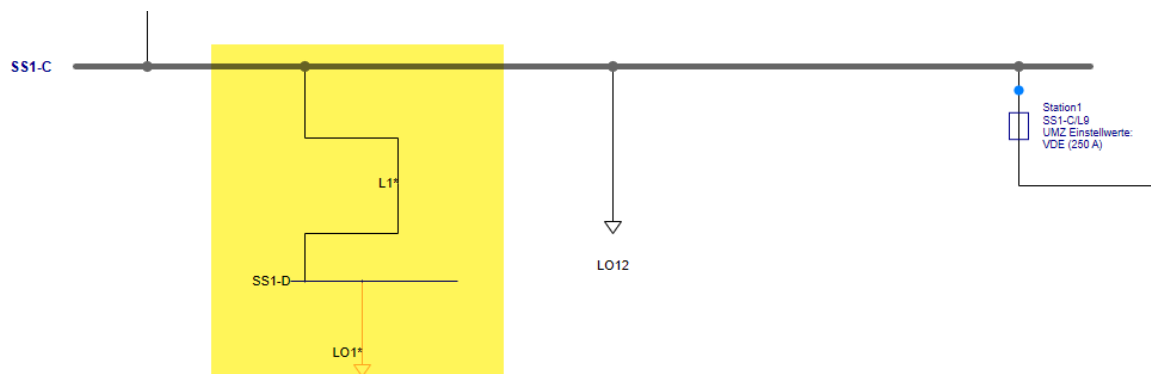
objLoad1.SetValue("GraphicElement.FrgndColor", 0x005BADFF)
objLoad1.SetValue("GraphicTerminal1.PosX", 0.1125)
objLoad1.SetValue("GraphicTerminal1.PosY", 0.06)
objLoad1.CreateGraphic(0.1125, 0.0450)

objLine1.SetValue("GraphicTerminal1.PosX", 0.1005)
objLine1.SetValue("GraphicTerminal1.PosY", 0.105)
objLine1.SetValue("GraphicTerminal2.PosX", 0.1005)
objLine1.SetValue("GraphicTerminal2.PosY", 0.06)
objLine1.AddPoint(0.1005, 0.0900)
objLine1.AddPoint(0.1200, 0.0900)
objLine1.AddPoint(0.1200, 0.0700)
objLine1.AddPoint(0.1005, 0.0700)
objLine1.CreateGraphic()

# Free objects
objLoad1 = None
objLine1 = None
objNodeSS1C = None
objNodeSS1D = None

```

The complete example code is available in the automation samples in "SimAutoSincal.py" and is intended to be used with the network "Example Ele1". This will generate new network elements at the busbar "SS1-C". In the example these are the line "L1*", the busbar "SS1-D" and the load "LO1*":



Switching in the Calculation Model with MRID

To simplify switching at the terminals of network elements and with switches (breakers) in automation the new SwitchByMRID function is available. This allows flexible switching states to be changed, whereby the identification is done via the master resource. The following Python snippet shows the

functional principle:

```
# States for switching
SwitchStateOff = 0x00000000
SwitchStateOn  = 0x00000001

# Terminals to be processed
SwitchTerminalAll = 0x000000F0
SwitchTerminal1  = 0x00000010
SwitchTerminal2  = 0x00000020
SwitchTerminal3  = 0x00000040

# Open terminal 1 at network element
Simulation.SwitchByMRID(SwitchStateOff | SwitchTerminal1, "289DAFC1-8541-4abb-AE9F-1C47E6A2D32B")

# Close all terminals at network element
Simulation.SwitchByMRID(SwitchStateOn | SwitchTerminalAll, "289DAFC1-8541-4abb-AE9F-1C47E6A2D32B")
```

Access to Attributes of Measured Values for Loads (Weighting Factors)

The calculation object for loads has been extended to allow access to the measured values. The measured values can be read out directly from the calculation object and can also be changed. The following Python snippet shows the functional principle:

```
# Get calculation object and show measure data
Load = Simulation.GetObj("LOAD", "LO1")
if Load:
    print("MeasureData:", Load.GetItem("MeasureData"))
    print("Pmax      :", Load.GetItem("Pmax"))
    print("Pmin      :", Load.GetItem("Pmin"))
    print("Imax      :", Load.GetItem("Imax"))
    print("cosphiimax :", Load.GetItem("cosphiimax"))
    print("Imin      :", Load.GetItem("Imin"))
    print("cosphiimin :", Load.GetItem("cosphiimin"))
    print("duMax     :", Load.GetItem("duMax"))
    print("duMin     :", Load.GetItem("duMin"))

    # Change Imax value
    Load.SetItem("Imax", 56) # [A]
```

Access to Transformers at the Installation Location of the Protection Device

The installation location of the protection device (ProtLocation) was also enhanced. The voltage and current transformers are now available in the calculation object.

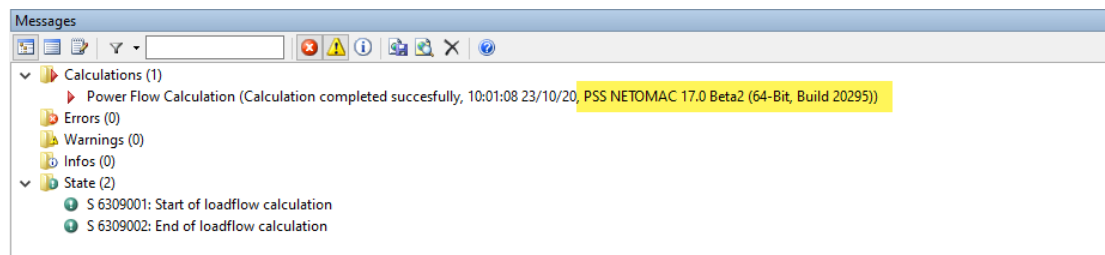
PSS®NETOMAC

User Interface

General Improvements

Extended Message Window

A tree view is now available in the message window, like in PSS SINCAL. This displays all calculations performed in the project to date, as well as errors, warnings, information, and state of the last calculation.



The calculation method, product version, beta or update number and the build number are now displayed so that it is clear with which program version a calculation was performed.

The previous list display and the ASCII log file are of course still available in the message window. These can be activated at any time using the buttons in the toolbar of the message window:



Display messages in tree view



Display messages in list view



Show log file

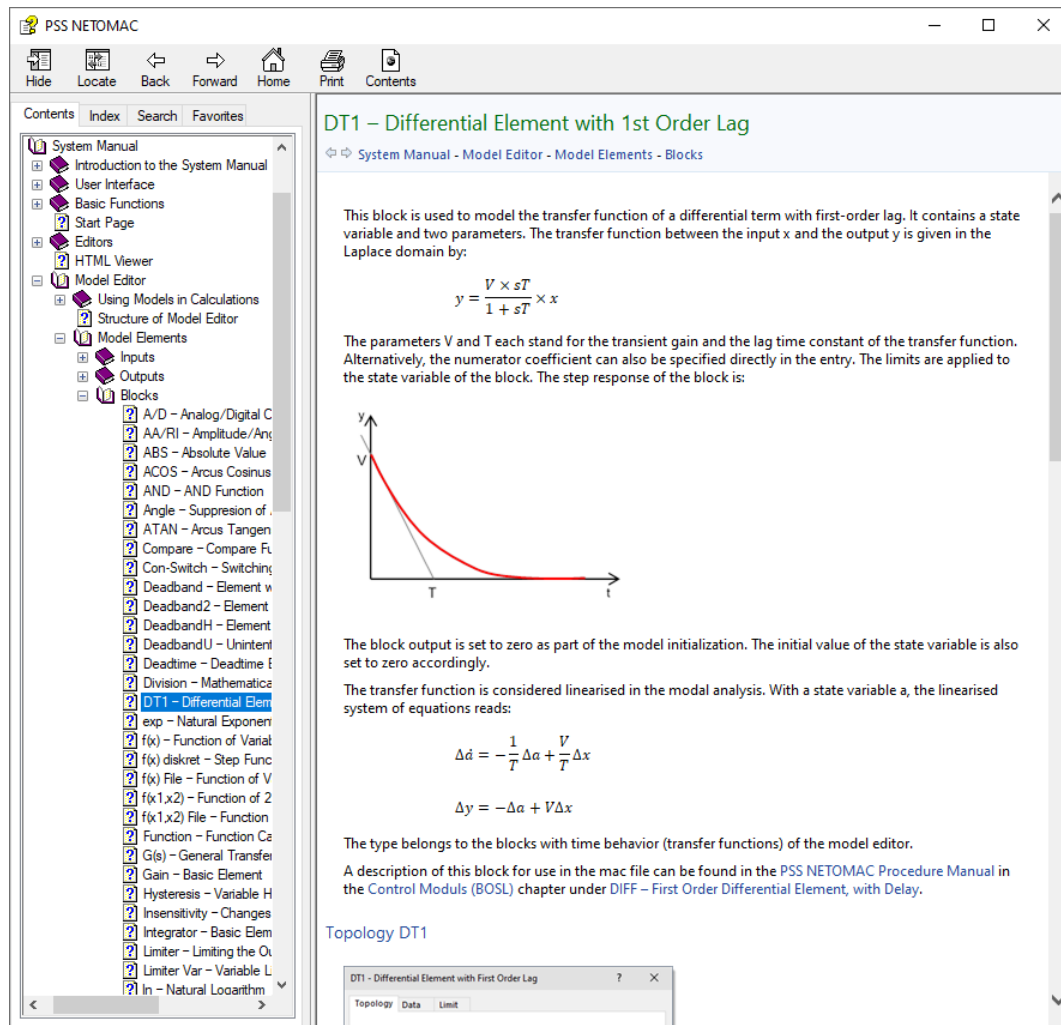
Model Editor

Comprehensive Documentation of all Model Elements

Comprehensive documentation of all model elements is now available in the PSS NETOMAC System Manual in the **Model Editor – Model Elements** chapter. This is divided into the following sections:

- Inputs
- Outputs
- Blocks
- Special Blocks

The documentation explains the basic structure of the models and contains comprehensive descriptions of all available model elements. The following figure shows an example of the new documentation for block **DT1 – Differential Element with 1st Order Lag**.



General information about the model element is provided in the documentation. Then the explanations for the different tabs of the screen forms follow. Here all input fields are described and there are also links to further information in the Procedure Manual available.

The new documentation is also integrated in the user interface of the model editor and can be called up in the input screen forms at any time.

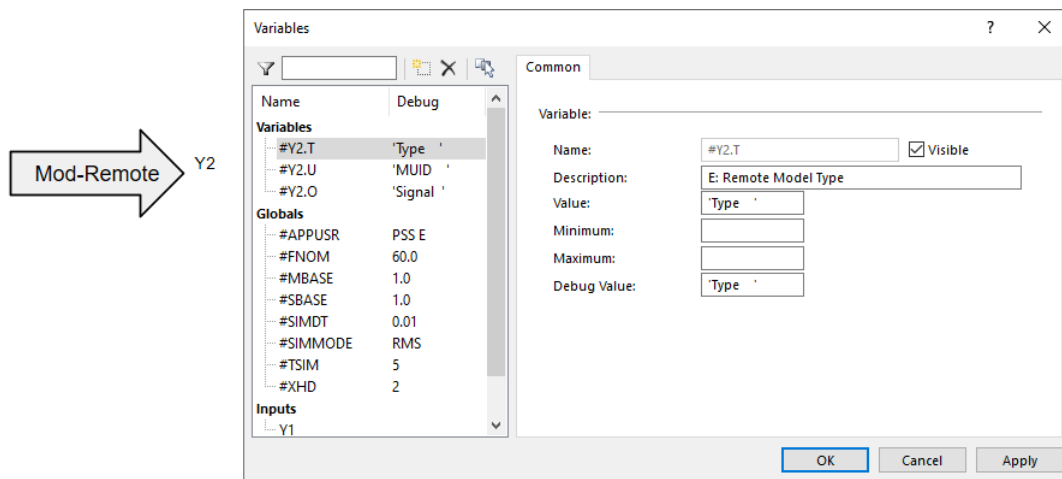
New Block "MODEL_REM" – Remote Signals from Model

With this new block, signals from remote models can be accessed in universal BOSL models that can be used in PSS NETOMAC, PSS SINCAL and PSS E.

MODEL_REM is an input block. Only a name is defined for the output signal. The complete identification of the signal to be included from the remote model is done via parameters, analogous to the already available block NET_REMOTE. These parameters must be defined by the user when inserting the model.

To integrate the signal from the remote model, three parameters are required:

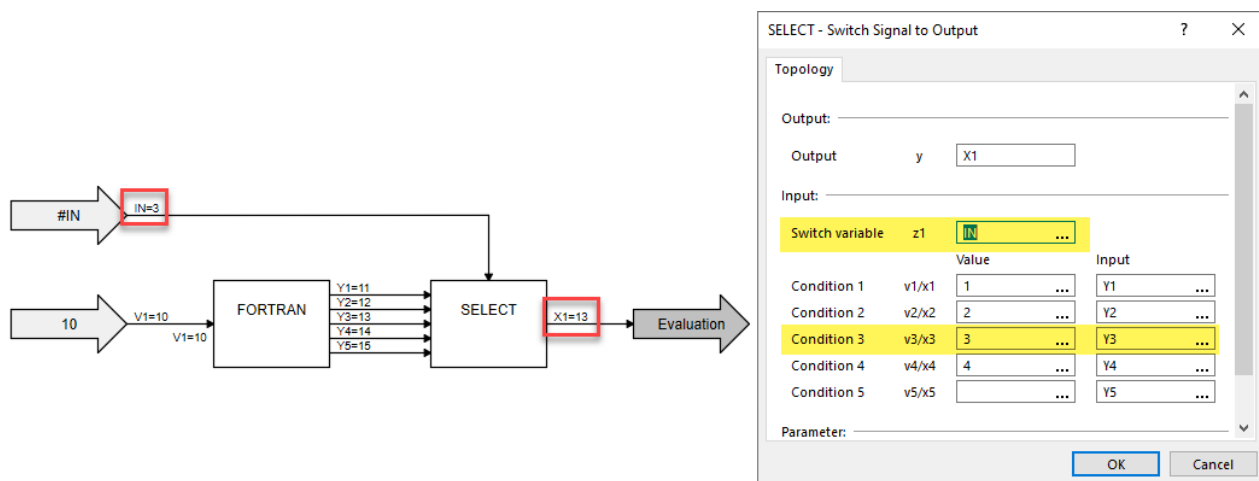
- #Out.T: Type of the remote model (output block)
- #Out.U: Name of the remote model (normally this is the element name)
- #Out.O: Variable of the remote model



New Block "SELECT" – Switch Signal to Output

With this new block it is possible to select in models, based on a control condition, from various input signals the one which is available at the output of the block.

The following example shows how to use the new block. Starting from the value IN="3" of the input at the **Switch variable**, the third condition of the SELECT block Y3=13 is available at the output.



Calculation Methods

General Improvements

Advanced Plot Identification

The plot identification has been made more flexible. Variables are now also allowed in the assignment number for the unique plot signal identification. This allows for e.g., pre-configured plot macros to be included and assigned variables with unique assignment numbers.

New BOSL Functions

Array Access to Node Results

In BOSL a new input block (**INPUT 040000**) is available, which allows array access to node results. The input block is defined with two lines:

- Line1: Definition of the result array
- Line2: Definition of the node result to be returned

The following example shows the application of this new functionality:

```
$1.....12.....23.....3AA1....12....23....34....45....56....67...78...89...9ZZ
arVal  EndInd  INPUT                                040000
nB                                           1

$ Print all voltages and names from result array
DO n = 1, EndInd
  Value = arVal(n,1)
  Index = arVal(n,2)
  s:Nam = NAMIDX(1,Index)
$
$          FORMAT      n      Index Value s:Nam
('n, Idx, Val, Name: ', 2(F5.0, ','), F8.3, ' ', 'A10)
FEND
ENDDO
$
$1.....12.....23.....3AA1....12....23....34....45....56....67...78...89...9ZZ
$ Get minimum and maximum values from result array
IF(EndInd.GT.0) THEN
  IdxMax = MAXLOC(arVal,1)
  ValMax = arVal(IdxMax,1)
  Index = arVal(IdxMax,2)
  s:Max = NAMIDX(1,Index)
$
  IdxMin = MINLOC(arVal,1,>.4)
  ValMin = arVal(IdxMin,1)
  Index = arVal(IdxMin,2)
  s:Min = NAMIDX(1,Index)
$          PRINT      IdxMaxValMaxs:Max IdxMinValMins:Min
ENDIF
$
```

With the input line in the example the amount of the node voltage is transferred into the array arVal (Name1). The array is 2 columns wide and contains as many lines as matching nodes were determined. The number of lines is returned in EndInd (Name2). A DO loop can be used to access the individual values of the array. The selected output value is available in the 1st column, the internal index for the node name is available in the 2nd column. With the internal index of the node name the actual node name can be returned as text. The **NAMIDX** function is available for this purpose.

The **MAXLOC** and **MINLOC** functions are available for evaluating the array to determine the index for the maximum and minimum value in the array

The example also uses a new function of the **FORMAT** block, the output of string variables. This was previously not possible because only numeric values could be used in the inputs of the block. Now, however, string variables (beginning with "s:") can also be used. The following snippet shows the application again:

```
$ Print all voltages and names from result array
DO n = 1, EndInd
  Value = arVal(n,1)
  Index = arVal(n,2)
  s:Nam = NAMIDX(1,Index)
$
```

```

$1.....12.....23.....3AA1.....12.....23.....34.....45.....56.....67...78...89...9ZZ
      FORMAT      n      Index Value s:Nam
('n, Idx, Val, Name: ', 2(F5.0, ','), F8.3, ' ', 'A10)
FEND
ENDDO
$

```

Array Access to Machine Variables

Analogous to node variables, array access to machine variables is also possible. The new input block (**INPUT 040000**) is also used for this purpose. The input block is defined with two lines:

- Line1: Definition of the result array
- Line2: Definition of the machine variable to be returned

The following example shows the application of this new functionality:

```

$1.....12.....23.....3AA1.....12.....23.....34.....45.....56.....67...78...89...9ZZ
arVal  EndInd  INPUT      040000
mEFD      1
$
$ Print all voltages and names from result array
DO n = 1, EndInd
  Value = arVal(n,1)
  Index = arVal(n,2)
  s:Nam = NAMIDX(2,Index)
$
      FORMAT      n      Index Value s:Nam
('n, Idx, Val, Name: ', 2(F5.0, ','), F8.3, ' ', 'A10)
FEND
ENDDO
$
$1.....12.....23.....3AA1.....12.....23.....34.....45.....56.....67...78...89...9ZZ
$ Get minimum and maximum values from result array
IF(EndInd.GT.0) THEN
  IdxMax = MAXLOC(arVal,1)
  ValMax = arVal(IdxMax,1)
  Index  = arVal(IdxMax,2)
  s:Max  = NAMIDX(2,Index)
$
  IdxMin = MINLOC(arVal,1,>.4)
  ValMin = arVal(IdxMin,1)
  Index  = arVal(IdxMin,2)
  s:Min  = NAMIDX(2,Index)
      PRINT      IdxMaxValMaxs:Max IdxMinValMins:Min
ENDIF
$

```

In the example, the input line is used to transfer the machine variable EFD to the array arVal (Name1). The array is 2 columns wide and contains as many lines as matching machines were determined. The number of lines is returned in EndInd (Name2). With a DO-loop the individual values of the array can be accessed. The selected output value is available in the 1st column, the internal index for the machine name is available in the 2nd column. With the internal index of the machine name, the actual machine designation can be returned as text.

Output of Error Messages with FORMAT Block

With the FORMAT block values of model variables can be written formatted into external files with each model call. Values of #variables can also be output. The output can be done in steady-state as well as in dynamic calculation methods. The FORMAT statement can now also be used to output errors, warnings, and information messages.

The following example shows the application of this new functionality:

```
$1.....2.....3.....A.1.....2.....3.....4.....5.....6.....7....8....9....ZZ
      FORMAT *
('E R R O R: This is an error for ', '#NAME ', '.')
FEND
      FORMAT *
('W A R N I N G: This is a warning for ', '#NAME ', '.')
FEND
      FORMAT *
('I N F O: This is an info message for ', '#NAME ', '.')
FEND
```

By using the keywords marked in the example, the FORMAT Block can be output as a calculation message:

- E R R O R: or ERROR: Output as error in the message window
- W A R N I N G: or WARNING: Output as warning in the message window
- I N F O: oder INFO: Output as information in the message window

The messages are logged in the message window with the following error codes:

- Error message: E 6309901
- Warning message: W 6309902
- Info message: I 6309903