SIEMENS

SIGUARD PDP

V2.10

Manual

Phasor Data Processing

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E50417-H1076-C419-A3





NOTE

For your own safety, please observe the warnings and safety instructions contained in this manual.

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Preface

Purpose of the Manual

This manual is a set of instructions for the software SIGUARD PDP. You obtain an overview of the possibilities for use and configuration.

Target Audience

This manual is addressed mainly to the operating crew, commissioning engineers, and quality managers who are responsible for the configuration, parameterization, and monitoring of power systems and their components.

Scope of Application of this Manual

This manual applies to SIGUARD PDP V2.10.

Standards

SIGUARD PDP was developed in compliance with guidelines in DIN EN ISO 9001:2008.

Additional Support

For questions about the system, please contact your Siemens sales partner.

Support

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Safety Information

This manual is not a complete index of all safety measures required for operation of the equipment (module, device). However, it comprises important information that must be noted for purposes of personal safety, as well as in order to avoid material damage. Information is highlighted and illustrated as follows according to the degree of danger.



DANGER

DANGER means that death or severe injury will result if the measures specified are not taken.

♦ Comply with all instructions, in order to avoid death or severe injuries.



WARNING

WARNING means that death or severe injury may result if the measures specified are not taken.

♦ Comply with all instructions, in order to avoid death or severe injuries.



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CAUTION means that medium-severe or slight injuries can occur if the specified measures are not taken.

♦ Comply with all instructions, in order to avoid medium-severe or slight injuries.

NOTICE

NOTICE means that material damage can result if the measures specified are not taken.

♦ Comply with all instructions, in order to avoid material damage.



NOTE

Important information about the product, product handling, or a certain section of the documentation, which must be given particular attention.



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1 SIGUARD PDP System Overview

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1.1 Overview

SIGUARD PDP (Phasor Data Processing) is software for **monitoring the status** of power transmission in extensive power-supply systems. When critical states are approached (frequency stability, voltage stability, transmission stability, and power swing), this is detected early and displayed. The threshold as of which a critical state is reached and requires intervention can be defined and subsequently changed at any time.

In addition, SIGUARD PDP supports you in the analysis of the power-supply system.

SIGUARD PDP works together with PMUs (phasor measurement units). These measuring devices are installed in the power distribution systems and connected to the current and voltage transformers. The time of the PMUs must be synchronized via GPS with an accuracy of < 5 μ s. This enables the PMUs to acquire the measured values with amplitude and phase as phasors (indicator values) with high precision and to transmit them via the communication interface. These time-synchronized measured values from regionally widely distributed measuring points can be collected and evaluated using SIGUARD PDP.

Software Components

SIGUARD PDP consists of 5 software components. They can run on one computer, but also be distributed over 3 computers. If the components are distributed over several computers, they communicate using SSI (SI-GUARD Service Interface). SSI requires a functional TCP connection.

The SIGUARD PDP components are:

• SIGUARD PDP Server with SIGUARD PDP Archive

The SIGUARD PDP Server stores the information of the PMU devices and makes it available to the other components. The SIGUARD PDP Server stores the information (measured values, events, and warning indications) in a ring archive and makes it available to further processing components, for example, SIGUARD PDP UI. The **IEEE C37.118** protocol is used for communication with the devices.

• SIGUARD PDP ISD (Island Detection)

This component evaluates frequency deviations and thereby detects the formation of an island within the network.

• SIGUARD PDP PSR (Power Swing Recognition)

This component detects active power swings in the power system. The parameters of the active power and the voltage angle difference that is proportional to the active power (frequency, magnitude, damping, and criticality), for several swings (modes) are observed and evaluated. In the overview diagram, a swing is marked with colored points, and on the map they are displayed with circular areas.

• SIGUARD PDP COM (Communication)

- C37.118

This component conveys the data and information via an IEEE C37.118 connection to another PDP system (for example, a second SIGUARD PDP).

- ICCP

With the Inter-Control Center Communications Protocol, information from SIGUARD PDP can be relayed to a SCADA-System in order to be able to display the data to the network control personnel there and to be able to process the data further in the more significant functions of the control system (EMS).

- OPC

An OPC DA-Server (V3) is made available with this component. Selected information from SIGUARD PDP can be read out and processed further by OPC Clients.

SIGUARD PDP UI (User Interface)

This component is the SIGUARD PDP user interface. You can use it to display and analyze the information.

SIGUARD PDP Engineer

This component is the SIGUARD PDP parameterizing tool.

SIGUARD PDP Phasor Data Processing, Manual E50417-H1076-C419-A3, Release





Recommendation: Install SIGUARD PDP server on a server computer, for example, in a server room with secure power supply, and also set up the archive on it. Install SIGUARD PDP UI on a different computer.

Figure 1-1 Software Components of SIGUARD PDP

SIGUARD PDP UI (User Interface)

The SIGUARD PDP user interface consists of several window sections:

• Menu and Toolbar

You can call up general functions via the menu and the toolbar.

• PSS Curve (Power System Status)

This window section displays the combined status of the entire measured or monitored power-supply system. An exceeded critical threshold is marked in color.

• SIGUARD PDP UI - Map

This window section shows the network topology of the power-supply system on a map. Objects in a critical state are marked in color:

- Island recognition as areas between the stations
- Power swing recognition as circular areas around the stations
- Chart View

This window section displays the detailed curves of individual measured values or calculated values over a defined time range. With the aid of these diagrams, you can analyze the power-supply system.

Measurements, applications and formulas

This window section lists the measuring points, applications, formulas, and statistics. You can create diagrams from these lists.



1.1 Overview

• Event list, Alarm list

In this window section, events and alarm indications are listed.

• Power Swing Analysis

In this window section, the PSR jobs for the stations in the power system are listed with the corresponding phase angle and PSR modes.



Figure 1-2 SIGUARD PDP UI, Main Window

Limit Editor

In the **Limit Editor**, you define the limiting values/thresholds for the individual measuring point of the power-supply system that are to play a role in the evaluation.



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🚪 Limit Editor			-						-	_ = >
Show All measurements										14
Measurem All measurements	Туре	Unit		Min3	Min2	Min1	Max1	Max2		Max3
NbgH/400 Application data Statistics	Analog	Hz		0	47.5	49	51	52.5		0
NbgH/400/VieR-Alpha/df/dt	Analog	Hz/s		0	0	0	0	0		0
VieR/400/BlnW/f	Analog	Hz		0	47.5	49	51	52.5		0
VieR/400/BlnW/df/dt	Analog	Hz/s		0	0	0	0	0		0
MlhM/400/NbgH/f	Analog	Hz		0	47.5	49	51	52.5		0
MlhM/400/NbgH/df/dt	Analog	Hz/s		0	0	0	0	0		0
ParG/400/NbgH/f	Analog	Hz		0	47.5	49	51	52.5		0
ParG/400/NbgH/df/dt	Analog	Hz/s		0	0	0	0	0		0
Rome/400/NbgH/f	Analog	Hz		0	47.5	49	51	52.5		0
Rome/400/NbgH/df/dt	Analog	Hz/s		0	0	0	0	0		0
CphS/400/NbgH/f	Analog	Hz		0	47.5	49	51	52.5		0
CphS/400/NbgH/df/dt	Analog	Hz/s		0	0	0	0	0		0
NbgH/400/VieR-Alpha/U1	Phasor	V		0	360000	380000	420000	430000		435000
NbgH/400/VieR-Alpha/U2	Phasor	V		0	360000	380000	420000	430000		435000
NbgH/400/VieR-Alpha/U3	Phasor	V		0	360000	380000	420000	430000		435000
NbgH/400/VieR-Beta/U1	Phasor	V		0	360000	380000	420000	430000		435000
NbgH/400/VieR-Beta/U2	Phasor	V		0	360000	380000	420000	430000		435000
NbgH/400/VieR-Beta/U3	Phasor	V		0	360000	380000	420000	430000		435000
NbgH/400/VieR-Gamma/U1	Phasor	V		0	360000	380000	420000	430000		435000
NbgH/400/VieR-Gamma/U2	Phasor	V		0	360000	380000	420000	430000		435000
NhoH/400/VieB-Gamma/113	Phasor	V		0	360000	380000	420000	430000		435000 ¥
							Save limits	Close		Cancel

Figure 1-3 SIGUARD PDP, Limit Editor

SIGUARD PDP Engineer

With **SIGUARD PDP Engineer**, you configure the complete SIGUARD PDP system. Here you can configure PMUs, calculated values, the graphical display, applications, and the data distribution in separate, respective windows.



Figure 1-4 SIGUARD PDP, SIGUARD PDP Engineer



1.2 Performance Features

1.2 Performance Features

SIGUARD PDP is self-standing software and runs independent of other applications.

Data Volume

SIGUARD PDP processes the data from up to 4,000 measuring channels (for example, phasors, analog/digital measured values) and 1,000 calculated values.

The measured values can originate in PMU devices or PMUs from third parties. The devices must be able to use the communication protocol IEEE C37.118. A maximum of 100 PMUs can be connected to the SIGUARD PDP Computer.

Free hard disk drive capacity for the ring archive of approx. 14 GB is required for the following configuration:

- 64 channels (for example, 8 PMUs with 8 channels each)
- A repetition rate of 10 values per second (reporting rate)
- A storage duration of 7 days

For storage of events, alarms, and time ranges, additional hard disk drive capacity is required.

The performance of SIGUARD PDP can be improved by setting up the archive on a hard disk drive separate from the one on which the SIGUARD PDP Server is set up. The performance can be further improved by setting up the ring archive and the permanent archive on different hard disks.

The archive is designed as a ring archive and can store data for a duration of 7 days, for instance. After 7 days have passed, the oldest data are overwritten. Archived data can be saved permanently in the permanent archive or exported to a CSV file and then processed further.

SIGUARD PDP UI

Up to 8 SIGUARD PDP UIs can be operated by a SIGUARD PDP Server. The associated licenses are required.

Time Synchronization

For the assignment of measured values detected simultaneously from locations that lie far apart, the measured values must have a precise timestamp. For this reason, all connected devices must have an accurate time base. No high-precision time base is required for the actual SIGUARD PDP software. However, you can synchronize the SIGUARD PDP Computer, for example, with the GPS/DCF 77 time signal receiver by Hopf or NTP (Network Time Protocol). This would also ensure highly precise timestamps assigned by the SIGUARD PDP Computer via NTP, for example, for communication monitoring. Furthermore, measuring devices erroneously synchronized with the wrong time, for example, measuring devices using local time instead of (Universal Time Coordinated), can be recognized.

Interfaces

The PMUs are connected via Ethernet (optionally TCP or UDP (User Datagram Protocol)) and the communication protocol IEEE C37.118 with the SIGUARD PDP computer.

Function Monitoring

SIGUARD PDP monitors:

- the communication between the SIGUARD PDP software components
- the communication with the devices
- the function of important software components

Events and alarms are saved and can be displayed in lists (see 2.7.1 Overview).



1.3 Configuration Example

The configuration example shown below contains the following components:

• PMU

The PMU devices are installed at strategically important points in the power-supply system and supply the measured values.

SIGUARD PDP Server

SIGUARD PDP server collects data from the PMU devices, stores them in an archive, and makes them available to SIGUARD PDP UI, for example.

• SIGUARD PDP UI (User Interface)

With SIGUARD PDP UI, you can display archived data and analyze it. On a SIGUARD PDP server, you can simultaneously access several SIGUARD PDP UIs.

In the example, the PMU devices are in 2 local networks (LAN - Local Area Network). These are connected with a local network on the office level via a WAN (Wide Area Network).



Figure 1-5 System Configuration with SIGUARD PDP, Example



1.4 Calculate Power System Status

1.4.1 Overview

All measured values of a system are evaluated by SIGUARD PDP UI with the aid of an algorithm and analyzed in such a way as to allow the point in time of a failure to be detected. The measured values are shown graphically with the PSS curve. The time range for the analysis can be selected as desired.



Figure 1-6 PSS Curve with Critical Measured Values (Red Curve)

The algorithm combines the measured values of the determined criteria and calculates the display height with it.

For this, the algorithm evaluates the following questions:

- How large is the difference between individual measured values and the set limiting value?
- How many measured values have approached the limiting value up to a defined limit?
- How is the significance of the measured values defined in comparison to other measured values (PSS factor)?
- How many measured values deviate from the set limiting value?

If the set limiting value of the curve is exceeded, it is displayed as critical (red curve, highlighted in red).

Further information on calculating the PSS curve can be found in chapter 1.4.3 Calculations.

1.4.2 Configuration of the measured value evaluation

The parameters of the measuring points are required to calculate the PSS curve. These can be configured with SIGUARD PDP Engineer:

- Amount of a phasor or an analog value
- Rated value
- 1 to 3 upper limiting values (H1 to H3)
- 1 to 3 lower limiting values (L1 to L3)
- Weighting (PSS factor)



NOTE

In order to be able to perform the calculation of the PSS curve, at least the rated value and a limiting value must be specified. Here the following must apply: H1 < H2 < H3 and L3 < L2 < L1.

The specification of the limiting values relates to the rated value. The current measured values are compared with the limiting values.



The various limiting values have different significance regarding the rated value:



Figure 1-7 Limiting Values and Critical Ranges

- (1) Limiting value H3
- (2) Limiting value H2
- (3) Limiting value H1
- (4) Rated value
- (5) Limiting value L1
- (6) Limiting value L2
- (7) Limiting value L3
- Measured values between H1 and L1 lie in the normal operating range
- Measured values between H1 and H2 or L1 and L2 lie in the questionable operating range
- Measured values between H2 and H3 or L2 and L3 lie in the critical operating range



NOTE

Only 1 alarm is always pending. If the value exceeds the limit from H1 to H2, there are 2 events: H1 outgoing and H2 incoming.

1.4.3 Calculations

The calculation of the PSS curve is performed according to a defined algorithm in 5 steps.

Step 1: Scaling of the Measured Values to Their Limiting Value

A measured value is scaled to its upper and lower limiting values (bands). This scaled value is shown as a percentage. The percentage states how highly loaded the corresponding band is.

• For measured values larger than the rated value, the following applies:

0 % = current measured value lies below the band.

100 % = current measured value is larger than or equal to the upper limit of the band

Scaled value X = (current value – lower limit of band)/(band upper limit – band lower limit)

For measured values smaller than the rated value, the following applies:

0 % = current measured value lies above the band.

100 % = current measured value is smaller than or equal to the lower limit of the band

Scaled value X = (current value - upper limit of band)/(band upper limit - band lower limit)

Example:

The PSS value should be composed of the 3 measured values M1, M2, and M3. Here the current values are M1 = 157, M2 = 120, and M3 = 135.

	M1		X _{M1}	M2		X _{M2}	M3		X _{M3}	GD _B
H3	160	H3 - H2	70.00 %	160	< H2	0 %	160	< H2	0 %	23.33 %
H2	150	> H2	100 %	150	< H1	0 %	150	H2 - H1	25.00 %	41.67 %
H1	130	> H1	100 %	130	H1 - N	66.67 %	130	> H1	100 %	88.89 %
Rated value	100			100			100			
Current measured value	157			120			135			

Table 1-1 Scaling of the Measured Values to Their Limiting Value

In this example, only the rated value and 3 upper limiting values H1 to H3 are defined. With the measured values M1 to M3, the scaled value X_{M1} to X_{M3} are shown as a percentage.

 The first measured value M1 (157) lies between the upper limiting values H2 (150) and H3 (160). Since the scaled value X_{M1} is larger than the rated value, it is calculated from:

X = (current value – band lower limit H2)/(band upper limit H3 – band lower limit H2) = (157 - 150) / (160 - 150) = 7 / 10 = 0.7000

The band between H2 and H3 is loaded with 70.00 %.

The second measured value M2 (120) lies between the rated value and the upper limiting value H1 (130).
 Since the scaled value X_{M2} is larger than the rated value, it is calculated from:

X = (current value – band lower limit N)/(band upper limit H1 – band lower limit N) = (120 - 100) / (130 - 100) = 20 / 30 = 0.6667

The band between the rated value and H1 is loaded with 66.67 %.

 The third measured value M3 (135) lies between the upper limiting values H1 (130) and H2 (150). Since the scaled value X_{M3} is larger than the rated value, it is calculated from:

X = (current value – band lower limit H1)/(band upper limit H2 – band lower limit H1) = (135 - 130) / (150 - 130) = 5 / 20 = 0.25

The band between H1 and H2 is loaded with 25.00 %.

These percentages enter into the further calculation of the PSS curve.

Step 2: Global Average Per Band (GD_B)

 $GD_B = Sum of all (value_B * weighting) / (sum of the weightings)$

 $GD_B = (X_{M1} + X_{M2} + X_{M3}) / 3$

In the example, the weightings of the measured values are (PSS factor) = 1.

In table 1-1, the 3 values GD_B are calculated for the 3 bands, for example, in band H3: $GD_B = (70 \% + 0 \% + 0 \%) / 3 = 23.33 \%$.

Step 3: Definition of the Local Maximum (LM)

The largest value in the highest band defines the local maximum.

Example: X_{M1}



Table 1-2 Definition of the Local Maximum

	X _{M1}	X _{M2}	X _{M3}
H3	70.00 %	0 %	0 %
H2	100 %	0 %	25 %
H1	100 %	66.67 %	100 %



NOTE

If all values are 0% in the highest band H3, the highest value (deviation from 0%) in the second-highest band H2 defines the local maximum.

Step 4: Calculation of the Average Between GD_B and LM

A single failure should also be evident in the global maximum.

 $T_B = (LM_B + GD_B) / 2$

Table 1-3 Definition of the Local Maximum

	X _{M1}	GD _B	Т _в
H3	70.00 %	23.33 %	46.67 %
H2	100 %	41.67 %	70.84 %
H1	100 %	88.89 %	94.45 %

Step 5: Calculation of the Global Indicator

The global indicator is the average value of the sum of T_B of all bands and is calculated as follows:

 $({\sf T}_{\sf B}({\sf H1}) + {\sf T}_{\sf B}({\sf H2}) + {\sf T}_{\sf B}({\sf H3}))\,/\,3 = 70.65~\%$

If the limiting value of 60 % is exceeded, as in the example, the PSS curve is displayed in red and is highlighted with a red area. The red coloring represents the critical range.



NOTE

The algorithm for calculating the PSS curve has a patent pending.



1.5 SIGUARD PDP Power Swing Recognition (PSR)

The SIGUARD PDP Power swing recognition (PSR) can recognize, evaluate, and display active power swings in the power system. In this way, critical power swings in the energy supply network are recognized and reported automatically.

The SIGUARD PDP Power swing recognition can execute several **PSR jobs** simultaneously. There are 2 different kinds of jobs, which differ regarding input variables:

• Angle difference between 2 voltage phasors which are measured at 2 different points in the power system (also see UI: **Phase Angle Difference**).

This variant requires 2 Phasor-Measurement Units (PMUs) that each supply at least voltage phasors.

• Active power that is measured as the product of the voltage phasor and current phasor at one point in the power system (see also UI: **Active Power**).

This requires a PMU which supplies the voltage and current phasors.

Different **Jobs** for swing recognition are defined, depending on the selected input variables and the corresponding PMU combination. The PSR executes these jobs simultaneously.

The input signals in the form of angle difference or active power, are written back to the PDP Server continually for comparison with the later events of the swing recognition in order to display them for subsequent analysis of swing processes in SIGUARD PDP UI. Within the PSR, these values are accumulated over preselected time ranges. If the data are complete, these values are transformed into the frequency range in order to recognize the characteristic frequencies for the observed swing process. Since several frequencies can be picked up simultaneously, the PSR can identify and calculate several modes simultaneously. The maximum number of the expected modes and their typical frequency ranges are defined in SIGUARD Engineer.

For every pickup frequency, the current value of the magnitude is calculated. It may be necessary to measure over a longer period of time, depending on swing frequency. For this reason, errors can occur during the increasing or decreasing process that is typical for power swings.

A quantity that is essential regarding the possible effects is the damping factor ξ (zeta) with respect to the swing frequency. In the following, it is referred to as damping for simplicity. The variable is dimensionless and stated in the following as percentages. It gives a relative measure – independent of the frequency of the power swing – for the change in magnitude of the swing from any given maximum to the next.

Negative damping ξ is characteristic of a power swing that is decreasing in magnitude. The following figure shows a corresponding change in magnitude with time for the sake of illustration.







The damping ξ of the power swing shown is -10 %. The frequency is 1.2 Hz.

A power swing with a damping ξ below -5 % is considered uncritical if the magnitude is not too high.



NOTE

Take special note of swing events above a damping of -3 %, since further pickups in the power system can lead to a quick rise in the magnitude.

Unattenuated power swings are particularly critical. A damping of 0 % corresponds to a magnitude that is not changing with time. Increasingly positive values are accompanied by an increasing magnitude trend that gets steeper over time. The following figure shows, as an example, a power swing with this behavior.



Figure 1-9 Increasing power swing for a job of the type Phase Angle Difference

The damping ξ of the power swing shown is +10 %. The frequency is 0.2 Hz.

In order to judge the consequences of a swing event, a quantity that characterizes the potential hazard is determined from the damping ξ (damping ratio) in conjunction with the current swing magnitude \hat{A} . This quantity is designated in the following as DOE (Degree of Exposure). The increase in the damping factor and swing magnitude is accompanied by a hazard. This hazard is indicated by an increasing value of the DOE. The following figure illustrates determination of the DOE value.





Figure 1-10 Calculating the DOE

The calculation of the DOE is based on limits of damping (damping ratio limits) and magnitude (magnitude limits). These limits are determined in SIGUARD Engineer (see chapter 4.7.3 Power Swing Recognition PSRs) for each job.



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2 SIGUARD PDP UI

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2.1 Overview

The program interface of SIGUARD PDP consists of the following interface components:

Menu and Toolbar

You can call up general functions via the menu and the toolbar (see 2.2 Menu and Toolbar).

PSS Curve

This window section displays the combined status of the entire measured or observed power-supply system as **Power System Status**.

• SIGUARD PDP UI - Map

This window section shows the network topology of the power-supply system on a map.

Chart View

This window section displays the detailed curves of individual measured values or calculated values over a defined time range.

• Measurements, applications and formulas

This window section contains lists than can be shown and hidden:

- Measuring points used
- All available measuring points
- Predefined formulas
- Voltage stability curves
- Statistics

You can find further information on this in chapter Measured values, applications and formulas.

• Event list, Alarm list

In this window section, events and alarm indications are listed.

PSR Analysis

In this window section, the PSR jobs for the stations in the power system are listed with the corresponding phase angles and PSR modes.

You can change the size and arrangement of the window sections to meet your requirements, see 2.8 Arranging Program Interface.

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Figure 2-1 Schematic Representation of the User Interface



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2.2 Menu and Toolbar

Menu Entries

You can call up the following functions via the menu:

• File > Save to CSV ...

With this menu item, you can save the measured values of the current time range as a CSV file, see 2.10 Reporting.

• File > Save time range...

With this menu item, you can save the measured values of the current time range in the permanent archive, see 3.4.1 Exporting of Time Ranges.

• File > Load time range...

With this menu item, you can load the measured values of a previously saved time range from the permanent archive, see 3.4.2 *Importing Time Ranges*.

• File > Delete time range...

With this menu item, you can delete the measured values of a previously saved time range from the permanent archive, see 3.4.3 *Deleting Time Ranges*.

• File > Exit

With this menu item, you close SIGUARD PDP UI.

Help > Contents...

With the menu item, you call up the online manual.

• Help > Index

With the menu item, you call up Online Help. The functionality of SIGUARD PDP discussed. It also contains instructions for working with the various components of SIGUARD PDP.

Help > About SIGUARD PDP UI...

With this menu item, you query the current SIGUARD PDP UI program version.

Toolbar

Via the toolbar in the main window, you can call up the following functions:

Table 2-1	Main Window	Toolbar
-----------	-------------	---------

lcon	Explanation
¥	Click this icon in order to open a new chart view.
	Click this icon in order to display the map SIGUARD PDP UI - Map.
0	Click this icon in order to open a new event list.
1	Click this icon in order to open a new alarm list.
	Click this icon to open the window section Power Swing Analysis .
1	Click this icon in order to save the current UI as a favorite.



lcon	Explanation
test_01 online01 online02 StartUpFavorite test_01	The selected favorite will be displayed in the text box. The list box displays all saved favorites.
*	Click this icon in order to delete a favorite.

Status of Limiting Values

Beneath the menu bar, there is a bar with the designation **PSS Curve**. The color of this bar shows the status of the limiting values.

• Gray

All entered limiting values are in effect and are accounted for in the display.

Orange

At least one limiting value was changed. The change affects the local computer, but not the entire system. You can find information on how to enter limiting values in the section *2.9 Limit Editor*.

• Pink

SIGUARD PDP UI has lost the connection to the SIGUARD PDP Server. Wait until the connection is reestablished or contact the administrator of the server.



2.3 Power System Status

In the **Power System Status** window section, you see a curve displaying the state of the complete power system. The curve can be calculated from all available measured values for which the limiting values are defined, see *1.4.1 Overview*. With the tool **SIGUARD PDP Engineer**, you can assign parameters for which measured values are to be included in the calculation, see *4.4 Phasor Measurement Unit (PMU)*. The curve is calculated from the weighted distances between the measured values and their limiting values.

You can define the displayed time range of the curve. It is divided into defined time steps, for example, hours. The right end of the diagram shows the current value.

Displaying Current Values

Display the current values as described in the following:

♦ Click the **Go online** button to the right of the selection list.

The curve is continuously updated with current values.



Figure 2-2 Power System Status, current values (online mode)

The set time range, for example, day, is represented as a curve and updated continuously. Values that have already been displayed are moved to the left. The latest value is shown on the right side.

If not enough values are available yet, for example, in the start phase, the left side of the curve is empty. It is completed by newly arriving values.

Displaying Values from the Past

For subsequent analysis, you can display values from the past (archive values) as curves in the **PSS Curve** and **Chart View** sections of the window.

Set the values from the past as follows:

♦ Click the Go offline button to the right of the selection list.

The curve is no longer updated with current values.

Switching to **Offline mode** only affects SIGUARD PDP UI. SIGUARD PDP continues to archive the incoming values, but they are not displayed in this SIGUARD PDP UI. You can launch a second instance of SIGUARD PDP UI on the same computer and thereby stay online.





Figure 2-3 Power System Status, Offline Values

The selected time interval is set by 2 **sliders**. A **cursor** is displayed within the time interval. You can move the sliders and the cursor on the time line with the mouse.

An enlarged display of selected values, for example, voltage and power of this time interval is possible in the **Chart View** window section.

The position of the cursor in the time interval has the following effects:

- Its time position is automatically transferred to the cursors in the line charts.
- Both phasors in vector diagrams and stability curves are displayed for the instant determined with the cursor.
- The state of the objects is shown in the window section SIGUARD PDP UI Map depending on the cursor position.
- In the **Event list**, a black horizontal line is shown, which separates the range of the events already entered from those that will arrive in the future, as seen from the cursor.
- The Alarm list displays the events that have been queued at this time point.

Setting Options/Displays

Change the display of the curve in the window section PSS Curve using buttons and list boxes.

The following table explains the setting options and displays for the **PSS Curve** window section.

Element	Explanation
Di , 2011-09-13 🔽	You can select the date from a calendar.
10 Minutes	You can select the time range to be represented as a curve from a list: Month Week Day Quarter day (6 hours) Hour 10 Minutes Minute 10 Seconds You can also change the time range shown by clicking the time bar, see below.
	 When offline display is activated, the top arrows enable you to scroll forward or backward through the value archive page by page. With the aid of the bottom arrows, you can move forward or backward through the archive in small steps.
Go online	Use this button to set online mode. The current values are displayed as a curve.

Table 2-2 Window Section PSS Curve





Element	Explanation
Go offline	Use this button to set offline mode. Values from the archive are dis- played as a curve. Using the arrows, you can scroll through the archive.
ОК	Non-critical values of the power-supply system are displayed as a black curve in the lower section of the display.
Critical	Critical values of the power-supply system are displayed as a red curve in the top part of the display. The higher the value is represented on the y-axis, the more critical it is. The critical time range is highlighted in light red.
I	Use this button to move the cursor to the start of the selected time range. This function is available only in offline mode .
	Use this button to start the sequence. The cursors in the charts move along automatically. In addition, the status of the objects at the respective instant is displayed on the map. This function is available only in offline mode .
11	Use this button to stop the sequence. This function is available only in offline mode with launched sequence.
Start simulation	Use this button to start simulating the PSS curve. This function is avail- able only if: • a connection to the SIGUARD PDP server is established • the offline mode is set • limiting values were changed locally

You can zoom in on the time range shown by clicking the **upper line of the time bar**, for example, from 1 min to 10 min.

You can zoom out of the time range shown by clicking the **lower line of the time bar**, for example, from 1 hour to 10 min.



Simulation of the PSS Curve

If you would like to test what effect the changed limiting values of the measured values have on the PSS curve, you can perform a simulation of the PSS curve. In this way, you can optimize the settings of the limiting values, such that the PSS curve shows the appropriate sensitivity for your power system. The simulation shows the effect a change in the limiting values has on the PSS curve. The simulated PSS curve is placed as a red line on the current PSS curve (black line).

Requirements for the simulation of the PSS curve (button Start simulation is active):

- A connection to the SIGUARD PDP server is established (status row: online).
- The offline mode is set.
- Limiting values were changed locally.



You simulate a PSS curve in this way:

Select any measured value, for example, a frequency, from the list All measurements, and display these as a diagram.



- ♦ Display the limiting values for the displayed diagram.
- ♦ Change one or several limiting values.



NOTE

Do not save the changes with **Save limits**, since otherwise the previous PSS curve would be changed in the system.

✤ For the simulation of the PSS curve, close the dialog for changing the limiting values with Close.

The color of the **PSS bar** bar changes from gray to orange.

♦ Start the simulation by clicking the button **Start Simulation**.

The simulated PSS curve is calculated. The original PSS curve is a black line; the simulated PSS curve with the changed limiting values is displayed as a red curve.



Figure 2-5 PSS Curve (Original and Simulated Curve)



2.4 Map

In the window section **SIGUARD PDP UI - Map**, the network topology of the power-supply system is displayed on a map. The individual objects/measuring points of the power-supply system, such as generators and lines, for example, are shown as icons.

The parameters of the power-supply system shown on the map can be assigned in the tool **SIGUARD PDP Engineer**, see *4.6.1 Overview*.

The map is taken from Google Earth and the objects of the power-supply system are shown. The navigation and the zoom functions are standard functions of Google Earth. In addition, further special functions are available.



Figure 2-6 Map, Map with Topology of the Power-Supply System

 \diamond If no map is open yet, click the button \mathbf{V} to display the map.

Google Earth is started and appears in the window section SIGUARD PDP UI - Map.

The current status of the objects is displayed in color. The general meaning of the color is:

Blue

The object is in normal operation, the measured values for this object lie within the defined range, the status is OK.

Yellow

The measured values for this object lie above the limiting value **Max1** or below the limiting value **Min1**, the status is not critical yet.

Red

The measured values for this object lie above the limiting value **Max2** or below the limiting value **Min2**, the status is critical.

• Gray

No current measured values are available for this graphical object.

Edge only

No measuring device is present.

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You can find a more detailed description of the meaning in the following table.

Setting Options/Displays

♦ Change the display of the map in the window section SIGUARD PDP UI - Map with the help of the icons.

The following table explains the setting options and displays available in the **SIGUARD PDP UI - Map** window section.

ар

Element	Setting options
	Click this icon on the toolbar of SIGUARD PDP UI to start Google Earth.
<u>()</u>	Click this icon in order to navigate with the standard functions of Google Earth.
<u>k</u>	Click this icon in order to select an area on the map. The measuring points that lie within the selected area are listed under Selected measurements .
*	Click this icon in order to bring an object into the middle of the map sec- tion. An object is displayed in the middle of the map section by clicking with the mouse pointer on the object. If you point to a substation symbol with the mouse pointer in this mode, the associated measured values are shown in a tooltip.
٦	Click this icon in order to zoom in on an area on the map.
	Zoom function: Zoom in
	Zoom function: Zoom out
🔁 Legend	Click this icon, in order to display the legend of the objects. The legend is explained as follows.
	Line The displayed colors mean: Red =The line is overloaded. Yellow =The line is heavily loaded. Dotted =The line is out of order. Blue =The line is operating normally. Gray =The values of the line are not captured.
G	Generator The displayed colors mean: Red =The generator is overloaded. Yellow =The generator is heavily loaded. Blue =The generator is operating normally. Unfilled =The values of the generator are not captured.



Element	Setting options					
	Substation The displayed colors mean: Red =In the substation, a voltage was measured that deviated strongly from the rated value. The limiting value Max2 or Min2 was violated. Yellow =In the substation, a voltage was measured that deviated con- siderably from the rated value. The limiting value Max1 or Min1 was violated. Blue =In the substation, a voltage was measured that is in the normal range. Gray =The substation is out of order. Unfilled =The values of the substation are not captured.					
\$	Compensator The displayed colors mean: Red =The compensator is overloaded. Yellow =The compensator is heavily loaded. Blue =The compensator is operating normally. Gray =The compensator is out of order. Dotted =The values of the compensator are not captured.					



Figure 2-7 Window section SIGUARD PDP UI - Map with a legend displayed

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Display of island-state detection (ISD)

If an island is formed between 2 or more substations, then the detected islands are displayed in the map as colored areas. The color scale corresponds to that of the diagrams (1st island shown in orange, 2nd island shown is blue, etc.).

- ♦ Open the event list.
- ♦ Filter this list with Island Detection.
- ♦ Select an event in order to display the corresponding islanding.

SIGUARD PDP UI - Map		×	🛃 Chart Vie	w		Selected mea	· × sureme ↓	Power Swing Analysis > Power Swing Recognition overview
	18	Event List		æ æ		 All measurem Predefined for Voltage stabition Statistics 	ents Me rmulas surements	PSR 366 cphs MMM P PSR 366 cphs MMM P PSR 366 mMM Mitpel debs.phi Primeworkge
S. Carlos	Market In Contract	Time 👻	Date	Name	Event element	Incidence	Transition	Message ^
1 × ALE				-	Island Detecti 🔽			
and the second		11:53:26.400	2011-08-18	ISD1	Island Detection	ISD potential network split t	appearing	Potential network split transition: ZONE=1 df/dt=-0.1117
6 19 A 19	Copenhagen	11:53:26.400	2011-08-18	ISD1	Island Detection	ISD potential network split t	disappearing	Potential network split transition: ZONE=1 df/dt=-0.0572
34	the second	11:53:26.300	2011-08-18	ISD1	Island Detection	ISD potential network split t	appearing	Potential network split transition: ZONE=1 df/dt=-0.0572
and the second		11:53:26.300	2011-08-18	ISD1	Island Detection	ISD potential network split t	disappearing	Potential network split transition: ZONE=1 df/dt=-0.2402
	Berlin	11:53:25.300	2011-08-18	ISD1	Island Detection	ISD potential network split t	appearing	Potential network split transition: ZONE=1 df/dt=-0.2402
	Muineim	11:53:25.300	2011-08-18	ISD1	Island Detection	ISD potential network split t	disappearing	Potential network split transition: ZONE=1 df/dt=-0.0004
Paris	Nürnberg	11:53:24.900	2011-08-18	ISD1	Island Detection	ISD network split	appearing	Network split: ZONE=1 f=49.49 ParG/400/NbgH/i ZO
	Munich Wilson	11:53:24.900	2011-08-18	ISD1	Island Detection	ISD potential network split	disappearing	Potential network split ZONE=1 f=49.89 ParG/400/Nb
1300	wanten wien	11:53:23.300	2011-08-18	ISD1	Island Detection	ISD potential network split t	appearing	Potential network split transition: ZONE=1 df/dt=-0.0004
- Vanet		11:53:23.200	2011-08-18	ISD1	Island Detection	ISD potential network split t	disappearing	Potential network split transition: ZONE=1 df/dt=-0.2267
REAL AND MA		11:53:22.600	2011-08-18	ISD1	Island Detection	ISD potential network split t	appearing	Potential network split transition: ZONE=1 df/dt=-0.2267
Barrow -	The last	11:53:22.500	2011-08-18	ISD1	Island Detection	ISD potential network split t	disappearing	Potential network split transition: ZONE=1 df/dt=-0.0005
Madrid	Rome	11:53:22.100	2011-08-18	ISD1	Island Detection	ISD potential network split t	appearing	Potential network split transition: ZONE=1 df/dt=-0.0005
	Kome	11:53:22.000	2011-08-18	ISD1	Island Detection	ISD potential network split t	disappearing	Potential network split transition: ZONE=1 df/dt=0.0011
A 4 4 1	© 2011 Cnes/Spot Image	11:53:21.200	2011-08-18	ISD1	Island Detection	ISD potential network split	appearing	Potential network split: ZDNE=1 f=49.89 ParG/400/Nb
Data SI	O, NOAA, U.S. Navy⊃NGArGEBCO Image IBCAO	11:53:20.600	2011-08-18	ISD1	Island Detection	ISD potential network split	disappearing	Potential network split: ZONE=1 f=49.79 Rome/400/Nb
A Contraction of the second	Image © 2011 TerraMetrics	Power Swing And	alysis 📲 Event List					
51'06'00.	88"N 11-49'32.29" O Höhei 486 mh	e 2423.50 km 🔘						

Figure 2-8 Islanding with a certain event



Display of power swing recognition (PSR)

A swing detected in the power system is shown in the map as red circular areas around the substations. The circular areas can also be connected by red, rectangular areas, if the swing affects several substations.

- ♦ Open the event list.
- ♦ Filter this list with Power Swing Recognition.
- ♦ Select an event in order to display the corresponding power swing recognition.



Figure 2-9 Power swing recognition with a certain event

You can find further information on the analysis of power swing detection in chapter 2.11.3 Power Swing Recognition.

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2.5 Chart View

In the **Chart View** window section, you can simultaneously display several **diagram groups**. The diagram groups are separated from one another by horizontal lines. Within a diagram group, the displayed time range is identical, for example, values of an instant are listed exactly one below the other. In order to group the display of measured values, you can open several Chart views.

The time lines of the diagrams of a diagram group are always scaled identically to ensure comparability of the values. Depending on the width of the y-axis label, however, diagrams in different diagram groups can be scaled slightly differently.

Depending on whether you drop a measuring point above or below the horizontal line, a new diagram is created within the diagram group (when you place the object above the line) or a new diagram group is generated (when you place the object below the line).

Every diagram group can contain several Line diagrams but only one Vector diagram.

The **Diagram type** is determined by the type of the first curve. An analog curve is displayed in a line diagram, a phasor in a vector diagram. In order to represent the change in the magnitude of a phasor with time in a line diagram without an additional analog value, first create an empty line diagram and pull the phasor into it. To

generate a blank line diagram, use the 12 button.

You can display several **curves** in each diagram. To represent an additional curve in an existing diagram, drag and drop a measuring point to the diagram. The curve adapts to the diagram type. A line diagram shows only the amplitude of a phasor.

In real time display mode, the curves in a line diagram move to the left. New values are added on the right side.



Figure 2-10 Chart View, display mode of several curves of a time range

The diagrams display the time range that has been selected with the slider in the **PSS Curve** window section. The cursor position on the time line corresponds to the cursor position in the **PSS Curve** window section.

In **offline mode**, a past event can be rerun repeatedly to analyze the underlying dynamic processes. A cursor then runs through the line diagrams.



Parameter of displayed curves

The measured values displayed are listed with the respective colors next to or above the diagram. The corresponding curve can be shown/hidden via the check box selections.

Right-click an entry in the list to open a context menu. The menu items mean:

Signals

Use this menu item to show/hide individual curves.

• Copy to clipboard

Select this menu item to copy the diagram to the Microsoft Windows clipboard.

• Show measure line (only in offline mode)

With this menu item, you can show a horizontal line for a certain measuring point. The precise measured value is shown at the intersection of the horizontal line with the diagram.

• Show second cursor (only in offline mode)

With this menu item, you can show a second cursor (vertical line). The difference from the first measured value is shown at intersection of this line with the diagram.

• Edit limits

With this menu item, you can open the Limit Editor for this signal. The limiting values are displayed. Alternately you can display the limiting values of a curve by double-clicking the corresponding entry in the curve list.

• Show average value (only for line diagrams, no formulas)

With this menu item, an average is generated for every measured value of the curve and the curve is thus smoothed. The smoothed curve is identified by **[Avg]** in the name.

Setting Options/Displays

The following table explains the setting options and displays for the Chart View window section.

Element	Explanation
	Click this element in order to generate an empty line diagram.
	A click on the left element successively reduces the height of all dia- grams (for overview).
-	A click on the right element successively enlarges the height of all dia- grams (for details).
	With a click on this element, the average values of the curve are displayed (smoothing average generation).
	This element is only active in online operation. Click this element in order to open a dialog in which you can switch on/switch off the trace of the tie point and change the chronological length of the tie point.
₩#	Click this element to start the editor for all limiting values.
**	Click this element in the Limit Editor to activate changed limiting values in the overall system. The color of the PSS Curve bar changes from orange to gray. This element is visible only if a limiting value was changed Limit Editor or if the Limit Editor is opened for an individual curve. It is opened by double-clicking a curve/legend entry.

Table 2-4 Window Section Chart View


Element	Explanation					
120	Click this element, in order to change the scale of the y-axis.					
	Y axis settings X Axis Axis properties Image: Constrained Image: Constrained					
	 Axis The following properties are to be set for the selected axis: dynamic With the setting dynamic, the scaling of the y-axis is always automatically selected such that the displayed curves are displayed at the maximum scale. maximized With the setting maximized, the scaling is corrected such that the displayed curves are displayed at the maximum scale. manual With the setting manual the scaling of the curves is set to the entered minimum and maximum values. zero-aligned If zero-alignment is selected, the y-axis is displayed from the zero point and the curves are re-scaled correspondingly. 					
	This element is active only with the setting maximized . Click this element in order to correct the scaling one time, such that the displayed curves are shown at maximum scale.					
×	Click this element to delete the relevant diagram, including all curves represented in it. All following diagrams move up by one line.					
Limits X Max3 440000 Max2 410000 Max1 405000 Min1 390000 Min2 380000 Min3 0	This element is called by double-clicking a measured value above the diagram. The border color correlates with the curve color. The element shows the currently valid limiting values for the associated curve. You can change and enable/disable the limiting values. Enabled limiting values are represented as a horizontal line in line diagrams and as a circular line in phasor diagrams. Effective limiting values are indicated by a blue background. Changed limiting values that are not yet effective are indicated by an orange background. When clicking the cross, the element is closed and the changes are saved locally. An active limiting value must be plausible (for example, Max2 > Max1), otherwise saving it is rejected.					



2.6 Measured Values, Applications and Formulas

2.6.1 Overview

In the window section Measurements, applications and formulas, you will find:

Selected measurements

The list contains measuring points that belong to the selected objects in the window section **SIGUARD PDP UI - Map**.

All measurements

The list contains all measuring points that are available in the power-supply system. In this list, you can also define whether the measuring points are listed in alphabetical order, sorted by unit or type.

Predefined formulas

The list contains all predefined formulas.

These formulas can be applied to the measured values.

• Voltage stability curves

The list contains special curves (applications), for example, voltage stability curves.

Statistics

Values that can be displayed in diagrams are gathered for each PMU.



Figure 2-11 Listings of Measuring Points, Measuring-Point Applications, and Formulas

You can define whether these are listed in alphabetical order, sorted by unit or type by clicking once or twice on the corresponding column heading.

Up to 10 measuring points/formulas/VSCs/statistics can be displayed in a diagram.

To do this, drag and drop the selected measuring point into the window section **Chart View**. A measuring point of the **Phasor** type is represented as a vector diagram unless you drag and drop it to a previously created line diagram. A measuring point of the **Analog** type is always displayed as a line diagram. You can insert measuring points into existing diagrams of the same type. You can select several measuring points and simultaneously drag and drop them into a diagram.

In the measurements window section, right-click a measuring point of the **Phasor** type to define it as a reference phasor or to delete it.





All phasors displayed in the window section **Chart View** refer to the reference phasor. This means that all phase angles are displayed relative to the phase of the reference phasor.

With the aid of the arrows, you can show or hide the complete window section or a listing.

Information on the use of predefined formulas can be found at 3.3 Displaying Curves.

2.6.2 Selected Measurements

The list **Selected measurements** contains all measuring points selected in the map. In this way, the number of measuring points can be limited to one substation, for example.



Figure 2-12 Listing of the Selected Measuring Points



2.6.3 All Measurements

The list All measurements contains all measuring points that are available in the power-supply system.



Figure 2-13 Listing of All Measuring Points



2.6.4 Predefined Formulas

The list **Predefined formulas** contains all predefined formulas in SIGUARD PDP. These formulas can be dragged into a Chart View in order to integrate corresponding measuring points into the formula as a parameter and calculate a curve from this. This curve is then shown in the Chart View. Assign a unique name to the calculated curve.



NOTE

Depending on the selected curve, only certain measured values can be used as input quantities. With some formulas, you can use constant values.



Figure 2-14 Listing of All Predefined Formulas



2.6.5 Voltage stability curves

The list **Voltage stability curves** contains all measuring points in the power system with which voltage stability curves can be calculated using the application VSC.



Figure 2-15 Listing of All Measuring Points for Calculation of the VSCs



2.6.6 Statistics

6 statistical values which can be displayed as diagrams are gathered for each PMU:

Count of received errors

Number of errors received per parameterizable counting period.

Count of received frames

Number of telegrams that are transmitted from the PMU to the SIGUARD PDP Server per counting period (for example, 600).

Count of telegram errors

Number of the PMU status flags contained in each telegram.

• Count of timestamp errors

Number of errors with deviation from the regularity of timestamps per repetition rate.

• Count of timestamp window error

Number of errors with deviation of timestamps per time slot (tolerance). The deviation can lie in the past or in the future.

• Latency

Measurement of maximum latency. The latency is the time difference between the sending of the measured values from the PMU to the arrival at the SIGUARD PDP Server.



NOTE

Take note that the absolute latency is analyzable only if the PDP Server is time-synchronized. If the server is not time-synchronized, you can only observe the difference between latencies of different PMUs.



Figure 2-16 Listing of Statistical Measured Values



2.7 Alarm List and Event List

2.7.1 Overview

SIGUARD PDP UI messages can be shown in the form of lists:

Alarm list

The Alarm list contains only appearing messages.

Event list

The event list contains all messages (appearing and disappearing messages).

The alarm list and the event list are opened in the lower right window section within SIGUARD PDP UI. The window can be separated and enlarged or inserted into another position in the SIGUARD program window (see *2.8 Arranging Program Interface*).

The alarm list or event list contains alarms or events that occurred in the time range that is set by the left and right limitation of the PSS curve.

2.7.2 Alarm List

Open a window for an alarm list in SIGUARD PDP by clicking the button

Alarm List									
Time -	Date	Name	Event element	Incidence	Message	^			
		-	-	-		1			
18:59:56.453	2010-09-21		Island Detection	ISD error	No Frequency Value Data Available				
18:59:46.406	2010-09-21	Rome	PMU Device	PMU device communication failure	create connection				
18:59:46.406	2010-09-21	Paris	PMU Device	PMU device communication failure	create connection	≡			
18:59:46.406	2010-09-21	Muelheim	PMU Device	PMU device communication failure	create connection				
18:59:46.406	2010-09-21	Munich	PMU Device	PMU device communication failure	create connection				
18:59:46.406	2010-09-21	Vienna	PMU Device	PMU device communication failure	create connection				
18:59:46.406	2010-09-21	Nuernberg	PMU Device	PMU device communication failure	create connection				
15:10:49.468	2010-09-21	Paris	PMU Device	PMU device communication failure	create connection				
15:10:49.468	2010-09-21	Vienna	PMU Device	PMU device communication failure	create connection				
15:10:49.468	2010-09-21	Nuemberg	PMU Device	PMU device communication failure	create connection				
15:10:49.468	2010-09-21	Rome	PMU Device	PMU device communication failure	create connection				
15:10:49.468	2010-09-21	Muelheim	PMU Device	PMU device communication failure	create connection				
15:10:48.937	2010-09-21		No Element	License Error	Missing license for enhanced PDC / ISD				
16:45:54.000	2010-09-20	MlhM/400/NbgH/f	Channel	Limit Low 2 violated	value 49.87 Hz				
16:45:53.900	2010-09-20	VieR/400/BlnW/U2	Channel	Limit Low 1 violated	value 379981 V				
16:45:53.880	2010-09-20	Rome/400/PalL/I3	Channel	Limit High 1 violated	value 1200.4 A				
16:45:53.880	2010-09-20	Rome/400/MadS2/I3	Channel	Limit High 1 violated	value 1200.4 A				
16:45:53.880	2010-09-20	Rome/400/VieR2/I3	Channel	Limit High 1 violated	value 1200.4 A				
16:45:53.880	2010-09-20	Bome/400/MadS1/I3	Channel	Limit High 1 violated	value 1200 4 A	¥			

Figure 2-17 Alarm list

The alarm list is comparable to an EXCEL table. It contains the following columns:



Element	Explanation
Time	Point in time at which the warning indication was tripped in hours:min- utes:sec 1/1000 (time stamp). The warning indications can be sorted ac- cording to time rising or falling, by clicking the heading Time with the left mouse button. The column is always shown.
Date	Date of tripping the warning indication in the format: Year-Month-Day (for example, 2010-09-21)
Name	Name of the physical PMU or the measuring channel that triggered the warning indication.
Event element	Element that triggered the warning indication (for example, PMU device, Channel, Island Detection, or Power Swing Recognition)
Incidence	Description of the event (for example, Limit Low 1 violated (limiting value shortfall) or PMU device communication failure or License Error)
Message	Additional information (for example, size of the measured value: Value 379981 V , since the lower limiting value 1 of 380 000 V was undercut).

Table 2-5	Parameters	of the Alarm list

For notes on editing the Alarm list, see 2.7.4 Editing of Messages.

2.7.3 Event List

Open a window for an event list in SIGUARD PDP UI by clicking the button

Event List							×
Time 👻	Date	Name	Event element	Incidence	Transition	Message	^
		-	-	-			
11:58:54.000	2011-07-05	Job CphS MlhM	Power Swing Re	PSR distinct pow	disappearing	Distinct power swing	
11:58:53.000	2011-07-05	Job CphS MlhM	Power Swing Re	PSR notified pow	appearing	Notified power swing	
11:58:52.000	2011-07-05	Job CphS MlhM	Power Swing Re	PSR distinct pow	appearing	Distinct power swing	
11:58:51.921	2011-07-05	ISD1	Island Detection	ISD potential net	appearing	Potential network split	
11:58:51.734	2011-07-05	ISD1	Island Detection	ISD potential net	disappearing	Potential network split	
11:58:48.421	2011-07-05	ISD1	Island Detection	ISD potential net	appearing	Potential network split:	
11:58:46.015	2011-07-05	ISD1	Island Detection	ISD potential net	appearing	Potential network split	
11:58:45.640	2011-07-05	ISD1	Island Detection	ISD potential net	disappearing	Potential network split	
11:58:45.046	2011-07-05	ISD1	Island Detection	ISD potential net	appearing	Potential network split	
11:58:44.953	2011-07-05	ISD1	Island Detection	ISD potential net	disappearing	Potential network split	=
11:58:44.234	2011-07-05	ISD1	Island Detection	ISD potential net	appearing	Potential network split	
11:58:44.156	2011-07-05	ISD1	Island Detection	ISD potential net	disappearing	Potential network split	
11:58:44.015	2011-07-05	ISD1	Island Detection	ISD potential net	appearing	Potential network split	
11:58:43.812	2011-07-05	ISD1	Island Detection	ISD potential net	disappearing	Potential network split	
11:58:42.921	2011-07-05	ISD1	Island Detection	ISD potential net	disappearing	Potential network split:	~

Figure 2-18 Event list

A horizontal line marks the current point in time (offline operation). Events which lie in the future (from the point of view of the current time cursor) are colored gray.

The time cursor (horizontal line) can be moved. Select the corresponding row and call up the context menu **Move > locator**.

The event list is comparable with an EXCEL table. It contains the following columns:



Element	Explanation
Time	Point in time at which the event indication was tripped in hours:min- utes:sec 1/1000 (time stamp). The event messages can be sorted ac- cording to time rising or falling. The column is always shown.
Date	Date of tripping the event indication in the format: Year-Month-Day (for example, 2010-09-21)
Name	Name of the physical PMU or the measuring channel that triggered the event indication.
Event element	Element that triggered the event indication (for example, PMU device, Channel, Island Detection, or Power Swing Recognition)
Incidence	Description of the event (for example, Limit Low 1 violated (limiting value shortfall) or PMU device communication failure or License Error)
Transition	Display whether an appearing or disappearing event indication is upcom- ing.
Message	Additional information (for example, size of the measured value: Value 379981 V , since the lower limiting value 1 of 380 000 V was undercut).

Table 2-6 Parameters of the Event list

For notes on editing the event list, see 2.7.4 Editing of Messages.

2.7.4 Editing of Messages

For a better overview of the alarm list and the event list, the table can be edited.

Editing Columns

Hiding columns

All columns with the exception of the column **Time** can be hidden. Open the context menu in the header. Only marked headers are displayed (shown).

Column sequence

You can move individual columns by dragging the header horizontally to another place in the table, thereby changing the column sequence.

Change column widths

All columns can be changed widthwise by dragging the column edge.

Sorting According to Column Contents

The alarm list and the event list can only be sorted according to time (rising or falling). For this, click the header of the column **Time**.

Filtering According to Column Contents

In the column **Name**, **Event element** (Element that triggered the alarm) and **Incidence** (event) are available in the selection lists according to whose parameters the lists can be filtered.

Copying the Contents of Lists

Select a line and press **<CTRL-A>**, in order to select all lines, and **<CTRL-C>**, in order to copy lines into the clipboard. Open the corresponding application (for example, Microsoft Word Pad) and press **<CTRL-V>**, in order to copy the contents of the clipboard into the file.



2.8 Arranging Program Interface

You can arrange the **Program Interface** of SIGUARD PDP according to your needs. You can display all window sections in one window or distribute it across several windows.

The window sections **Menu**, **Toolbar**, and **PSS Curve** make up the main window, and they can be opened only once.

The window sections **Chart View**, **Event list**, **Alarm list**, and **PSRs** can be opened several times. The window section **SIGUARD PDP UI - Map** can be opened only once.

All Window Sections in One Window

In the initial start of SIGUARD PDP UI, the PSS curve is displayed in the main window. Further components can be opened with a click on the symbols on the top left. The components, for example, the map and lists, are also inserted into the main window.



Figure 2-19 All Window Sections in One Window

Window Sections on Several Monitors

When using **2 Monitors** you can distribute the window sections between these, for example, in 2 windows. But you can also display window sections on additional monitors.

You can distribute window sections between 2 windows as follows:

- Select a window section, for example, the map, with the mouse and drag it out from the main window to the second monitor.
- Drag additional window sections into the window on the second monitor.



♦ Arrange the window sections in both windows according to your needs.

The desired display is shown in the 2 windows. You can place the 2 windows in 2 monitors.



Figure 2-20 Main Window with Chart View

							x
Siguard PDP Map			× Event List:2				×
N 10 10 10 10 10 10 10 10 10 10 10 10 10	1 a 🔍 🔍 🛛	🔁 Legen	d Time	 Date 	Name	Event element	^
			100		-		-
at i			17:23:00.500	2010-10-22	MlhM/400/NbgH	Channel	
	- otel		17:23:00.400	2010-10-22	MlhM/400/NbgH	Channel	
	- Hartin		17:23:00.234	2010-10-22		Island Detection	
	, Dat	0	17:23:00.234	2010-10-22		Island Detection	
	- Martin	TO PE	17:23:00.234	2010-10-22		Island Detection	
Sela a	Ber	lin	17:23:00.234	2010-10-22		Island Detection	
		Callenge - Callenge	17:23:00.000	2010-10-22	MlhM/400/NbgH/f	Channel	
and the second second	Mulheim		17:23:00.000	2010-10-22	MlhM/400/NbgH/f	Channel	
			17:23:00.000	2010-10-22	NbgH/400/BlnW	Channel	=
Paris	Nur	nberg	17:23:00.000	2010-10-22	NbgH/400/BlnW	Channel	
	Munich	Wien	17:23:00.000	2010-10-22	NbgH/400/VieR	Channel	
1-12	Per-		17:23:00.000	2010-10-22	NbgH/400/VieR	Channel	
1		不可以也	17:23:00.000	2010-10-22	NbgH/400/VieR	Channel	
	and the second second	Che I The	17:22:59.625	2010-10-22		Island Detection	
and a substitution		A CONTRACTOR	17:22:59.625	2010-10-22		Island Detection	
A COMPANY	A Star	1 the	17:22:59.453	2010-10-22		Island Detection	
CHARLES		Barrie	17:22:59.453	2010-10-22		Island Detection	
and and and	- Eline	Rome	17:22:59.453	2010-10-22		Island Detection	
1 and			17:22:59.453	2010-10-22		Island Detection	
1 3 1		SF. Pre-	17:22:59.360	2010-10-22	ParG/400/NbgH	Channel	
100 1 1	mage © 2010 Terra	Metricsermo	17:22:59.360	2010-10-22	ParG/400/Rome	Channel	~
488 km		Aller	<	III			>

Figure 2-21 Second Window with Map and Event List



Save User Interface

When closing, SIGUARD PDP UI saves the current display of the program interface as a favorite with the designation **StartUpFavorite**. When reopening, the program interface of SIGUARD PDP is shown in the saved display.

You can also save additional displays as Favorites.

You can save a display as a favorite as follows:

♦ Click in the toolbar on the icon **Save Favorite**.

The Save Favorite dialog is opened.

Siguard PDP	- Save Favorite		×
Favorite Name	Favorit_1		
		Save	Cancel

Figure 2-22 Enter Name for Favorites

♦ Give the favorite a name and close the dialog with Save.

The favorite is saved under the name entered.



NOTE

The following are not saved in the favorite:

- The list of measuring points under Selected measurements.
- The calculated values generated and displayed by a predefined formula (under Predefined formulas).

Call up Saved User Interface

You call up a saved user interface as follows:

♦ Select the desired user interface under Favorite name.

The saved user interface is displayed.

Deleting a Saved User Interface

To delete a saved user interface, proceed as follows:

♦ Select the desired user interface under Favorite name.

The saved user interface is displayed.



NOTE

A deleted user interface cannot be restored after deletion.

♦ In the toolbar, click the icon **Delete Favorite**.



2.9 Limit Editor

In the **Limit Editor**, you define the limiting values/thresholds that are to play a role in the evaluation. All configured measuring points are listed.

The limiting values/thresholds can be defined in the tool **SIGUARD PDP Engineer**, see 4.4 Phasor Measurement Unit (PMU).

Starting Limit Editor

Start the Limit Editor as follows:

♦ In the window section Chart View, click the top left button

You can enter limiting values for all measuring points and subsequently change them (see 2.5 Chart View).

3 minimum and 3 maximum values are possible for each measuring point. Enable the limiting values to ensure that they are effective. Measuring points for which no limiting values are effective are not considered when calculating the system status (Power System Status).

🕻 Limit Editor		_	_		_		_		_		_		_		×
Show All														[14
Measurement name	Туре	Unit		Min3		Min2		Min1		Max1		Max2		МахЗ	^
NbgH/400/BlnW-Alpha/I1	Phasor	A		0		0		0		1300		1500		0	1
NbgH/400/BlnW-Alpha/I2	Phasor	A		0		0		0		1300		1500		0	
NbgH/400/BlnW-Alpha/I3	Phasor	A		0		0		0		1300		1500		0	
NbgH/400/BlnW-Beta/I1	Phasor	A		0		0		0		1300		1500		0	
NbgH/400/BlnW-Beta/12	Phasor	A		0		0		0		1300		1500		0	
NbgH/400/BlnW-Beta/13	Phasor	A		0		0		0		1300		1500		0	
NbgH/400/MlhM/l1	Phasor	A		0		0		0		750		950		0	
NbgH/400/MlhM/12	Phasor	A		0		0		0		750		950		0	1
NbgH/400/MlhM/13	Phasor	A		0		0		0		750		950		0	1_
VieR/400/BlnW//U1	Phasor	V		0		360000		380000		420000		430000	<	440000	1
VieR/400/BlnW//U2	Phasor	V		0		360000		380000		420000		430000	<	440000	L
VieR/400/BlnW//U3	Phasor	V		0		360000		380000		420000		430000		435000	
VieR/400/BlnW//I1	Phasor	A		0		0		0		1300		1500		0	
VieR/400/BlnW//l2	Phasor	A		0		0		0		1300		1500		0	
VieR/400/BlnW//I3	Phasor	A		0		0		0		1300		1500		0	
MchP/400/NbgH/U1	Phasor	V		0		360000		380000		420000		430000	✓	440000	
MchP/400/NbgH/U2	Phasor	V		0		200000		210000		240000		250000	✓	260000	
MchP/400/NbgH/U3	Phasor	V		0		360000		380000		420000		430000		440000	
MchP/400/NbgH/I1	Phasor	A		0		0		0		750		850		0	
MchP/400/NbgH/12	Phasor	A		0		0		0		750		950		0	
MchP/400/NbgH/13	Phasor	A		0		0		0		750		950		0	
MIhM/400/NbgH/U1	Phasor	V		0		380000		390000		405000		410000		440000	
MIhM/400/NbgH/U2	Phasor	V		0		380000		390000		405000		410000		0	
MIhM/400/NbgH/U3	Phasor	V		0		380000		390000		405000		410000		0	~
									-						
										Save limits		Close	J	Cancel	

Figure 2-23 Limit Editor, Definition of the Limiting Values

Entering Limiting Values

♦ Set the parameters for the limiting values.

6 columns are available for entering the limiting values:

• Min1, Min2, Min3

In these columns, enter the lower limiting values/threshold. **Min3** is the lower/most critical value. **Min1** is the upper/least critical value.

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• Max1, Max2, Max3

In these columns, enter the upper limiting values/thresholds. **Max1** is the lower/least critical value. **Max3** is the upper/most critical value.

Copying Limiting Values and Activations

Copy limiting values and activations as follows:

- While keeping the left mouse button pressed, select the limiting values and activations by dragging with the mouse.
- ♦ Right-click in the selection and select Copy from the context menu.
- Right-click the cell, which corresponds to the upper left corner of the area to be inserted, and select **Paste** from the context menu.

Effect of limiting values:

- The limiting values affect the coloring in the geographical overview display in Google Earth. The color of the stations indicates whether the voltages have violated limiting values. The color of the lines indicates whether the currents have violated limiting values.
- The limiting values are drawn into the line and vector diagrams.
- The limiting values influence the status of the curve in the **PSS Curve** window section.

Setting Options/Displays

♦ Make settings in the Limit Editor with the help of the buttons and selection lists.

The following table explains the setting options and displays of the Limit Editor.

Table 2-7 Limit Editor Window Section

Element	Explanation
All measurements Selected measurements All measurements Application data Statistics	 Use this element to select which measuring points are to be listed: Selected measurements The measuring points preselected in the map are listed. All measurements All measuring points are listed. Application data for example, data from power swing recognition (PSR) Statistics Measured values from the PMUs
3	Click this element to activate changed limiting values in the overall system. The Limit Editor is closed.
50,05	Enter the limiting value and enable it by checking it. Subsequently, ac- tivate the changes.
Save limits	Click this element to activate changed limiting values in the overall system. The Limit Editor is closed.
Close	Click this element to save the changes locally and to exit the Limit Editor. The changes are only effective on the local computer.
Cancel	Click this element to discard the changes and to exit the Limit Editor.



2.10 Reporting

In order to document an event, diagrams can be stored in the clipboard and inserted from there, for example, into Microsoft Word.

Copying a Diagram into the Clipboard

You can copy a diagram into the clipboard as follows:

- ♦ Right-click the diagram in the Chart View window section.
- Select Copy to Clipboard ... from the context menu.

Export in Metafile	×
Size of Metafile	
Width in cm: 13,4	
(Minimum-)Height in cm: 7.9	
OK Cancel	

Figure 2-24 Export to metafile

♦ Enter the image size and click OK to confirm.

Export Values

You can export the measured values of the time range selected with the sliders from the SIGUARD Archive into a **CSV file**. Then edit this CSV file further with a spreadsheet program.

You export measured values into a CSV file as follows:

- ♦ Switch to offline mode.
- ♦ In the window section **PSS Curve**, set the desired time range with the sliders.
- ♦ Select the menu item File > Save to CSV....
- ♦ Enter the file name in the dialog Save Csv.
- ♦ Click Save.

The measured values are exported into a CSV file. The path and the directory were defined during the installation of SIGUARD PDP.



NOTE

Note that it may not be possible to process the file with common spreadsheet programs if it contains more than 255 columns and more than 65,536 lines. For each phasor, you need 3 columns; for each analog value, you need 2 columns, plus an additional column for the time stamp. 65,536 lines amount to 1 h 39 min at 10 values per second or 21 min at 50 values per second.

You can determine the quality of the measured values from the CSV file, see the following example.



TimeStamp	MihM/400/NbgH/df/dt	MihM/400MbgH/df/dt.qual	MihM/400/NbgH/f	MihM/400/NbgH/f.qual	MihM/400MbgH/11.val	MihM/400AbgH/11.deg	MihM/400AbgH/11.qual	MihM/400MbgH/i2.val
Wed Mar 25 11:54:40:900 2009	-0.002033		49.999756		876	-24.165001	нı∨	874
Wed Mar 25 11:54:41:000 2009	-0.002219		49.999798		890	-24.365999	H1V	890
Wed Mar 25 11:54:41:100 2009	-0.001661		49.999779		906	-24.479	н1∨	905
Wed Mar 25 11:54:41:200 2009	-0.001533	DAI	49.999832	DAI	917	-24.656002	DAI	917
Wed Mar 25 11:54:41:300 2009	-0.001403	DAI	49.999847	DAI	930	-24.820999	DAI	929
Wed Mar 25 11:54:41:400 2009	-0.000914	DAI	49.999859	DAI	940	-24.98	DAI	937
Wed Mar 25 11:54:41:500 2009	-0.000575	DAI	49.999908	DAI	945	-25.242001	DAI	943
Wed Mar 25 11:54:41:600 2009	-0.000183	DAI	49.999943	DAI	951	-25.341002	DAI	947
Wed Mar 25 11:54:41:700 2009	-0.000025	DAI	49.999981	DAI	950	-25.565001	DAI	949
Wed Mar 25 11:54:41:800 2009	0.000533	DAI	49.999996	DAI	949	-25.689001	DAI	946
Wed Mar 25 11:54:41:900 2009	0.000517	DAI	50.000053	DAI	945	-25.886	DAI	942
Wed Mar 25 11:54:42:000 2009	0.001019	DAI	50.000053	DAI	937	-25.926001	DAI	935
Wed Mar 25 11:54:42:100 2009	0.000994	DAI	50.000103	DAI	929	-26.150002	DAI	926
Wed Mar 25 11:54:42:200 2009	0.001164	DAI	50.000099	DAI	917	-26.210001	DAI	916
Wed Mar 25 11:54:42:300 2009	0.001242	DAI	50.000118	DAI	906	-26.438002	DAI	905
Wed Mar 25 11:54:42:400 2009	0.001203	DAI	50.000126	DAI	893	-26.596001	DAI	891
Wed Mar 25 11:54:42:500 2009	0.001178	DAI	50.000122	DAI	880	-26.712999	DAI	878
Wed Mar 25 11:54:43:700 2009	-0.001817	ERR	49.999817	ERR	844	-29.075003	ERR H1 V	843
Wed Mar 25 11:54:43:800 2009	-0.001839	ERR	49.999817	ERR	856	-29.294003	ERR H1 V	854
Wed Mar 25 11:54:46:100 2009	0.000225	NSY	50.000046	NSY	848	-32.864998	NSY H1V	846
Wed Mar 25 11:54:46:200 2009	0.000097	NSY	50.000023	NSY	839	-33.021	NSY H1V	838

Figure 2-25 Extract from a CSV Export File



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Abbreviation	Meaning	Source of the quality code
COE	PMU communication error	SIGUARD PDP Server
СТО	Collector time-out	SIGUARD PDP Server
SC1	Time synchronization 1	PMU
SC2	Time synchronization 2	PMU
COC	Configuration change	PMU
TGR	Transfer trigger	PMU
CLF	Time error	PMU
NSY	PMU not synchronized	PMU
ERR	PMU error	PMU
DAI	PMU data invalid	PMU
DAM	PMU data missing	PMU
OOS	Out of service	SIGUARD PDP Server
L3V	Limit violation Minimum 3	SIGUARD PDP Server
L2V	Limit violation Minimum 2	SIGUARD PDP Server
L1V	Limit violation Minimum 1	SIGUARD PDP Server
H1V	Limit violation Maximum 1	SIGUARD PDP Server
H2V	Limit violation Maximum 2	SIGUARD PDP Server
H3V	Limit violation Maximum 3	SIGUARD PDP Server
DNF	Data not found in archive	SIGUARD PDP Server
PCE	Calculation library error	SIGUARD PDP Server
ADI	Application data invalid	SIGUARD PDP Server
DAS	Data suspect	SIGUARD PDP Server

 Table 2-8
 Significance of the Quality Code in an Exported CSV File

2.11 Applications

2.11.1 Overview

In SIGUARD PDP UI, various applications can be executed:

- Island Detection in Networks (ISD)
- Recognition of swings in the network (PSR)
- Display of Voltage Stability Curve (VSC)

The configuration and parameter assignment of individual applications is done in SIGUARD PDP Engineer, see *4.7.1 Overview*.

2.11.2 Island State Detection (ISD)

Island detection in SIGUARD PDP uses the measured values present in every PMU **Frequency** (f) and **Frequency Changing Speed** (df/dt).

2 component applications are present:

Static Island Detection

Here, all frequency values are compared with one another. 3 different conditions are distinguished:

- If the difference between 2 frequency values lies below one of the lower limiting values, no islanding is detected.
- If the difference between at least 2 neighboring frequency values lies between the lower and upper limiting values, potential islanding is reported. This notification can be understood as a warning indication.
- If the difference of at least 2 neighboring frequency values lies above an upper limiting value, then, with sufficient certainty, islanding is detected and a corresponding notification is generated. This notification can be understood as a warning indication.

Dynamic Island Detection

Here, all rates of frequency change are compared with one another. 2 conditions are distinguished here:

- If the difference between at least 2 neighboring values of the rate of frequency change lies under the limiting value, then there is no islanding.
- If the difference between at least 2 neighboring values of the rate of frequency change lies above a limiting value, then islanding is possibly present or is in the process of arising. This notification can be understood as a warning indication.

For the parameter assignment of the application **Island State Detection**, see 4.7.2 *Island State Detection* (*ISD*).



Display of Island Detection in the Event or Alarm List

All notifications generated by SIGUARD PDP ISD are to be found in the event list. When potential or certain island formations are detected, corresponding entries are written into the alarm list.

ľ	Alarm List					
	Time 👻	Date	Name	Event element	Incidence	Message
			-	Island Detecti 🔽	-	
I	11:35:14.900	2011-09-14	ISD1	Island Detection	ISD potential net	Potential network subsplit: ZONE=1 SUBZONE
	11:35:14.900	2011-09-14	ISD1	Island Detection	ISD network split	Network split: ZONE=1 f=49.54 ParG/400/Nbg
1	11:35:14.700	2011-09-14	ISD1	Island Detection	ISD potential net	Potential network split transition: ZONE=1 df/dt
Ì						
1						
l						

Figure 2-26 Alarm List, Filtered according to the Event Element Island Detection

In the filtered alarm list, the detected islands are displayed with the event **ISD network split** or **ISD potential network split**. An **ISD network split** in the **Message** column of which Zone 1, Zone 2 and Zone 3 are entered is a definite event for island detection. This means that 3 islands were detected.



NOTE

The displayed values in the respective ISD event for frequency und frequency increase are averages of the PMU values over a time constant given in the SIGUARD configuration file. Consequently, they deviate from the respective PMU values on the measuring time point given in the ISD event. Moreover, if several PMUs or frequency measuring points lie in a zone, then a further averaging of its average values occurs.



Display of Island Detection on the Map

Various colored areas corresponding to the number of recognized islands are displayed on the map. If only one substation is contained in the island, then the area around the substation is displayed as a square. If there are several substations, then the area is displayed as a polygon with the substations as corners.

The colored display correlates with the colors of the Chart Views (1st island = orange, 2nd island = blue, 3rd island = green, etc.).

You can find further information on parameterization in chapter 4.7.2 Island State Detection (ISD).



Figure 2-27 Map with Detected Islands



2.11.3 Power Swing Recognition

A detected active-power swing is displayed in various window sections at the user interface (UI):

Display of the Power Swing Recognition on the Map

If a power swing measured in terms of angle difference is present, the locations of the 2 PMUs involved are circled and the connection line is inserted between them (see connection Mülheim – Nürnberg in the following figure). If a power swing measured in terms of active power is present, then the PMU where the measurement was made is present is marked with a circle (see Copenhagen in the following figure). The color of the icon matches the color in the previous figure.



Figure 2-28 Power Swings on the Map



Display of Power Swing Recognition in Power Swing Analysis

All notifications generated by SIGUARD PDP PSR can be found in the event list. Corresponding entries are written in the alarm list in the case of recognized power swings.

I	Alarm List					
1	Time 👻	Date	Name	Event element	Incidence	Message
			-	Power Swing 🔽		
	14:42:27.000	2011-09-14	PSR Job MIhM N	Power Swing Re	PSR distinct power swing	f = 00.83 Hz A = 0000.11 W deg z = $\cdot 0.053$
	14:42:26.000	2011-09-14	PSR Job CphS M	Power Swing Re	PSR notified power swing	f = 00.81 Hz A = 00021679656 W deg z = -0.0
1						

Figure 2-29 Alarm List Filtered According to the Event Element Power Swing Recognition

In the filtered alarm list, the recognized power swings are displayed with the corresponding event.

All jobs configured with SIGUARD Engineer and their corresponding modes are listed in the window section-**Power swing analysis**. Picked up modes are displayed with icons identified by colors. The colors of the icons correspond to the color in *Figure 1-10*.

Power Suize Applusis							
Power Swing Recognition overview							
▼ ▼ <u>IQ</u>							
••••••••••••••••••••••••••••••••••••••							
DSD Job CobS MIM Mode 1 0 8 1 2Hz							
PSR Job CphS Minim Mode 1 0.0-1.2Hz							
PSR 300 CphS Minin Mode 2 0.03-0.1312							
PSR Job CphS Minim Mode 3							
- A Phaceungle							
PSP Job MbM NbaH Made 1 0 8-1 2Hz							
Frequency							
Magnitude							
Damping ratio							
PSR Job MIbM NbgH Mode 3							
PSR Job Mihm NbgH Mode 4							
▼● PSR Job MlhM Rome delta phi							
PSR Job MIhM Rome Mode 1 0.8-1.2Hz							
PSR Job MlhM Rome Mode 2 0.05-0.15Hz							
PSR Job MihM Rome Mode 3							
PSR Job MlhM Rome Mode 4							

Figure 2-30 Interface Components for Power Swing Analysis



Element	Explanation			
Power Swing Recognition overview	Click the element and drag it into a Chart View in order to generate a PSR Overview .			
	Click this element in order to close the entire PSR tree structure.			
~	Click this element in order to open the first hierarchy of the PSR tree structure.			
-	Click this element in order to open the entire PSR tree structure.			
ĒQ	Click this element in order to display the name of the measuring points in the PSR tree structure or switch to display of the parameter names again.			
0	Gray marking No power swing was recognized.			
<u>-</u>	Yellow marking (1) PSR notified power swing A recognized power swing was reported.			
9 2	Bright orange marking (2) PSR distinct power swing A distinct power swing was recognized and reported.			
.	Dark orange marking (3) PSR critical power swing A critical power swing was recognized and reported.			
•	Red marking (4) PSR undamped critical power swing An undamped critical power swing was recognized and reported.			

Table 2-9	Interface Components for Power Swing Analysis
	interface components for rower owing / marysis

Display of Power Swing Recognition in Power Swing Recognition Overview

Using drag and drop from the Power swing analysis, this diagram can be displayed in the **Chart View** window section. The diagram shows all recognized power swings for the current time point in the frequency damping diagram.





Display of the Input Curves in the Chart View

The input curves (active power or phase angle) and the quantities determined therefrom for a recognized mode (frequency, magnitude damping ratio and DOE) in the **Power Swing Analysis** window section can be displayed in the **Chart View** window section.



NOTE

Take note of the following:

- A separate license is required for the application PSR. If you have not purchased a PSR license, then this application cannot be run.
- In order to avoid an overload of the server, control the computing time needs of PSR.exe, before you define other PSR jobs. You can observe the computing time needs in percent on the **Processes** tab of the Windows Task Manager. The application should not consume more than 50 % of the calculation module (approx. 12.5 % for a four-ore processor).
- A patent is pending for the algorithms of the PSR.

You can find further information on parameterization of the PSR in chapter 4.7.3 Power Swing Recognition PSRs.

2.11.4 Voltage Stability Curve (VSC)

SIGUARD PDP offers the option to calculate and output a voltage stability curve (P-V curve) in the SIGUARD PDP UI.

2 different modes are supported:

- Measurement of the voltage stability curve of a line with a PMU at the beginning and end, respectively (voltage and current measurement)
- Measurement of the voltage stability curve of a line with a PMU at the beginning of the line (voltage and current measurement) and the associated 2-port parameters.

If the line is equipped with only one PMU, the 2-port parameters of the line (Resistance R [Ω], Reactance X [Ω], Conductance G [μ S], and Susceptance B [μ S]), are used for the calculation of voltage and current at the end of the line, see following illustration.



Figure 2-32 2-Port Equivalent Circuit of the Transmission Line

- (1) R = Resistance
- (2) X = Reactance
- (3) G = Conductance
- (4) B = Susceptance



The current load admittance is calculated with the measured or calculated voltages and currents in the endpoint node of the line. The corresponding line load is represented as an operating point on the curve (red cross) (see following illustration). The voltage stability curve itself arises through variation of the complex load admittance in the endpoint node of the line from zero to infinity. The recalculation of the curve is performed with each update of the SIGUARD PDP UI.



Figure 2-33 Example of a Voltage Stability Curve

All parameterized voltage stability curves (VSCs) are listed in the lower right window section in SIGUARD PDP UI under **Applications - Voltage stability curves**. By dragging a voltage stability curve, for example, **MIhM - NbgH**, with the mouse into the window section **Chart View** beneath the timing diagram, the voltage stability curve is displayed (see 3.3 *Displaying Curves*).

A red cross marks the current operating point. In the figure above, the critical point is nearly reached. With minimally higher power, the stability criteria are violated and a network disconnection can result.



NOTE

If controllable reactive power sources are present in the endpoint node of the line or in its vicinity, the curve shape of the voltage stability curve is not constant, rather it varies with the degree of the reactive power fed in. Therefore no quantitative statement can be gained from the diagram as to how much additional transferable power can be transported via the line. Nonetheless, a qualitative evaluation of the voltage stability curve is help-ful, as it allows the user the option of evaluating the distance to maximum power.

For the parameter assignment of the voltage stability curves, see 4.7.4 Voltage Stability Curve (VSC).





3 Working with SIGUARD PDP UI

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3.1 Sample Event

A simple example is given to illustrate the handling of SIGUARD PDP.

In this example, a time range is selected from the archive that is displayed as critical in the **PSS Curve** window section. The essential curves for this time range are to be displayed and analyzed. The analysis is performed in **offline mode**. The goal of the analysis is to find out why the PSS curve keeps going into the red range.

Procedure

The suggested procedure is to illustrate the individual steps for examining and assessing an event.

Proceed as follows:

- Select the time range in which the event to be examined is found.
- Display the essential curves to the event.
- Export the time range into the permanent archive.
- Import the time range from the permanent archive.
- Create and print a report.



3.2 Selecting the Time Range

The analysis of a time interval can only be performed in **offline mode**. In offline mode, the information from the devices is still stored in the archive and can later be viewed and analyzed.

In the window section **PSS Curve**, select the time range you want to display and analyze.

You can see the temporal progression of the selected range in the window section SIGUARD PDP UI - Map.

Switch on Offline Mode

Click the Go offline button to set Offline mode.

The following figure shows the status curve with several critical ranges. These are displayed in red.



Figure 3-1 Power System Status, Curve with Critical Ranges

Selecting the Time Range

- ♦ Set the length of the visible time range with the list box 10 Minutes
- ♦ Scroll with the arrows to the desired location in the archive.
- ♦ Move the sliders on the time line to the desired points using the mouse.

The time range between the sliders is represented in the diagrams.

The selected time range is displayed in the **From** and **To** boxes.



Figure 3-2 Power System Status, Selecting the Time Range



3.2 Selecting the Time Range

Starting the Sequence

- \diamond Click the button \square in order to position the cursor at the left edge of the selected time range.
- \diamond Click the button $\boxed{}$ in order to run the time range.

On the map (**SIGUARD PDP UI - Map** window section), you can see the projected sample project. It consists of 4 substations/measuring points and associated high-voltage lines. The coloring of the objects changes, depending on the state at different instants.

The default object coloring is **blue**. An exceedance of the first limiting values is displayed in **yellow**, a violation of the second limiting value is displayed in **red**.

In the figure, the line between the measuring points **Mülheim** and **Paris** is clearly critical. The cause is to be found below.



Figure 3-3 SIGUARD PDP UI - Map, Following the Progression

Stop Sequence

♦ Click the button to stop the sequence.

Selecting a Specific Instant

♦ In the selected time range, click on a point to display the state at this instant.

On the map, you see the objects colored depending on the state at this instant.



3.3 Displaying Curves

Map with Objects

In the **SIGUARD PDP UI - Map** window section, you see a map with the power-supply system inserted. The power-supply system consists of objects, for example, generators and lines. You can display **tooltips** for the individual objects. Furthermore, a **legend** is available.

Display Tooltips

You can call tooltips for the individual objects on the map. Measured values are displayed for the respective objects.

- ♦ Click the [★] button to display tooltips.
- ♦ Place the cursor over an object to display the tooltip.

The available information on the object is displayed.



Figure 3-4 SIGUARD PDP UI - Map, Display Tooltip



Showing the Legend

The objects of the map and their coloring are described in a legend.

♦ Click the Legend button to display it.

The legend is shown.



Figure 3-5 SIGUARD PDP UI - Map, Display Legend

For further information on the objects in the map, see 2.4 Map

Selecting Objects

On the map, select the objects for which you want to display curves.

♦ Click the key button.

In the SIGUARD PDP UI - Maps window section, select an area around the objects for which you want to perform an analysis.

The selection is shown.





Figure 3-6 SIGUARD PDP UI - Map, Select Objects

♦ In the right side of the window, click the arrow above **Measurements**, **Applications**, **Formulas**.

The list of measured values is displayed.

The measured values available for the selected objects are listed in **Selecting Measurements**. In the next step, you can display curves for these measured values.

✓ Selected measurements						
Name	Туре	Unit	RefPhasor	I		
CphS/400/BlnV//I1	Phasor	А		lea		
CphS/400/BlnVV/12	Phasor	A		ĩ		
CphS/400/BInVV/I3	Phasor	A		e		
CphS/400/BInVV/U1	Phasor	V		IEn		
CphS/400/BInW/U2	Phasor	V		ts,		
CphS/400/BInW/U3	Phasor	V		음		
CphS/400/MlhM/1	Phasor	A		Đ,		
CphS/400/MlhM/l2	Phasor	A		Ca		
CphS/400/MlhM/I3	Phasor	A		E.		
CphS/400/MlhM/U1	Phasor	V		S.L		
CphS/400/MlhM/U2	Phasor	V		B		
CphS/400/MlhM/U3	Phasor	V		1		
CphS/400/NbgH/f	Analog	Hz		8		
				Ē.		
► All measurements						
Predefined formulas						
Voltage stability curves						
► Statistics						

Figure 3-7 Measurements, Listed Measured Values



Zoom in on the Map Section

You can enlarge the display of a map section. Details of the power-supply system are visible in the enlarged display. For example, multiple lines become visible that have previously only been represented as one single line.

The details are only displayed if they have been previously parameterized.

♦ Click the button to zoom in on the map section.

The map is displayed in an enlarged form.



Figure 3-8 SIGUARD PDP UI - Map, Enlarged Map Section

 \diamond Click the Solution to undo the enlargement.



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Displaying Curves

You can now represent the available measured values as curves in diagrams.

To analyze the event, create the following charts:

- A timing diagram with currents
- A vector diagram with voltages
- A diagram with a voltage stability curve
- ♦ In the Chart View window section, click the ^L button to generate a blank line diagram.
- Drag and drop 2 measured currents with the mouse pointer, for example, NbgH/I1 and MIhM/I1, to the generated diagram.

You can select several measured values in the list and simultaneously drag them into a diagram.

These measured values are current phasors of the measuring points Nuremberg and Mülheim. The timing diagram represents the time characteristic of the absolute current values, but not their phase.

As a time range, the time range selected in **PSS Curve** is displayed in the window section.



Figure 3-9 Timing Diagram, Currents

The figure shows considerable changes of the amperage and damped oscillations. The amperage changes are caused by connecting and disconnecting a heavy load. The oscillations indicate a power swing.

Create a diagram with voltage phasors for further examination.

In the Chart View window section, you can scroll down to insert and display further diagrams.

Drag and drop a voltage phasor, for example, NbgH/U1, to the Chart View window section below the timing diagram.

A vector diagram with a voltage vector is displayed.

♦ In addition, drag and drop a voltage phasor, for example, MIhM/I1, to the vector diagram.





Figure 3-10 Vector Diagram, Voltages

The vector diagram shows the characteristics of the phase angles of the voltages, that is whether there is a phase displacement and how large this difference is. Furthermore, it can be seen whether the phase between the voltages increases or decreases or remains the same. This enables you to derive, for example, whether 2 generators oscillate against each other.

A voltage stability curve can provide additional information.

The voltage stability curves are listed in Applications.

Drag and drop a voltage stability curve, for example, MIhM -> NbgH, to the Chart View window section below the timing diagram.

A diagram with the voltage stability curve is displayed.



Figure 3-11 Diagram with Voltage Stability Curve

The voltage stability curve displays the voltage over the power at a specific instant. In the figure, the critical point has almost been reached. If the power was slightly higher, stability criteria would be violated and a disconnection could occur.


Displaying Measured Values in the Diagram

The measured values can only be displayed in the offline mode.

- ♦ Move the mouse pointer over the diagram.
- ♦ In the context menu, select Show measure line > <Measured value>.



Figure 3-12 Showing a Measuring Line (Horizontal Line)

A horizontal line is shown in the color of the diagram. The current measured value is displayed at its intersection with the diagram. In the time line, the date and time of day are shown for the cursor position.

♦ In the context menu, select **Show second cursor**.



3.3 Displaying Curves



Figure 3-13 Showing a Second Cursor (Vertical Line)

A second cursor (gray vertical line) and an additional horizontal measuring line are shown. At the intersection with the diagram, the difference from the first measured value is displayed. In the time line, the time difference from the first measured value is displayed at the position of the second cursor.

Displaying Average Values of a Diagram

The average value can be generated only for line diagrams.

♦ Display a curve, for example:



Figure 3-14 Diagram without Smoothing Average Generation



♦ In the context menu, select Show average value.



Figure 3-15 Diagram with Smoothing Average Generation

The line diagram is displayed smoothed. The name of the measuring point is followed by [Avg] (average).



Hiding the Map

Click the X in the upper right of the window SIGUARD PDP UI - Map to hide the map. The display of the Chart View window section is enlarged.

You can also pull the component **Chart View** out of the main window and position and zoom in anywhere on the desktop.



Figure 3-16 Chart View, Hidden Map



Changing Limiting Values

The limiting values can be shown and edited to the right of the diagram.

- ♦ Above the diagram, double-click a measured value to display its limiting values.
- ♦ Change a limiting value.



Figure 3-17 Changed/Configured Limiting Value

The old limiting values are displayed as a tooltip. After changing a limiting value, the background of the limiting value is displayed in orange.

♦ Click the is button to save and activate the changed limiting value.

The background of the limiting value becomes blue.



Opening the Limit Editor

 \diamond Open the Limit Editor by clicking the $\stackrel{\checkmark}{\simeq}$ button.

🍟 Limi	t Editor													_ ■ >
Show	Selected measurements													111
Measurer	nent name	Туре	Unit		Min3		Min2		Min1		Max1	Max2		Max3
CphS/40)/BinW/I1	Phasor	A		0		0		0		1200	1400		0
CphS/40	0/BlnW/12	Phasor	A		0		0		0		1200	1400		0
CphS/40	3/BinW/13	Phasor	A		0		0		0		1200	1400		0
CphS/40	3/MI6M/11	Phasor	A		0		0		0		1200	1400		0
CphS/40	0/MIhM/12	Phasor	A		0		0		0		1200	1400		0
CphS/40	0/MIhM/13	Phasor	A		0		0		0	$\mathbf{\mathbf{\overline{v}}}$	1200	1400		0
CphS/40	J/MIhM/U1	Phasor	V		0	$\mathbf{\mathbf{v}}$	360000		380000		420000	430000		440000
CphS/40	J/MIhM/U2	Phasor	V		0	\checkmark	360000	$\mathbf{\mathbf{\overline{v}}}$	380000	$\mathbf{\mathbf{\overline{v}}}$	420000	430000		440000
CphS/40	J/MIhM/U3	Phasor	V		0	\checkmark	360000	$\mathbf{\mathbf{\overline{v}}}$	380000	\checkmark	420000	430000		440000
CphS/40)/BinW/U1	Phasor	V		0	\checkmark	360000	$\mathbf{\mathbf{\overline{v}}}$	380000	$\mathbf{\mathbf{\overline{v}}}$	420000	430000	\checkmark	440000
CphS/40)/BinW/U2	Phasor	V		0	$\mathbf{\mathbf{v}}$	360000	$\mathbf{\mathbf{\overline{v}}}$	380000	$\mathbf{\mathbf{\overline{s}}}$	420000	430000	$\mathbf{\mathbf{\overline{v}}}$	440000
CphS/40)/BinW/U3	Phasor	V		0	$\mathbf{\mathbf{v}}$	360000	$\mathbf{\mathbf{\overline{v}}}$	380000	$\mathbf{\mathbf{\overline{v}}}$	420000	430000	$\mathbf{\mathbf{\overline{s}}}$	440000
CphS/40	J/NbgH/f	Analog	Hz		0	$\mathbf{\mathbf{v}}$	47.5		49	$\mathbf{\mathbf{\overline{v}}}$	51	52.5		0
	Save limits Close Cancel													

Figure 3-18 Limit Editor

It lists all measured values with the associated limiting values. You can change and enable/disable the limiting values.

- ♦ Enter new limiting values.
- ♦ Activate the changed limits with a check.
- ♦ Activate the changed limiting values by selecting Save Limits.

The Editor is exited.

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Using Predefined Formulas

A number of predefined formulas are available in **Formulas**. These formulas can be applied to measured values.

Use predefined formulas as follows:

♦ Drag and drop the desired formula, for example, ActivePower, in the Chart View window section.

A dialog is displayed in which you have to enter the parameters necessary for the new curve.

100				
90				
80				
70	Formula : Active power (two inpu	ts)		
50	Measurement name : Enter re:	suli name		
40	_ Measurement 1 [Phasor, ∀]:	drag & drop measurement		
30	Measurement 2 [Phasor, A]:	drag & drop measurement		
20 10	Factor :	Enter value		
D				
	15 30 Fri 10/22/2010 17:48	45	15 Fri 10/22/2010 17:49	30 45

Figure 3-19 Inserting a Predefined Formula

- ♦ In Measurement name, enter any name for the new curve.
- Drag and drop measuring points (voltage phasor and associated current phasor) from the Measurements window section to the Measurement 1 and Measurement 2 text boxes.
- ♦ In Factor, enter a decimal value.

The curve is multiplied with this value. Typically this Value is 1. When calculating power this factor can deviate since it depends on the measurement (phase-to-phase voltage or phase-to-ground voltage).



Figure 3-20 Entering Parameters for Formula

♦ After entering the last parameter press the key Enter on the keyboard.

The diagram with the calculated curve is displayed.





Figure 3-21 Diagram with Calculated Curve



3

3.4 Export and Import of Time Ranges

3.4.1 Exporting of Time Ranges

In SIGUARD PDP UI, measured data are continuously saved in a ring archive. If the ring archive is full, earlier measured data are overwritten and are lost. To prevent this, time ranges and the measured values contained in them are saved in a permanent archive. These data can also be loaded again and are available for evaluation purposes.

Additionally, time ranges and the measured values contained in them can be saved in CSV format (commaseparated value). This format can, for example, be opened in a spreadsheet and further processed.

Importing is not possible here. However, a CSV export from a permanent archive can be performed.

Proceed as follows:

Permanent Saving as Time Ranges

Select the menu File > Save time range....

The Save time range dialog is displayed.

SIGUARD PDP UI - Save Time range 🛛 🗙 🗙								
Time range	Time range							
Locator left	13:27:00:000 18:08:2011							
Locator right	13:36:22:000 18:08:2011							
	Save							

Figure 3-22 Save Time Range Dialog

The beginning point in time **Locator left** and the final point in time **Locator right** are automatically displayed in the dialog and cannot be changed.

Changing the time range is possible only in the **PSS Curve** window section.

- In the Time range entry field, enter the name of the time range (for example, TimeSlice_01) that you want to save.
- ♦ Click the button Save, to save the time range.

The time range is possibly stored as several files and directories.



NOTE

Saving can last several minutes even though the window has already been closed. The amount of time required for saving depends on the amount of the data that must be written in the permanent archive, and on the length of the time range you have selected.



3.4 Export and Import of Time Ranges

Saving Time Ranges in CSV Format

♦ Select the menu File > Save to Csv....

The Save Csv dialog is displayed.

SIGUARD PDP UI - Save Csv 🛛 🗙 🗙								
File name	Time range.csv							
Locator left	13:27:00:000 18:08:2011							
Locator right	13:36:22:000 18:08:2011							
	Save Cancel							

Figure 3-23 Dialog Save Csv

The beginning point in time **Locator left** and the final point in time **Locator right** are automatically displayed in the dialog and cannot be changed.

Changing the time range is possible only in the PSS Curve window section.

- ♦ Enter the file name in the entry field File name.
- ♦ Click the button Save, to save the time range in CSV format.

The export directory is on the server and was defined during the installation. From a UI, you can also find the directory under the path **\\<servername>\SIGUARD_Export** in order to copy or further process the export files.



NOTE

Saving can last several minutes even though the window has already been closed. The amount of time required for saving depends on the amount of the data that must be written in the permanent archive, and on the length of the time range you have selected.



3.4.2 Importing Time Ranges

Time ranges can be selected again and are available for evaluation again. They are no longer loaded into the ring archive.

Loading Time Ranges

♦ Select the menu File > Load time range....

The Load time range dialog is displayed.

SIGUARD PDP UI - Load Time range 🛛 🗙 🗙							
Available time ranges							
Name	Date From	Date To					
Time range Time range 01	13:27:00:000 18:08:2011 13:30:19:000 18:08:2011	13:36:23:000 18:08:2011 13:32:59:000 18:08:2011					
Time range 02	13:30:19:000 18:08:2011	13:32:59:000 18:08:2011					
	13.30.13.000 16.06.2011	13.32.33.000 16.06.2011					
		Ok Cancel					

Figure 3-24 Load Time Range Dialog

All available time ranges are displayed with name, start, and end time in a list format. The size of the window can be changed.



NOTE

The time range is not displayed in the list, until the export from the ring archive into the permanent archive has finished completely.

- ♦ Select the time range that you would like to view/evaluate.
- ♦ Confirm your selection by clicking the **OK** button.

The loaded time range with the corresponding measured values is displayed in the **PSS Curve** window section.

You can leave this display from the permanent archive by selecting new data from the permanent archive or by displaying current values in online Mode.



3.4.3 Deleting Time Ranges

Time ranges and the measured values contained in them, which were saved in the permanent archive can be deleted selectively.

Deleting a Time Range

♦ Select the menu File > Delete time range....

The **Delete time range** dialog is displayed.

SIGUARD PDP UI - Delete	Time range	×
Available time ranges		
Name	Date From	Date To
Time range	13:27:00:000 18:08:2011	13:36:23:000 18
Time range 01	13:30:19:000 18:08:2011	13:32:59:000 18
Time range 02	13:30:19:000 18:08:2011	13:32:59:000.18
Time range 03	13:30:19:000 18:08:2011	13:32:59:000 18
<	ш	>
	Delete	Cancel

Figure 3-25 Delete Time Range Dialog

All available time ranges are displayed with name, start, and end time in a list format. The size of the window can be changed.

♦ Select the time range that you would like to delete.



NOTE

Time ranges can only be deleted individually.

Deleted time ranges cannot be restored.

♦ Confirm your selection by clicking the **Delete** button.

The time range with the corresponding measured values is deleted and the dialog is closed.



3.5 Conclusion from the Analysis

The analysis of the sample event leads to the following result:

- The PSS Curve is in the red range due to exceeded current limiting values, see Figure 3-1.
- The cause for the exceedance is the periodic connection of a high load.
- The periodic connection of a high load causes power oscillations that are well damped, see Figure 3-21.
- The current limiting value is briefly exceeded, see *Figure 3-9*.
- So that undesired protection trips do not arise, the protection settings of the line must be checked.



3.6 Creating and Printing Reports

Using the **Copy to Clipboard** function, you can create, save, and print reports. To do this, insert the diagrams, for example, into Microsoft Word and comment on them.

- ♦ Right-click the diagram in the Chart View window section.
- ♦ Select Copy to Clipboard ... from the context menu.

Export in Metafile	×				
Size of Metafile					
Width in cm: 13,4					
(Minimum-)Height in cm: 7,9					
OK Cancel					

Figure 3-26 Settings for the Metafile

- ♦ In the next dialog, enter the image size and confirm with **OK**.
- ♦ Open a blank document or a self-prepared report template using the text editor.
- ♦ Use <CTRL> + <V> to insert the clipboard contents into the document.
- ♦ Open the event list or the alarm list.
- Select the relevant messages (click them individually or select them with Ctrl-A) and copy the messages with Ctrl+C into the clipboard.
- ♦ Insert the events or alarms into the document with Ctrl+V.
- ♦ Add your own text as comments. For this, use the default settings of the text editor.
- ♦ Save the document and print it.



4 SIGUARD PDP Engineer

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4.1 Overview

Application of SIGUARD PDP Engineer

SIGUARD PDP Engineer is the parameterizing and settings tool for SIGUARD PDP. You can set up and change the function of SIGUARD PDP with it. The following tabs are available for editing:

• PMU

Add, duplicate, change, or delete physical and logical PMUs.

Adding or changing measuring points for existing or new PMUs.

Calculation

Add, duplicate, change, or delete calculated values.

Assign parameters of calculated values with factor and formula that uses the input measured values from the measured and calculated values.

Graphics

Add, duplicate, or delete elements for graphical representation of power-supply systems. Use of Google Earth functions.

Application

Adding, duplicating, deleting, and parameterization of various applications:

- Voltage Stability Curve (VSC)
- Island State Detection (ISD) in networks
- Swing recognition in networks (Power Swing Recognition PSR)

Communication

Adding, duplication, deletion, and parameterization of communication via various interfaces:

- C37.118

Creation of PDC server and logical PMUs and configuration of the measuring channels

- ICCP

Parameterization of the communication settings, assignment and parameterization of measuring points and assignment of event objects.

- OPC

Parameterization of the OPC servers and assignment and parameterization of the measuring points.

Installation

The tool **SIGUARD PDP Engineer** is available on DVD and is installed on the target computer together with SIGUARD PDP UI (see *Administrator Manual, System installation*).

Program Window

The main window of **SIGUARD PDP Engineer** is composed of the following window sections:

Menu							
Toolbar	Toolbar						
Tabs							
Overview	Parameter / Properties	Lists					
Error messag	es / Information						
	Ļ						





NOTE

You can change the individual windows sections in the direction of the arrow by dragging the boundary line.

Menu

Via the menu you call up general functions (see 4.2 Menu).

Via the toolbar you call up functions, which can be used within a project (see 4.3 Toolbar).

Toolbar

Tabs

Via the tabs you select various configuration and parameterizing options.

Depending on the selected tab, corresponding window sections and functions are available to you (see 4.4 Phasor Measurement Unit (PMU) to 4.8.4 OPC).

Overview

In the left window section, the tree structure of the existing elements for the selected tab are shown.

Parameters/Properties

In the middle window section, the parameters and/or properties of the selected element are shown.



Lists

In the right window section, lists are shown depending on the selected tab (for example, measured and calculated values or element types).

• Error messages after Validation

In the lower window section, **Project validation - Errors** error messages are shown based on the validation, for example:

- Info (tab name): Description
- Error (tab name): Error description

For further information, see 4.9 Shared Functions.

Current error messages

For every element that is marked with a warning symbol, 🙂 a quick info (tooltip) can be shown. Point to the element with the cursor. The quick info contains the element type and a description of the error that has appeared.

For further information, see 4.9 Shared Functions.



4.2 Menu

Each menu consists of the following parts:

Menu Group Project

Within the menu group **Project**, you can call up the following functions:

Project > New...

Creates a new project.

Project > Open...

Open an existing project.

You can open only one project at a time. If you want to open another project or want to create a new one, you must close the Engineer.

Project > Save

Save changes to an existing project.

• Project > Validate

Tests a project for validation and shows information or any errors in the window section **Project validation Errors**.

Project > Print...

Prints all data of a project on your printer (also in PDF format).

• Project > Activate

Activates a project that has been edited, check for validation, and saved object for the runtime process.

Project > Exit

Close the open project.

If the project has not been saved yet, a security question is asked whether it should be saved prior to closing.

Menu Group Edit

Within the menu group Edit, you can call up the following functions, which are also implemented in the toolbar:

• Edit > Undo

Reverses an executed function.

Edit > Redo
 Restores a reversed function.



NOTE

You can reverse up to 500 changes.

Menu Group Help

Within the menu group **Help**, you can call up the following functions:

- Help > Engineer... Calls up the help function of SIGUARD PDP UI and SIGUARD PDP Engineer
- Help > About...
 Gives information about the program version of SIGUARD PDP Engineer

4.3 Toolbar

Buttons

Executes the following functions via the buttons on the toolbar:

Table 4-1 Toolbar of SIGUARD PDP Engineer

Element	Explanation
*	Click the button New , in order to create a new project.
7	Click the button Open , in order to open an existing project.
	Click the button Save , in order to save changes to an existing project.
	Click the button Validate , in order to check the opened project for valida- tion.
3	Click the button Undo , in order to reverse an executed function.
C	Click the button Redo , in order to restore a reversed function.
	Click the button Print in order to print all data from a project.
\mathbf{z}	Click the button Activate , in order to activate a project that has been edited, tested for validation, and saved for the runtime process.

4.4 Phasor Measurement Unit (PMU)

The following prerequisites must be fulfilled to parametrize a PMU:

- An existing project or a new project must be open.
- The tab **PMU** must be selected.

Tab PMU Is Selected

When you have selected the tab PMU, the layout for adding and editing physical and logical PMUs is shown.

<		ected PMU det	ails																
	PMI	J device name	Munich		PMU device	ID 30													
Nuemberg	IP a	ddress	192.168	3.0.109	Port	4730													
Vienna	Rep	orting rate	10	-	Timeout	2		-	sec										
Muelheim	Con	munication type	tcp																
Paris Rome		Name		PMU dev name	Log PMU ID	Index	Type	1	Jnit	An	chive	Nominal	Min3	Miná		Min1	1	Max1	Max2
	•	MchP/400/Nbp	H/U1	Munich	31	1	Phasor		1	-		400000	0	3600	00 🔽	380000		420000	430000
		MchP/400/Nbg	H/U2	Munich	31	2	Phasor	Ψv	1	-		400000	0	2000	00 💽	210000		240000	250000
		MchP/400/Nbg	H/U3	Munich	31	3	Phasor	- v	/	-		400000	0 (3600	00 E	380000		420000	430000
		MchP/400/Nbg	H/I1	Munich	31	5	Phasor	- 4	.	-		500	0 [0	E	0		750	850
		MchP/400/Nbg	H/12	Munich	31	6	Phasor	- 4		-		500	0 [0	E	0		750	950
		MchP/400/Nbg	H/13	Munich	31	7	Phasor	- 4	۱.	-		500	0 [0	E	0		750	950
		MchP/400/Nbg	H/ł	Munich	31	1	Analog	۲ ا	łz			50	0	49.9		49.95		50.05	50.1
		MchP/400/Nbg	H/df/dt	Munich	31	2	Analog	۲ -	lz/s	-		0	0 [0	E	0		0	0
		MchP/400/Nbg	H/SST1	Munich	31	1	Digital	-		-		0	0 [0	E	0		0	0
		MchP/400/Nbg	H/SST2	Munich	31	2	Digital	-		-		0	0 [0	E	0		0	0
		MchP/400/Nbg	H/SST3	Munich	31	3	Digital	-		-		0	0 [0	E	0		0	0
		MchP/400/Nbg	H/ET1	Munich	31	4	Digital	-		-		0	0 [0		0		0	0
		MchP/400/Nbg	H/ET2	Munich	31	5	Digital	-		-		0	0 [0		0		0	0
		MchP/400/Nbg	HALS	Munich	31	6	Digital			-		0	0 [0		0	0
		MchP/400/Nbg	H/AT	Munich	31	/	Digital			-		0	0 0					0	0
		McnP/400/Nbg	HZLETT	Munich	31	8	Digital	Ě.		-		0	0 0			0		0	0
		McnP7400/Nbg	H/Wam	Munich	31	3	Digital			_		0	0 [0		0	0
		McnP/400/Nbg	H/Alarm	Munich	31	10	Digital	<u> </u>				U	0 (0		0		U	U

Figure 4-2 Selected Tab PMU

• Available PMUs

In the left window section, the overview of all available PMUs in the directory All PMUs is shown.

• Selected PMU details

In the middle window section, the parameter data of the selected PMU is shown. If no PMU is created or selected this window section is colored gray.

In the upper part the parameters of the selected PMU are shown, and in the lower part the measuring points created for this PMU are shown in a table.



SIGUARD PDP Engineer

4.4 Phasor Measurement Unit (PMU)

Functions

The following functions can be performed when the tab **PMU** is selected:

Table 4-2	Functions for PMUs

Element	Explanation
*	Click the button New , in order to create a new, physical PMU in the marked directory All PMUs or a logical PMU within a marked physical PMU.
	Click the button Duplicate , in order to duplicate either a marked, physical PMU with the same name and subordinated logical PMUs or a marked logical PMU.
×	Click the button Delete , in order to delete either a marked logical PMU or a marked physical PMU with all subordinated, logical PMUs.

Parameters of a Physical PMU

When you have selected a physical PMU in the window section **Available PMUs**, the following right window section is displayed.

💐 SIGUARD PDP Engineer Pi	roject: "Testnet"								
Project Edit Graphics									
達 🔁 🔒 🖓 🔊 (연 📑 🗄	2								
PMU Calculation Graphics Application Communication									
Available PMUs	Available PMUs Selected PMU details								
📑 🖹 🗙	PMU device name	Munich		PMU device I	D 30				
All PMUs	IP address	192.168	3.0.109	Port	4730				
Vienna	Reporting rate	10	-	Timeout	2		sec		
Communication type top									
► 📘 Paris	L 19		Dut I	L DUULD			1.1.2		
▶… 🔛 Rome	Name	_	PMU dev name	Log PMU ID	Index	Type	Unit	An	
	MchP/400/Nbg	pH/U1	Munich	31	1	Phasor -	v	-	
	MchP/400/Nbg	gH/U2	Munich	31	2	Phasor 🖣	v	-	
	MchP/400/Nbg	gH/U3	Munich	31	3	Phasor -	v	-	

Figure 4-3 Parameters of a Physical PMU

In the following table, the setting options of the properties/parameters of a physical PMU are explained.

Table 4-3 Parameters of a Physical PMU

Element	Explanation
PMU device name	The name of the physical PMU can be selected freely, for example: <i>Munich</i> Note Ensure that all names in the overall system are unique, so that messages in the event and alarm list can be assigned uniquely. The uniqueness is checked in the framework of the validation.
PMU device ID	ID of the connected, physical PMU The data must be inherited from the configuration of the physical PMU. for example: <i>30</i>
IP address	IP address of the connected, physical PMU The data must be inherited from the configuration of the physical PMU, for example: <i>192.168.0.109</i>
Port	Port to which the physical PMU is connected. The data must be inherited from the configuration of the physical PMU, for example: <i>4712</i>



Element	Explanation
Reporting rate	Number of telegrams (frames) per second that are transferred from the physical PMU.
	The data must be inherited from the configuration of the physical PMU.
	You can set the value via a list box from 10 frames/second up to 60 frames/second.
	If the value does not agree with the configuration of the physical PMU, an error message appears and no transfer takes place.
Timeout	Time in secs how long a delayed telegram from the PMU was waited for.
Communication type	You can select the type of communication tcp or udp via a list box.
UDP port	Display only in case of selected type of communication udp , for example: <i>4713</i>

Further information can be found in the bibliography under /1/.



NOTE

In case of missing or erroneous entry, the entry field is highlighted in red.

Parameters of a Logical PMU

When you have selected a logical PMU in the window section **Available PMUs**, the following right window section is displayed.

💐 🛛 SIGUARD PDP Engineer Pr	oject: "Testnet"						
Project Edit Graphics							
達 🔁 🔂 🖓 🖄 여기 📑 🖩	2						
PMU Calculation Graphic	a Application	Communication					
Available PMUs	Selected PMU det	ails					
📑 🖹 🗙	Logical PMU name	Munich DAU1	Logical PMU II	D 31			
- 🔁 All PMUs		192.168.0.109	Port	4730			
Vienna		10 💌		2			
Munich		tcp					
Muelheim	Name	PMU dev name	Log PMU ID	Index	Туре	Unit	Arc
i⊷ 🔛 Rome	MchP/400/Nbg	H/U1 Munich	31	1	Phasor 🔽	V	-
	MchP/400/Nbg	gH/U2 Munich	31	2	Phasor 💌	v	-

Figure 4-4 Parameters of a Logical PMU

In the following table, the setting options of the properties/parameters of a logical PMU are explained.

Table 4-4	Parameters of a Logical PMU
-----------	-----------------------------

Element	Explanation
Logical PMU name	The name of the logical PMU can be selected freely, for example: <i>Munich DAU1</i>
	Note
	Ensure that all names in the overall system are unique, so that messages in the event and alarm list can be assigned uniquely. The uniqueness is checked in the framework of the validation.
Logical PMU ID	ID of the connected, logical PMU. The data must be inherited from the configuration of the physical PMU, for example: <i>31</i>



4.4 Phasor Measurement Unit (PMU)



NOTE

The remaining parameter fields are not active (colored gray).

Editing Measuring Points

Add measuring points

In order to add a measuring point, click in the last line of the column **Name**. Enter a name for the new measuring point. An additional blank line is inserted, by which a further measuring point can be defined.

The name **PMU device** of the physical PMU and the **Logical PMU ID** are automatically entered. The parameters **Index**, **Type**, and **Unit** make an entry according to the configuration of the physical PMU. Add further parameters.

Copying/inserting measuring points

To copy measuring points, select one or several measuring points (lines) in the table and select the context menu **Copy**.

To insert copied measuring points, select the line at which it should be inserted and select the context menu **Paste**. As many lines, including the marked line, are always overwritten, as lines are inserted.

Column sequence

You can move individual columns by dragging the heading to another place in the table, and thereby change the column sequence.

Delete measuring points

To delete measuring points, select one or several measuring points (lines) in the table and press .



NOTE

Ensure that you create precisely those measuring points that the PMUs to be connected actually use in later operation. A comparison with the parameter data of the PMUs is recommended.



Parameters of a Measuring Point

For every logical PMU the created measuring points are displayed in window section under the PMU parameters in the form of a table. They can be edited only with a selected logical PMU.

All PMUs	Log	ecteu r mo uetalis																			
All PMUs	703	ical PMU name Munich	DAU1	Logica	I PMU IE	31]												
Nuemberg		ddress 192.16	8.0.109	Port		4730			ĩ												
Vienna		orting rate 10	-	Timeor		2] sec												
Munich		munication tune	_																		
Munich DAU1		interret () po																			
Paris	_	Name	PMU dev name	Log PMU ID	Index	Туре	U	nit	A	chive		Nominal		Min3	Min2	Min1	Max1		Max2	Max3	ľ
Home		MchP/400/NbgH/U1	Munich	31	1	Phasor	- V		-			400000		0	360000	380000	420000		430000	440000	1
		MchP/400/NbgH/U2	Munich	31	2	Phasor	- V		-			400000		0	200000	210000	240000	2	250000	260000	1
		MchP/400/NbgH/U3	Munich	31	3	Phasor	- V	_	-			400000		0	360000	380000	420000		430000	440000	1
		MchP/400/NbgH/11	Munich	31	5	Phasor	• A	_	-			500		0	0	0	750	2	850	0	1
		MchP/400/NbgH/12	Munich	31	5	Phasor	• A	_				500		0	0	0	750		950	0	1
		MchP/400/NbgH/13	Munich	31	1	Phasor		-	-			500		0	0	0.05	750		950	0	-
		McnP/400/NbgH/r	Munich	31	1	Analog	H	2				00		0	49.9	49.35	0.00	-	00.1	0	-
	H	MohP/400/NbgH/a/a/	Munich	21	1	Diatal		2/5				0		0	0	0	0	=	0	0	0
		McbP/400/NbgH/SST2	Munich	31	2	Digital	-		-		H	0	H	0	0	0	0	=	0	0	0
		McbP/400/NbgH/SST3	Munich	31	3	Digital	-		-			0		0	0	0	0		0	0	0
		MchP/400/NbgH/ET1	Munich	31	4	Digital	-		-		Ē	0	Ē	ů N	0	0	0		0	0	0
		MchP/400/NbgH/ET2	Munich	31	5	Digital	-		-		Ē	0	ī	0	0	0	0		0	0	0
		MchP/400/NbgH/LS	Munich	31	6	Digital	-		-			0		0	0	0	0		0	0	0
		MchP/400/NbgH/AT	Munich	31	7	Digital	-		-		ī	0		0	0	0	0		0	0	C
		MchP/400/NbgH/LET1	Munich	31	8	Digital	-		-			0		0	0	0	0		0	0	0
		MchP/400/NbgH/Wam	Munich	31	9	Digital	-		-			0		0	0	0	0		0	0	0
		MchP/400/NbgH/Alarm	Munich	31	10	Digital	-		-			0		0	0	0	0		0	0	0
	*						-		-												T

Figure 4-5 Parameters of the Measuring Points

In the following table, the setting options of the properties/parameters of the measuring points are explained.

Table 4-5	Parameters of the	Measuring Points

Element	Explanation
Name	The name of a measuring point can be selected freely, for example: <i>MchP/400/NbgH/U1</i>
PMU device name	Name of the physical PMU The data are automatically inherited, for example: <i>Munich</i>
Log PMU ID	ID of the logical PMU The data are automatically inherited, for example: <i>31</i>
Index	The index is a pointer to the protocol transferred from the PMU, in order to identify the corresponding measurement. The data must be inherited from the configuration of the physical PMU, for example: 7
Туре	The measurement type can be entered via a list box. Available types are: <i>Phasor, Analog,</i> or <i>Digital</i> .



4.4 Phasor Measurement Unit (PMU)

Element	Explanation
Unit	The unit of the measured value that is measured at this measuring point can be entered according to measurement type via a list box, for example: <i>A</i> for current, <i>V</i> for voltage, <i>W</i> for active power, <i>VA</i> for apparent power, <i>VAr</i> for reactive power, <i>Degree</i> for the phase angle, <i>Hz</i> for frequency, or <i>Hz/s</i> for the frequency changing speed.
Archive	If the check box is marked, the measured values at this measuring point are saved in the archive.
Nominal	Entry of the rated value of the value to be measured, for example: <i>400000</i> If the check box is selected, the rated value is included in the measure- ment.
Min1 Min3	Definition of up to 3 lower limiting values regarding the rated value, for example: <i>380000</i> , <i>360000</i> and <i>340000</i> .
Max1 Max3	Definition of up to 3 upper limiting values regarding the rated value, for example: <i>420000, 430000</i> and <i>440000.</i> If the respective check box is marked, the corresponding limiting value is included in the measurement.
Factor PSS	The PSS factor states the influence of the measurement on the PSS curve. The higher the PSS factor selected, the greater the influence on the PSS curve. Standard = 1

Saving a Project

The data of a project should be saved after every change or reconfiguration. You can even save a project when the validation is still not successful.



NOTE

After saving a project, newly created measuring points are entered into the list **Available measurements**; deleted measuring points are also deleted from this list.

For further information on saving a project, see 4.9 Shared Functions.

Validation

Current errors can be displayed in tooltips during entry. A complete validation takes place via the menu Project

> Validate or via the icon ^L. If error messages are displayed, re-edit the configuration. If the validation is free of errors, the project can be activated for the runtime process.

For further information on validating a project, see 4.9 Shared Functions.

Activation of a Project

After successful validation, an opened and saved project can be made available to the runtime process. This

takes place via the menu Project > Activate or via the icon

For further information on activating a project, see 4.9 Shared Functions.



4.5 Calculated Measurements

The following requirements must be satisfied for creating and editing calculated values:

- A project must be created or an existing project must be opened.
- The tab Calculation must be selected.

The Calculation Tab Is Selected

When you have selected the tab Calculation, the layout for adding and editing calculated values is displayed.



Figure 4-6 Selected Tab Calculation

Calculated measurements

In the left window section, the overview of all existing calculated values are shown in the directory **All cal**culated objects.

Selected calculated measurements

In the middle window section, the parameter data (Name, Factor, and Formula) of a selected calculated value is displayed.

Available measurements

In the right window section, all available values **Available measurements** are displayed with name, type, and unit, which are used for the input measurand of the formula.



4.5 Calculated Measurements

Functions

The following functions can be executed via buttons in the tree view when the tab **Calculation** and marked element are selected.

Element	Explanation
*	Click the button Create a new calculation , in order to create a new, cal- culated value in the marked directory All calculated objects .
	Click the button Duplicate a selected calculation , in order to duplicate a marked, calculated value for further editing.
×	Click the button Delete the selected calculation or press the key Delete , in order to delete a marked, calculated value.

Table 4-6	Eunctions for	Calculated	Values
		Galculatea	values

Parameters of a Calculated Value

When you have selected a calculated value in the window section **Calculated measurements**, the following middle window section is displayed.

Image: Sec: Sec: Sec: Sec: Sec: Sec: Sec: Se	💐 SIGUARD PDP Engineer Project: '	'Testnet''						-	чX
Image: Control of the product of t	Project Edit Graphics								
Intell Calculation Descent Section Construction Section Section Section Calculation Construction Section Section Section Calculation Construction Factor Factor Factor Calculation Mark Losses Night MM Calculation Diplet Brays Mark Losses Night MM Calculation Diplet Brays Mark Losses Night MM Calculation Diplet Brays Mark Mark Section Section Diplet Brays Mark Mark Diplet Brays Diplet Brays Mark Mark Diplet Brays Diplet Brays Mark Mark Mark Mark Diplet Brays Mark Mark Mark Mark Diplet Brays Mark Mark Mark Mark Mark Diplet	📑 🔁 📴 🗘 🏷 (H 📑 🔯 I								
Eductode excutaments Selected calculated measurements Available measurements Parts Fonds Fonds Calculated about Tops	PMU Calculation Graphics App	lication Communication							
Part Part Factor Factor Factor Refer Upper Upper Upper Image: Stand S	Calculated measurements	Selected calculated measurement				Available measurements			
• Concer Hogel MMM • Model Alberte Loarse: Hogel MMM • Concert Model Loarse: Hogel MMM • Concert Model • Preset/1 • Concert Loarse: Hogel MMM • Concert Hogel MMM • Concert • Preset/1 • Preset/1 • Concert • Preset/1	📑 🗏 🗙	Name	Factor	1	Formula	Name	Туре	Unit	^
	PHU Calculation Graphics App Calculated measurements Calculated measurements Calculated objects A calculated objects MIN4 (NoNHA) MIN4 (icelon Comunication Selected calculated measurement Name Cosee NbgH MihM Save results to archive	Factor 1	× [Formula Active power (six input:) P = ReV(1 * conj(13) + ReV(2* conj(2)) + ReV(3* conj(3)) Input messurements V McHP/400/NbgH/U1 A Imit/M-400/NbgH/U12 A Imit/M-400/NbgH/U13 A Imit/M-400/NbgH/U13 A Imit/M-400/NbgH/U13	Available measurements Name Losse Night MMM Mich? 4000/Night/Alam Mich? 4000/Night/Alam Night/4000/Night/Alam	Type Calculated Oigidal Oigidal Digidal Calculated Phasor Phaso	Unit W Bihagy Bihagy Bihagy Bihagy Bihagy Bihagy Bihagy Bihagy Bihagy Bihagy Bihagy Bihagy V V V V V V V V V V V V V	
								_	

Figure 4-7 Parameters of a Calculated Value

A calculated value consists of the **Name**, which is made up of the **Factor** and the **Formula**. In the following table, the setting options of the properties/parameters of the calculated values are explained.





Element	Explanation
Name	In this field, the name of the calculated value is entered, changed, or dis- played in the case of an existing value. The name can be selected freely. If no entry takes place a name is automatically assigned.
Factor	Multipliers for calculated values Only numerical entries with a period in the place of the comma are valid.
Formula	You can select various formula functions. For this, corresponding input measurand Input measurements are necessary, which can be defined via measured and calculated values.
Save results to archive	If the check box is marked, its value is saved in the archive. Saving is not necessarily required, since the value can also be recreated based on the input measurand. However, you must expect a longer retrieval time, since greater amounts of data must be retrieved from the archive.
Input measurements	Input measurand for the calculation that is assumed from the measured and calculated values Available measurements . For certain formulas, it is also possible to enter constants.

Table 4-7 Parameters of a Calculated Value



NOTE

Empty entry fields are highlighted in red. Enter a value.

Defining Calculated Values

If a newly created calculated value is not yet defined, for example, if no formula is stored, the list box is **undefined**.

Define a formula with the corresponding input measurands. The type of the calculated value is determined from the first input measurand (phasor, analog, or digital), and furnished with the corresponding unit in the overview, if the formula allows variable input measurands. Other formulas require input measurands of a precisely defined type.

Defining Formulas

The following formula functions are available.

Table 4-8 Overview of the Formulas for a Calculated Value

Element	Formula	Explanation
Active power (6 inputs)	P = Re{V1*conj(I1)} + Re{V2*conj(I2)} + Re{V3*conj(I3)}	Calculation of the active power with 6 input measurands
Active power (substation usage)	P = Re{(bb1*V1 + bb2*V2 + bb3*V3) *conj(I)}	Calculation of the active power, based on the busbar voltages (V1 to V3) and the current in the bay (i) while considering the position of the busbar disconnector (bb1 to bb3)
Active power (2 inputs)	P = Re{V*conj(I)}	Calculation of the active power with 2 input measurands
Add 2 analogs	x = a + b	Addition of 2 analog values
Add 2 phasors	X = A + B	Addition of 2 phasors (2 voltages or 2 currents, respectively)
Angle difference between 2 phasors	x = deg(A) - deg(B)	Calculation of the phase angle between 2 phasors



4.5 Calculated Measurements

Element	Formula	Explanation
Apparent power (6 inputs)	S = IV1*conj(I1)I + IV2*conj(I2)I + IV3*conj(I3)I	Calculation of apparent power with 6 input measurands
Apparent power (substation usage)	S = I(bb1*V1 + bb2*V2 + bb3*V3) *conj(I)I	Calculation of the apparent power, based on the busbar voltages (V1 to V3) and the current in the bay (i) while considering the position of the busbar disconnector (bb1 to bb3)
Apparent power (2 inputs)	S = IV*conj(I)I	Calculation of apparent power with 2 input measurands
Conductance from V and I	G = Re{[(V1*I1 - V2*I2) + (V1*I2 - V2*I1)] / (V2**2 - V1**2)}	Conductance G of a line through measurement of the voltage and current at the beginning and the end
Conjugate a phasor	X = conj(A)	Conjugation of a phasor (voltage or current)
Divide 2 analogs	x = a/b	Division of 2 analog values (num- bers)
Logical AND	x = AND(a,b)	Logical AND relation of 2 digital inputs
Logical NOT	x = NOT(a)	Logical inversion of a digital input
Logical OR	x = OR(a,b)	Logical OR operation of 2 digital inputs
Logical XOR	x = XOR(a,b)	Logical XOR operation of 2 digital inputs
Multiply 2 analogs	X = a*b	Multiplication of 2 analog values (numbers)
Negative sequence	Xneg = (A + a**2*B + a*C)/3	Calculation of system components negative-sequence system
Positive sequence	$Xpos = (A + a^*B + a^{**}2^*C)/3$	Calculation of system components positive-sequence system
Power factor	lambda = P/S = Re{V*conj(I)} / IV*conj(I)I	Calculation of the power factor from active power and apparent power and the input measurands voltage and current
Reactance from V and I	X = Im{1/Yq} = Im{V1**2 - V2**2) / (V1*I2 - V2*I1)}	Reactance X of a line through voltage and current measurement at the beginning and the end
Reactive power (6 inputs)	Q = Im{V1*conj(I1)} + Im{V2*conj(I2)} + Im{V3*conj(I3)}	Calculation of reactive power with 6 input measurands
Reactive power (substation usage)	Q = Im{(bb1*V1 + bb2*V2 + bb3*V3) *conj(I)}	Calculation of the apparent power, based on the busbar voltages (V1 to V3) and the current in the bay (i) while considering the position of the busbar disconnector (bb1 to bb3)
Reactive power (2 inputs)	Q = Im{V*conj(I)}	Calculation of reactive power with 2 input measurands
Resistance from V and I	R = Re{1/Yq} = Re{(V1**2 - V2**2) / (V1*I2 - V2*I1)}	Resistance R of a line through mea- surement of the voltage and current at the beginning and the end
Rotate a phasor	X = A * Power(e,x)	Rotation of a phasor
Scaling of analog	x = m * a + c	Scaling of an analog value a with the help of a gradient m and a con- stant summand c



Element	Formula	Explanation
Subtract 2 analogs	x = a - b	Subtraction of 2 analog values (numbers)
Subtract 2 phasors	X = A - B	Subtraction of 2 phasors (2 voltages or 2 currents, respectively)
Susceptance from V and I	B = Im{[(V1*I1 - V2*I2) + (V1*I2 - V2*I1)] / [V2**2 - V1**2)}	Susceptance B of a line through measurement of the voltage and current at the beginning and the end
Zero sequence	Xzero = (A + B + C)/3	Calculation of system components zero-sequence system

Allocate Input Quantities

Depending on the formula, a corresponding number of entry fields for the input measurands **Input measurements** are represented. Before each field, the type/unit of the measured or calculated value **Available measurements** is displayed, which must be routed to this field.

Example:

If, for example, a phasor is supposed to be multiplied by an analog value, then a phasor must be routed as the first input measurand. Only an analog value can be routed to the second input measurand. Other routings are not valid and cannot be executed.

Assuming Formulas

In case of duplicated calculated values, there are 2 possibilities for defining formulas and corresponding input measurands:

- Selection of a formula via the list box and reallocation of the input measurands from the measured and calculated values Available measurements
- Select the contents of the list box by double-clicking. This activates the group function and the selection
 of the formula can be performed via the keys
 Arrow up> or
 Arrow down>, where already existing input
 measurands are maintained and do not need to be rerouted.



NOTE

The old input measurands are only assumed if the list box is opened up and a function is selected with the same input types.

Saving a Project

The data of a project should be saved after every change or reconfiguration. You can even save a project when the validation is still not successful.

For further information on saving a project, see 4.9 Shared Functions.

Validation

Current errors can be displayed in tooltips during entry. A complete validation takes place via the menu Project

> Validate or via the icon . If error messages are displayed, re-edit the configuration. If the validation is free of errors, the project can be activated for the runtime process.

For further information on validating a project, see 4.9 Shared Functions.



4.5 Calculated Measurements

Activation of a Project

After successful validation, an opened and saved project can be made available to the runtime process. This

takes place via the menu **Project > Activate** or via the icon

For further information on activating a project, see 4.9 Shared Functions.



4.6 Graphical Representation of Power-Supply Systems (Graphics)

4.6.1 Overview

The following requirements must be met in order to create and edit graphical displays of networks:

- A project must be created or an existing project must be opened.
- The tab Graphics must be selected.

The Graphics Tab Is Selected

If the tab **Graphics** was selected, the layout for creating network graphics is displayed.



Figure 4-8 Selected Tab Graphics

• Elements

In the left window section, the overview of all elements already existing in the directory **root** are shown (for example, **Layer1** for the complete graphic or parts of a graphic and subelements for stations, lines, and others). The overview represents an organization of the graphical elements for a network.

• Graphics view

In the upper part of the middle window section, Google Earth is opened as a background. A network can be overlaid graphically over the map from the element types.



4.6 Graphical Representation of Power-Supply Systems (Graphics)

• Element properties

In the lower part of the middle window section, the properties of the marked element are displayed. The properties are divided into:

- General properties, tab Properties
- Properties of the coordinates, tab Coordinates
- Setting for the camera, tab Camera
- List of routed measurements, tab Measurements
- Element types

A library of graphical elements is shown in the upper part of the right window section. These elements are available for drawing a graphical network structure in the window section **Graphics view**.

Available measurements

In the lower part of the right window section, all available measurements **Available measurements** are shown with name, type, and unit, which are drawn on for the configuration of the element properties and produce a color according to the quality of the measured value.

Functions for Elements

The following functions can be executed for editing the elements via buttons.

Table 4-9	Functions for Elements

Element	Explanation		
*	Click the button New , in order to create a new graphic New layer in the directory root or an element in the marked graphics folder.		
	Click the button Duplicate , in order to duplicate an existing graphic or an existing graphic element. The graphic or the graphic element is inserted at the end of the respective group.		
×	Click the button Delete , in order to delete a graphic or graphic element.		
KML	Click the button KML, in order to import coordinates for a graphic element in KML format.		



Functions for Graphical Editing

The representation of a network on the map is comparable to a structure with 2 levels that lie on top of one another:

Google Earth level

Representation of the map with the corresponding Google Earth functions

User level

Representation of a network with the parameters that are defined in SIGUARD PDP Engineer in the tab **Graphics**.

The following functions can be performed for graphical processing of the elements in the window section **Graphics view** via buttons.



Figure 4-9 Interface for the Editing of Graphic Elements



4.6 Graphical Representation of Power-Supply Systems (Graphics)

Element	Explanation
<u> </u>	Click the button Navigate in map , to navigate within the map and use the functions of Google Earth.
Google Earth level	
*	 Click the button Drag mode, in order to define, or change the position of an element. Positioning Element Click the button Drag mode.
User level	 Select a layer in the tree structure under which the new element should be created. Select an element in the window Element types. Use drag and drop to pull the element to the desired position in Graphics view. The newly positioned element appears in the tree structure. For this, the properties under Properties can now be defined. Changing Element Position Click the button Drag mode. Select the element in the tree structure. Use drag and drop to pull the selected element to the new position in Graphics view. The graphical icon changes its position.
User level	Click the button Zoom to area , in order to select a rectangle, the contents of which are enlarged to the size of the window section.
Google Earth level	Click the button Zoom in , in order to gradually enlarge the map.
Coogle Earth level	Click the button Zoom out , in order to gradually scale down the map.
Coogle Latti level	

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4.6.2 Properties of the Elements

The parameter assignment of the properties of an element is distributed to the following tabs.

Properties

On the tab Properties, the following parameters are available.

Element prope	erties VieR		
Properties	Coordinates	Camera	Measurements
Internal name	VieR		
Displayed	Wien		
Displayed	WIGH		
Description	Substation	Vienna Ruthr	nergasse

Figure 4-10 Parameter Properties

Table 4-11 Parameters of the Tab Properties

Element	Explanation
Internal Name	Name of the element that is displayed in the overview (technical name)
Displayed	Name of the element that is displayed in the map (for example, Berlin)
Description	Description of the element

Coordinates

On the tab Coordinates, the following functions are available.



Figure 4-11 Parameter Coordinates



4.6 Graphical Representation of Power-Supply Systems (Graphics)

Element	Explanation
	Click the button Add Coordinate and into the map, in order to add a new
+	coordinate for this element. The new coordinate is inserted under the
	marked line.
	The parameters of a coordinate are shown in a table. Editing is not pos-
	sible here.
	• Longitude
	 Parameter for the geographical length in degrees (length in degrees). Latitude
	Parameter for the geographical width in degrees (width in degrees).
	Height
	Parameter for elevation over NN.
a	Click the button Change Coordinate, in order to change the position of
	an element.
	• Select the element in the tree structure, the position of which is to be changed
	Click the button Change Coordinate.
	The cursor appears as + - icon in Graphics view
	• Position the cursor on the new position and double-click the left mouse
	button.
	The new coordinates are assumed in the table.
	 Position to a new element and in order to fly to individual coordinates with the saved camera position. Double-click the element in the tree structure, the camera position of which (angle of view and elevation) is to be assumed. The selected camera position is displayed in Graphics view. Click the element in the tree structure for which the camera position (angle of view and elevation) is to be assumed. The previous coordinates are displayed. Click the button Fly to coordinate. The camera position (field of vision and elevation) is transferred to the new element and displayed in Graphics view.
	and the corresponding camera position displayed:
	 Select the coordinates and click the button Fly to coordinate. Double-click a coordinate (line).
	The camera position (field of vision and elevation) of the selected coor- dinates is displayed in Graphics view . During the start of the line, the camera elevation can be adapted via the Google function. The next operation of the button Fly to Coordinate will remember this.
x	Click the button Remove Coordinate, in order to delete a marked coor-
	dinate for this element.

Table 4-12Functions of the Tab Coordinates

Camera

The camera position is the way of viewing an element in Google Earth. The setting occurs via a double-click on the element and scrolling in horizontal or vertical direction.

On the tab **Camera**, the following functions for the configuration of the camera position of an element are available.

Element prop	erties NbgH			
Properties	Coordinates	Camera	Measurements	
Camera positio	n Se	et 📄	Clear	
1				

Figure 4-12 Settings for the Camera Position

Table 4-13 Functions of the Tab Came

Element	Explanation
Set	Click the button Set , in order to save the set camera position for an ele- ment. To display this camera position in Graphics view again, double-click the element in the tree structure.
Clear	Click the button Clear , in order to delete the set camera position for an element.

Measurements

On the tab **Measurements**, the measuring points are displayed which were defined for this element. In this way, a linkage of the graphic element to the measuring channels is created.

		Coordinates	Camera	Measureme	nts
	Measurem	ientName			MeasurementType
•	NbgH/400	/VieR-Alpha/	U1	F	Phasor
	NbgH/400	J/VieR-Alpha/	U2	F	Phasor
	NboH/400	WieB-Alnha/	113	8	0

Figure 4-13 Parameter Measurements



4.6 Graphical Representation of Power-Supply Systems (Graphics)

Element	Explanation
MeasurementName	Allocation of measuring points The measuring points are assumed from Available measurements into the column MeasurementName and thus are defined for this graphic el- ement. The quality of the measured values is responsible for the coloring of the elements in SIGUARD PDP UI. The measuring points cannot be edited here.
MeasurementType	Type of measuring point (for example, phasor, analog, or digital mea- sured value and, calculated analog or digital measured value).

Table 1 11	Eurotiona of t	ha Tah Ma	oouromonto
1able 4-14	Functions of t	ne lad we	easurements

In order to delete measuring points, select a measuring point (line) and click the corresponding button

4.6.3 Element Types

In the upper right window section, **Element types** of the tab **Graphics** various types of elements are available to you for the creation of a graphical network structure.

Element types	
Layer Substation PMU Generator Compensator Line (5 pixel) Line (3 pixel)	

Figure 4-14 Overview of the Element Types

 Table 4-15
 Functions of the Tab Measurements

Element	Explanation
Layer	Folder for graphic elements
Substation	Element for a Station
PMU	Element for a Phasor Measuring Unit (PMU)
Generator	Element for a current generator
Compensator	Element for a Static Var Compensator SVC
Line (5 pixel)	Element for a thick line (collective representation of parallel systems)
Line (3 pixel)	Element for a thin line (individual line)



Saving a Project

The data of a project should be saved after every change or reconfiguration. You can even save a project when the validation is still not successful.

For further information on saving a project, see 4.9 Shared Functions.

Validation

Current errors can be displayed in tooltips during entry. A complete validation takes place via the menu Project

> Validate or via the icon . If error messages are displayed, re-edit the configuration. If the validation is free of errors, the project can be activated for the runtime process.

For further information on validating a project, see 4.9 Shared Functions.

Activation of a Project

After successful validation, an opened and saved project can be made available to the runtime process. This

takes place via the menu Project > Activate or via the icon

For further information on activating a project, see 4.9 Shared Functions.



4.7 Applications

4.7.1 Overview

For configuring and assigning parameters of applications, the following requirements must be met:

- An existing project or a new project must be open.
- The tab Application must be selected.

The Application Tab Is Selected

When you have selected the tab Application, the layout for adding and editing applications is displayed.

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PMU Calculation Graphics Application Communication				
Existing applications	Available measurements			
* E ×	Name	Туре	Unit	^
	CphS/400/BlnW//I1	Phasor	A	
	Cph5/400/BinW/12 Cph5/400/BinW/13	Phasor Phasor	A	
	CphS/400/BlnW/U1	Phasor	V	
	CphS/400/BinW/U2 CphS/400/BinW/U2	Phasor		1.
	CphS/400/MIhM/I1	Phasor	Å	
	CphS/400/MIhM/12	Phasor	A	
	CphS/400/MihM/U1	Phasor Phasor	Ŷ	
	CphS/400/MlhM/U2	Phasor	V.	
	CphS/400/MIhM/U3 CohS/400/NhoH/dt/dt	Phasor	V Hz/s	
	CphS/400/NbgH/f	Analog	Hz	
	MINM < NbgH	Calculat	Degree	
	Mihm/400/NbgH/dr/dr	Analog	Hz	
	MlhM/400/NbgH/I1	Phasor	A	
	MihM/400/NbgH/12 MihM/400/NbgH/13	Phasor Phasor	A	
	MlhM/400/NbgH/P	Calculat	W	
	MIM/400/NbgH/U1 MIM/400/NbgH/U2	Phasor	V.	
	MihM/400/NbgH/U3	Phasor	v.	
	NbgH/400/BinW-Alpha/I1	Phasor	A	
	NbgH/400/BinW-Alpha/12 NbgH/400/BinW-Alpha/13	Phasor	Å	
	NbgH/400/BlnW-Alpha/U1	Phasor	V.	
	NbgH/400/BinW-Alpha/U2 NbgH/400/BinW-Alpha/U3	Phasor Phasor	v.	
	NbgH/400/BlnW-Beta/11	Phasor	À	
	NbgH/400/BirW-Beta/12	Phasor	A	
	NbgH/400/bl/W-Beta/U1	Phasor	Ŷ	
	NbgH/400/BinW-Beta/U2	Phasor	¥	
	NbgH/400/MihM/I1	Phasor	Å	
	NbgH/400/MlhM/12	Phasor	A	
	NbgH/400/MihM/U1	Phasor Phasor	Ŷ	
	NbgH/400/MIhM/U2	Phasor	Ý	
	NbgH/400/MihM/U3 NbgH/400/vieB.Alpha/df/dt	Phasor	V Ha/e	v
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				-

Figure 4-15 Selected Tab Application

• Existing Applications

In the left window section, all available communication interfaces are displayed as folders:

- Island detections (ISDs)
- Power swing recognitions (PSRs)
- Voltage stability curves (VSCs)
- Selected Application

In the middle window section, the parameter data of the selected application is shown.



• Available measurements

In the right window section, all available values **Available measurements** are displayed with name, type, and unit, which are used for the input measurands of the configuration of the applications.

4.7.2 Island State Detection (ISD)

To configure island detection, the folder **ISDs** is selected and a name for the folder **ISDs** is defined:



Figure 4-16 Name for ISDs folder is assigned

Next, the folder ISDs is opened and island detection is selected.



NOTE

You need a corresponding SIGUARD PDP license for the ISD to function. The existence of this license is not queried in the SIGUARD PDP Engineer.



Functions

For a selected folder **ISDs** or selected island detection, the following functions can be performed via buttons.

Element	Explanation
*	Click the button New island detection in order to create a configuration scheme for a new application Island detection in the ISDs folder.
	Click the button Duplicate island detection to duplicate a configuration of an existing application Island detection for further processing.
×	Click the button Delete island detection in order to delete an application Power swing recognition .

Table 4-16 Toolbar of the ISDs application

Parameters of an Application ISDs

If the folder **ISDs** is opened and an island detection is selected, the following middle window section **Applica**tion - Island detection is displayed:



Figure 4-17 Parameters of the Application ISDs

In the following table, the setting options of the properties/parameters of the application ISDs are explained.

Table 4-17	Parameters of the Application ISDs
------------	------------------------------------

Element	Explanation
Name	In this field the name of the application Island detection is entered, changed, or displayed for an existing application.
Active	If the check box is marked, the application is switched to active.
Time constant	Time constant for static (Default = 1) and dynamic island detection (De- fault = 0.2) in seconds
Limit for Network Split	Upper limiting value in Hz for static island detection If the frequency difference between at least 2 neighboring frequencies is larger than the upper limiting value (Standard = 0.05 Hz), an island is de- tected.
Limit for Potential Network Split (static island detection)	Upper limiting value in Hz for static island detection If the frequency difference between at least 2 neighboring frequencies is smaller than the lower limiting value (Standard = 0.01 Hz), no island is detected. If the frequency difference between at least 2 neighboring frequencies lies between the lower and upper limiting values, there is a possible network split. If the check box is marked, a message is triggered in the case of an ex- ceedance of the limiting value.
Limit for Potential Network Split (dy- namic island detection)	Upper limiting value in Hz for dynamic island detection If the difference between at least 2 neighboring values for the rate of fre- quency change is larger than the limiting value (Standard = 0.001 Hz/s), there is a possible network split (island detection).



Configuration of Sites

A site is the aggregation of measuring points of a PMU.

It consists of the measuring points for a frequency (f) and a frequency changing speed (df/dt). In order to be able to compare frequency changing speeds, at least 2 sites per application **Island detection** must therefore be created and switched to **active**.

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PMU Calculation Graphics	Application	Communical	tion							
Existing applications	Applicati	on - Island dete	ction				Available measurements			
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	Inditio	1 Gat		ICUVE			CphS/400/BinW/12	Phasor	Ã	
ISD1				Static	Dynamic		CphS/400/BlnW/I3	Phasor	A	
v∎ PSRs	time c	onstant		1 [s]	0.2 [s]		CphS/400/BinW/U2	Phasor	v	
PSR common							CphS/400/BlnW/U3	Phasor	Y	=
							CphS/400/MihM/11 CphS/400/MihM/12	Phasor Phasor	Å	
PSR Job MIhM NbgH delt	Limit f	or Network Split		0.05 [Hz	1		CphS/400/MlhM/I3	Phasor	A	
VSCs				0.00 [112			CphS/400/MIhM/U1 CphS/400/MIhM/U2	Phasor	v	
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		Site			ar/at	Active	MihM/400/NbgH/df/dt	Analog	Hz/s	
	· · ·		Cph5/400/NbgH/r				MihM/400/NbgH/I1	Phasor	A	
	8						MIhM/400/NbgH/l2	Phasor	A	
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							MlhM/400/NbgH/U1	Phasor	V	
							MIhM/400/NbgH/U2 MIhM/400/NbgH/U3	Phasor	V.	
							NbgH/400/BinW-Alpha/I1	Phasor	Å	
							NbgH/400/BinW-Alpha/I2	Phasor	A	
							NbgH/400/BinW-Alpha/13 NbgH/400/BinW-Alpha/U1	Phasor	Ŷ	
							NbgH/400/BinW-Alpha/U2	Phasor	Ý	
							NbgH/400/BinW-Alpha/U3 NbgH/400/BioW-Reta/U1	Phasor	Å	
							NbgH/400/BinW-Beta/12	Phasor	Ä	
							NbgH/400/BlnW-Beta/I3	Phasor	A	
							NbgH/400/BinW-Beta/U1 NbgH/400/BinW-Beta/U2	Phasor	v	
							NbgH/400/BlnW-Beta/U3	Phasor	V	
							NbgH/400/MihM/I1 NbgH/400/MibM/I2	Phasor	Â	
							NbgH/400/MIhM/I3	Phasor	Ä	
							NbgH/400/MIhM/U1	Phasor	N.	
							NbgH74007mirim702 NbgH74002MibM7U3	Phasor	v.	~
							· <		>	
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										111

Figure 4-18 Configuration of Sites for Island Detection



NOTE

Empty entry fields are highlighted in red. The measuring points must be inserted here via drag and drop.

In the following table, the setting options of the properties/parameters of the Sites are explained.

Table 4-18 F	Parameters of	of the	Sites
--------------	---------------	--------	-------

Element	Explanation
Site	Numbering occurs automatically.
f	Sort the list Available measurements according to type. Insert a measuring point for the frequency (f) from Available measure- ments . It is checked whether a measuring point for the frequency is also insert- ed. The measuring point can come from different PMUs.



Element	Explanation
df/dt	Sort the list Available measurements according to type. Insert a measuring point for the rate of frequency change (df/dt) from Available measurements . It is checked whether a measuring point for the frequency changing speed is also inserted. The measuring point can come from different PMUs.
Active	If the check box is marked, the provision for the corresponding measur- ing point for the evaluation of island detection occurs.

4.7.3 Power Swing Recognition PSRs

To configure power swing recognition, the folder **PSRs** is selected and a name for the folder **PSRs** is assigned:

Project Edit Help PMU Calculation Graphics Application Communication Existing applications Application Power Swing Recognition Name Type U CphS/400/Bitw//1 Phasor A CphS/400/	nit 🕹	~
Image: State of the state o	nit 🛛	~
PMU Calculation Graphics Application Existing applications Application Power Swing Recognition Name Type Y X Cph5/400/Ehv//1 Phase Application	nit 🗹	^
Existing applications Available measurements	nit 🗹	^
Y ■ Name Type U Cph5/400/BHW//11 Phasor A Cph5/400/BHW//12 Phasor A	nit <u>1</u>	^
Cph5/400/BhW/11 Phaser A Cph5/400/BhW/12 Phaser A Cph5/400/BhW/12 Phaser A		
Name (for all) PSR Main ChristModellint/13 Phator A PSR Job Mith NbgH dels_phi PSR Job Mith NbgH dels_phi Phator A PSR Job Mith NbgH dels_phi PSR Job Mith NbgH dels_phi Phator A PSR Job Mith NbgH dels_phi PSR Job Mith NbgH dels_phi Phator A PSR Job Mith NbgH dels_phi PSR Job Mith NbgH dels_phi Phator A PSR Job Mith NbgH dels_phi PSR Job Mith NbgH dels_phi Phator A PSR Job Mith NbgH dels_phi PSR Job Mith NbgH dels_phi Phator A PSR Job Mith NbgH dels_phi Phator A Phator A PSR Job Mith NbgH dels_phi Phator A Phator A PSR Job Mith NbgH A Phator A Phator A PSR Job Mith NbgH A Phator A Phator A PSR Job Mith NbgH A Phator A Phator A PSR Job Mith NbgH A Phator A Phator A PSR Job Mith NbgH A Phator A Phator A PSR Job Mith NbgH A Phator A Phator A PSR Job Mith NbgH A Phator A Phator A PSR Job Nith NbgH A Phator A Phator A PSR Job Nith NbgH A Phator A Phator A <	r 2/s z z z z z z z z z z z z	=
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Figure 4-19 Name for PSRs Folder is Assigned

Next, the folder **PSRs** is opened and a swing recognition is selected.



NOTE

You need a corresponding SIGUARD PDP license for the PSR to function. The existence of this license is not queried in the SIGUARD PDP Engineer.



Functions

For a selected folder **PSRs** or selected power swing recognition, the following functions can be performed via buttons.

Element	Explanation
*	Click the button New power swing recognition to create a configuration scheme for a new application Island detection in the PSRs folder and a subordinate job.
	Click the button Duplicate power swing recognition to duplicate a con- figuration of an existing application Power swing recognition for further processing.
×	Click the button Delete Power Swing Recognition to delete a configuration for an application Island detection .

Table 4-19	Toolbar of the PSRs Application

Parameters of application PSRs

If the folder **PSRs** is opened and you have opened a new power swing recognition, the following middle window section **Application Power Swing Recognition** is displayed:

Project Edit Belo FRU Calculation Reprint Communication Existing spytications Applications Name (for all PSR Main Passor A Communication) Figli Stations Passor A Communication Cpd: 400.016W/12 Phaser A Communication Figli Stations Cpd: 400.016W/12 Phaser A Communication Cpd: 400.016W/12 Phaser A Communication Figli Stations Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser A Communication Figli Stations Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser A Communication Figli Stations PSR Job MM Nogri della phi Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser A Communication Cpd: 400.016W/13 Phaser	蔵 SIGUARD PDP Engineer Project: "	Netomac Testnet"				ГX
PRU Calculation Singletics Application Childing and the second seco	Project Edit Help					
PMU Calculation Graphics Applications Entropy applications Applications Applications Name Type Unit A Status Applications Applications CalcAdDBW/H1 Phase A CalcAdDBW/H1 Phase V CalcAdDBW/H1 <t< th=""><th>🖻 🗟 🗗 🏷 (ち) 🤁 📓 🔄</th><th></th><th></th><th></th><th></th><th></th></t<>	🖻 🗟 🗗 🏷 (ち) 🤁 📓 🔄					
Exting applications Application Rower Swing Recognition Application Rower Swing Recognition 	PMU Calculation Graphics Appl	cation Communication				
Name Type Unit CPS-400.06.W/11 Phase A CPS-400.06.W/12 Phase A CPS-5400.06.W/13 Phase A CPS-5400.06.W/14 Phase A CPS-5400.06.W/13 Phase A CPS-5400.06.W/14 Phase A CPS-5400.06.W/11 Phase V CPS-5400.06.W/11 Phase V CPS-5400.06.W/11 Phase A CPS-5400.06.W/11 Phase A CPS-5400.06.W/11 Phase A CPS-5400.06.W/11 Phase A CPS-5400.06.W/12 Phase A CPS-5400.06.W/13 Phase A CPS-5400.06.W/13 Phase A CPS-5400.06.W/13 Phase A CPS-5400.06.W/13 Phase V CPS-5400.06.W/13 Phase V CPS-5400.06.W/13 Phase V CPS-5400.06.W/13 Phase V CPS-5400.06.W/14 Phase<	Existing applications	Application Power Swing Recognition	Available measurements			
Cpic5 4000/BMV/11 Photo: A Cpic5 4000/BMV/12 Photo: A Cpic5 4000/BMV/13 Photo:	📑 🗎 🗙		Name	Туре	Unit	^
	ISO: ISO: PR: 150 PSR:	Name (for all) PSR Main PSR Name PSR common	CpF-X40078Hv//1 CpF-X40078Hv//12 CpF-X40078Hv//13 CpF-X40078Hv//14 McF-Y40078Hy/X18 McF-Y40078Hy/X18 McF-Y40078Hy/X13 McF-Y40078Hy/X13 McF-Y40078Hy/X13 McF-Y40078Hy/X13 McF-Y40078Hy/X13 McF-Y40078Hy/X13 McF-Y40078Hy/X13 McF-Y40078Hy/X13 McFY40078Hy/X13 McFY40078Hy/X13 McFY40078Hy/X13 McFY40078Hy/X13 McFY40078Hy/X1	Phasor Ph	A A A A A V V V V V V V V V V V V V V V	E E E E E E E E E E E E E E E E E E E

Figure 4-20 Parameters of the PSRs Application



The setting options for the properties/parameters of the application **PSRs** are explained in the following table.

Element	Explanation
PSR Name	In this field, the name of the application Power swing recognition is entered, changed, or displayed for an existing application.
Active	If the check box is selected, the application is switched to active.
ISD	If the check box is selected, the results of the application ISD (Island State Detection) are used by suppressing calculation of jobs whose input variables lie in 2 different islands.

Table 4-20 Parameters of the PSRs Application

Parameters of a PSR Job

If you have selected **PSR job**, the following middle window section **Application power swing recognition** is displayed:

PMU Calculation Graphics Applic	ation Communication			
kisting applications	Application Power Swing Recognition			Available measurements
· 🗉 🗙		Thresholds / Events, nominal	250000	Name Type Unit
Sloe Sloe	Name (for all) FSR Main PSR Name FSR common Job Name New Job 1128 Job Mode @ Active Power Prix Output signal Output New Job 1128 Inputs Only one Phase Inputs Voltage 1 Current	Threshold Value Magnitude / Alam 0.1 Magnitude / Warning 0.02 Damping Ratio / Alam 0.03 Damping Ratio / Warning 0.05	Event Active	CpHS /400/BH/W. Phasor A CpHS /400/BH/W. Phasor V CpHS /400/BH/W. Phasor V CpHS /400/BH/W. Phasor V CpHS /400/BH/W. Phasor V CpHS /400/BH/W. Phasor A CpHS /400/BH/M. Phasor A CpHS /400/HM. Chasor V CpHS /400/HM. Phasor V
	L3 Modes Rame Frequency Innimum Frequency Innimum	Maximum Irequency		MchP/400/Nbp, Analog Hz, MchP/400/Nbp, Analog Hz, MchP/400/Nbp, Dipital MchP/400/Nbp, Dipital MchP/400/Nbp, Dipital MchP/400/Nbp, Phasor A MchP/400/Nbp, Phasor A MchP/400/Nbp, Phasor A MchP/400/Nbp, Dipital MchP/400/Nbp, Dipital
	Outputs Mode	Type Name	Archive	MchP/400/Nbg Digital MchP/400/Nbg Digital MchP/400/Nbg Digital MchP/400/Nbg Phasor V MchP/400/Nbg Phasor V MchP/400/Nbg Phasor V MchP/400/Nbg Digital MiHM < NbgH Calculat De
				MihM/400/Nbg Analog Hz. MihM/400/NbgH/f Analog Hz MihM/400/Nbg Phasor A V K IIII 3

Figure 4-21 Parameters of the PSR Job

The setting options for the properties/parameters of a **PSR job** are explained in the following table.

Table 4-21Parameters of a PSR Job

Element	Explanation
Job Name	In this field, the name of the PSR job is entered, changed, or displayed for an existing PSR job.
Active	If the check box is selected, the PSR job is switched to active .
ISD	If the check box is selected, the processing of this job is set, if the ISD has recognized that the input values lie in different islands. Only effective with jobs in Job mode Phase angle .

4.7 Applications

Element	Explanation
Job mode	 PSR recognizes 2 different Job modes: Active Power. Voltage and current are linked to one another at a PMU location. The active power calculated from that is analyzed for power swings. Phase angle. The voltages are linked together at 2 different locations. The voltage angle difference calculated from this is analyzed for power swings.
Thresholds/Events, nominal	This rated value is used as reference for the relative threshold values stated below for the warning or the alarm based on the magnitude. Also see <i>Figure 1-10</i> in chapter <i>1.5 SIGUARD PDP Power Swing Recognition (PSR)</i> .
Threshold - Magnitude/Alarm	If this relative value for the magnitude is exceeded, then this power swing is placed in the 1st row of the DOE table. Reference value is the rated value, see above. Also see <i>Figure 1-10</i> in chapter <i>1.5 SIGUARD PDP Power Swing Recognition (PSR)</i> .
Threshold - Magnitude/Warning	If this relative value for the magnitude is exceeded, then this power swing is placed in the 2nd row of the DOE table. Reference value is the rated value, see above. Also see <i>Figure 1-10</i> in chapter <i>1.5 SIGUARD PDP Power Swing Recognition (PSR)</i> .
Threshold - Damping Ratio/Alarm	If this value for the damping factor is exceeded, then this power swing is placed in the 3rd column of the DOE table. Note that this value must be negative. Also see <i>Figure 1-10</i> in chapter <i>1.5 SIGUARD PDP Power Swing Recognition (PSR)</i> .
Threshold - Damping Ratio/Warn- ing	If this value for the damping factor is exceeded, then this power swing is placed in the 2nd column of the DOE table. Note that this value must be negative. Also see <i>Figure 1-10</i> in chapter <i>1.5 SIGUARD PDP Power Swing Recognition (PSR)</i> .



Input Parameters

After the general parameters for the **PSR job** were set, the **Inputs** (measured values for voltage and current) must be defined in the middle window section **Application power swing recognition** for each phase.

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PMU Calculation Graphics Applic	ation	Communic	ation									
Existing applications	Applic	ation Pow	er Swing Rec	ognition					^	Available measu	urements	
_* ≞ ×				Thr	esholds / Events, nor	inal	250000			Name Calls (400/Dia)/	Type	Unit ^
→ ISDs → 注 ISD1	Name	e (for all)	PSR Main		Threshold Magnitude / Alarm	Value	Ev	ent Active		CphS/400/BirW CphS/400/BirW	Phasor Phasor Phasor	A A
▼- ¹ PSRs	PSR	Name PS	R common	V	Magnitude / Warning	0.02	Die	tinct		CphS/400/BlnW	Phasor	<u> </u>
New Job 1128	Job I	Name Ne	w Job 1128		Damping Batin / Alarm	-0.02	No	tified 🔽		CphS/400/BlnW	Phasor	v
	Job I	Hode 💿	Active Power	O Pha	Damping Ratio / Warn	ng -0.05				CphS/400/MlhM CphS/400/MlhM	Phasor Phasor	A
PSR Job MIhM NbgH delta_phi	Outp	ut signal	Output New Jo	6 1128 🗸		-				CphS/400/MlhM	Phasor	A
I vsn sob minim nome deka_pril ▼- ¹ VSCs	۲.	-		> <	ш	>				CphS/400/MlhM CphS/400/MlhM	Calculat	. W
										CphS/400/MlhM	Calculat	VAr
NbgH> MlhM	Inpu	ts 🗏 Ui	nly one Phase							CohS/400/MihM	Phasor	- V
		Inputs	Voltage 1	Current						CphS/400/MlhM	Phasor	
	•	L1	CphS/400/E	8InW/U1 CphS/4	00/MIhM/I1					CohS/400/Nbg	Analog f Analog	Hz/s Hz
		L2	CphS/400/E	8InW/U2						MchP/400/Nbg	Digital	
		L3								MchP/400/Nbg MchP/400/Nbg	Digital Analog	Hz/s
										MchP/400/Nbg	Digital	
	Mode	es								MchP/400/Nbg MchP/400/Nbg	Digital Analog	Hz
		1	Frequency	Minimum	M suirouro	_				MchP/400/Nbg	Phasor	A
		Name	band	frequency	frequency					MchP/400/Nbg MchP/400/Nbg	Phasor Phasor	A
	*									MchP/400/Nbg	Digital	
										MchP/400/Nbg MchP/400/Nbg	Digital	
										MchP/400/Nbg	Digital	
										MchP/400/Nbg MchP/400/Nbg	Digital	v
	Outpu	ts								MchP/400/Nbg	Phasor	v
		Mode			Type Name			Archive		MchP/400/Nbg MchP/400/Nbg	Phasor	V
										MihM < NbgH	Calculat	. Degr
										MIhM/400/Nbg	Analog	Hz/s
										MihM/400/Nbg	r Anaiog Phasor	A V
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Figure 4-22 Input parameters for the phases

The setting options for the properties/parameters of the Inputs are explained in the following table.

Table 4-22 Parameters of the Input Variables

Element	Explanation
Inputs L1 - L3	 The following measuring points from the Available measurements list must be defined for each phase: One measuring point Voltage 1 and one measuring point Current for the job mode Active Power One measuring point Voltage 1 and Voltage 2 for the job mode Phase Angle
	These values are pulled into the table via drag and drop from the Avail-able measurements . Fields that must contain values are marked red.
Only one phase	If the check box is selected, the phases 2 and 3 are hidden. Only one phase is active.



Determine Modes for the Job

After the definition of the input variables, the Modes ¹ must be defined in the middle window section Application Power Swing Recognition.

For this, a mode name is defined. The appropriate outputs are created automatically.

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PMLI Calculation Graphics Applic	ation Communication							
Existing applications	Application Power Swing Recognition					Available measurements		
🕐 🗉 🗙	Tł	resholds / Events,	nominal	2.5E+08		Name	Туре	Unit 📤
The ISDs	Name (for all) PSB Main	Threshold	Value	Event Active		CphS/400/BlnW/l1 CphS/400/BlnW/l2	Phasor Phasor	A A
		Magnitude / Alarm	0.15	Critical		CphS/400/BinW//13 CphS/400/BinW//11	Phasor Phasor	Å.
- PSR common		Magnitude / Warr	ning 0.1	Distinct 🗹		CphS/400/BlnW//U2	Phasor	Ý.
PSR Job CphS MIhM P	Job Name PSR Job CphS MlhM	Damping Ratio / A	Alarm -0.03	Notified 🗹		CphS/400/BlnW/U3 CphS/400/MlbM/U1	Phasor	∨ ≡
PSR Job MIhM NbgH delta_phi	Job Mode 💿 Active Power 🔘 F	Damping Ratio / \	√aming -0.05			CphS/400/MIhM/12	Phasor	Â
VSCs	Output signal PSR CphS MIhM Ac 🗸					CphS/400/MIhM/I3	Phasor	A
-2 MIhM -> NbgH	< m > <	ш	>			CphS/400/MIhM/PowerFactor	Calculat	w
-2 NbgH> MlhM						CphS/400/MIhM/Q	Calculat	VAr
	Inputs Only one Phase					CphS/400/MIhM/U2	Phasor	v I
	Inputs Voltage 1 Cu	rrent				CphS/400/MlhM/U3	Phasor	V
	L1 CphS/400/MIhM/U1 CpH	s/400/MlhM/I1				CphS/400/NbgH/dt/dt CphS/400/NbgH/t	Analog	Hz/: Hz
	L2 CphS/400/MIhM/U2 CpH	S/400/MIhM/12				MchP/400/NbgH/Alarm	Digital	112
	L3 CphS/400/MlhM/U3 Cph	s/400/MlhM/13				MchP/400/NbgH/AT MchP/400/NbgH/df/dt	Digital	Ha/s
						MchP/400/NbgH/ET1	Digital	11673
	Modes					MchP/400/NbgH/ET2	Digital	11-
	Houes	Les Les		Ter 1		MchP/400/NbgH/I1	Phasor	A
	Name	band fre	nimum iauencv	frequency	Ĥ	MchP/400/NbgH/I2	Phasor	A
	PSB Job CobS MIbM Mode 1 0.8-1 2Hz	20 🔽	1	12	=	MchP/400/NbgH/LET1	Digital	A
	PSB Job Colds Millel Mode 2.0.05-0.154		- 15	0.15		MchP/400/NbgH/LS	Digital	
	PCD Lab CallS Millin Mode 2 000 0 13	12 0.0		0.13		MchP/400/NbgH/SST1 MchP/400/NbgH/SST2	Digital	
	PSR 300 Cpris minim mode 3				~	MchP/400/NbgH/SST3	Digital	
	Outputs					MchP/400/NbgH/U1 MchP/400/NbgH/U2	Phasor Phasor	V V
	Mode	Type	Name	Archive	^	MchP/400/NbgH/U3	Phasor	Ý
	ESB Job CobS MIbM Mode 1 0.8-1 2Hz	Frequency	PSB CobS MIbM	Mode 01 Freg		MchP/400/NbgH/Warn MIMM / NbaH	Digital	Deg
	PSR Job CphS MIhM Mode 1 0.8-1.2Hz	Magnitude	PSR CphS MlhM	Mode 01 Ampl	=	MlhM/400/NbgH/df/dt	Analog	Hz/:
	PSR Job CphS MlhM Mode 1 0.8-1.2Hz	Damping Ratio	PSR CphS MlhM	Mode 01 Damp 🛛		MihM/400/NbgH/I	Phasor	H2 A
	PSR Job CphS MIhM Mode 1 0.8-1.2Hz	Degree of Exposure	PSR CphS MihM	Mode 01 DOE		MihM/400/NbgH/12	Phasor	A
	PSB Job CohS MIhM Mode 2 0.05-0 15	Hz Frequency	PSB CohS MihM	Mode 02 Freg		MihM/400/NbgH/P	Calculat	Ŵ
	PSB Job CobS MIM Mode 2 0 05-0 15	Iz Magnitude	PSB CohS MibM	Mode 02 Ampl		MIhM/400/NbgH/U1	Phasor	¥.
	PSB Job CokS MikM Mode 2 0.05-0.15	12 Damping Batio	PSB CobS MIbM	Mode 02 Damp	~	MINM/400/NDgH/U2	Phasor	<u> </u>
		ing to shipping risks		mass of Many		• m		
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Figure 4-23 Definition of the Mode Name/Outputs

The setting options for the properties/parameters of the application **Modes** are explained in the following table.

Table 4-23	Parameters	of the	Input	Variables

Element	Explanation
Name	If a name is entered for the mode, for example, Mode4 , the correspond- ing Outputs are created for this (entries for the types: • Frequency • Magnitude • Damping ratio • Degree of Exposure
Frequency band	If the check box is selected, the fields for Maximum frequency and Minimum frequency are released for the maximum and minimum fre- quencies.



^{1.} Available power swings can also be composed of partial power swings with different frequencies. These partial power swings are also designated a power swing mode.

Element	Explanation
Minimum frequency	Minimum frequency Power swings with a natural frequency larger than this minimum frequen- cy and smaller than the maximum frequency Maxf are preferentially as- signed to this mode.
Maximum frequency	Maximum frequency Power swings with a natural frequency larger than the minimum frequen- cy Minf and smaller than this maximum frequency are preferentially as- signed to this mode.

Selecting Modes

In order to maintain the overview with several modes, the entire row can be selected for a mode, for example, **Mode2**. In this case, only the outputs for Mode2 are displayed.



Figure 4-24 Selected Mode/Outputs

Table 4-24 Par	ameters of the (Output (Quantities
----------------	------------------	----------	------------

Element	Explanation
Mode	If a name is selected for the mode, for example, Mode4 , the correspond- ing Outputs are displayed with the name of the mode.
Туре	Type of output quantities (for example, frequency, magnitude, damping)
Name	Name of the output quantity
Archive	Selection, so that the output quantities are saved in the archive.

You can find further information on saving, activating, and validating the project in chapter 4.9 Shared Functions.



4.7.4 Voltage Stability Curve (VSC)

To configure the display of a voltage stability curve, the folder **VSCs** is selected and a name for the folder **ICCP** is defined:

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DNU Calabian Cardina Andresian Communication	
rimo calculation organics application commanication Evisition annications Voltanestability curves	Available measurements
	Name ^
	CphS/400/BlnW/l1
↓ 50/s ↓ ↓ 50/s Name (for all) VSCMain	CphS/400/BlnW/12
	CphS/400/BinW/13
PSR common	CphS/400/BlnW/U2
PSR Job CphS MIhM P	CphS/400/BlnW/U3
PSR Job MihM NbgH deta_r	CphS/400/MIM/12
	CphS/400/MlhM/I3
2 Mihm -> NbgH	CphS/400/MihM/P CphS/400/MihM/PowerEactor
	CphS/400/MlhM/Q
	CphS/400/MIhM/U1
	CphS/400/MinM/02 CphS/400/MihM/U3
	CphS/400/NbgH/df/dt
	Lph5/400/NbgH/f MchP/400/NbgH/Alarm
	MchP/400/NbgH/AT
	MchP/400/NbgH/df/dt
	MchP/400/NbgH/ET2
	MchP/400/NbgH/f
	MchP/400/NbgH/l1 MohP/400/NbgH/l2
	MchP/400/NbgH/I3
	MchP/400/NbgH/LET1
	MchP/400/NbgH/LS MchP/400/NbgH/SST1
	MchP/400/NbgH/SST2
	MchP/400/NbgH/SST3
	MchP/400/NbgH/U2
	MchP/400/NbgH/U3
	MchP/400/NbgH/Warn
	MlhM/400/NbgH/df/dt
	< m >
Project validation	
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Figure 4-25 Name for VSCs Folder is Assigned

Next, the folder **VSCs** is opened and a curve is selected.

Functions

For a selected folder **VSCs** or a selected voltage stability curve, the following functions can be performed via buttons.

Table 4-25	Toolbar of the VSCs Application
------------	---------------------------------

Element	Explanation
*	Click the button New voltage stability curve in order to create a config- uration scheme for a new voltage stability curve in the VSCs folder.
	Click the button Duplicate voltage stability curve to duplicate a configuration of an existing voltage stability curve for further processing.
×	Click the button Delete voltage stability curve to delete a configuration of an existing voltage stability curve.



Parameters of an Application VSCs

The following configurations for the display of a voltage stability curve are possible:

- Configuration with input measurands and line parameter (1 PMU)
- Configuration with input measurands and output measurands (2 PMU)

If you open the folder VSCs in the window section Existing applications, a voltage stability curve is selected and the check box 1 PMU has been selected, the following middle window section Voltage stability curves is displayed:

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PMU Calculation Graphics Applic	ation Communication				
Existing applications	Voltage-stability curves	Available measurements			
📑 🗏 🗙		Name	Туре	Unit	^
	 1 PMU 2 PMU Pmax Vinax Vin In R X G B 	Nime Mihi → NbgH Cph5/400/Bitw//1 Cph5/400/Bitw//1 Cph5/400/Bitw//1 1500 M/W Cph5/400/Bitw//1 500 KV Cph5/400/Bitw//1 500 KV Cph5/400/Bitw//1 500 KV Cph5/400/Bitw//1 6 Cph5/400/Bitw//1 Cph5/400/Bitw//1 6 Cph5/400/Bitw//1 Cph5/400/Bitw//1 6 Cph5/400/Bitw//1 Cph5/400/Mitw//1 6 Cph5/400/Mitw//1 Cph5/400/Mitw//1 0 Ditm Cph5/400/Mitw//1 0 Ditm Cph5/400/Mitw//1 0 Ditm MitW/400/NbgH//1/1 0 µS MitW/400/NbgH//1 0 µS MitW/400/NbgH//1 0 µS MitW/400/NbgH//1 0 µS MitW/400/NbgH//1 0 µS MitW/400/NbgH//2 0 µS MitW/400/NbgH//2 0 µS MitW/400/NbgH//2 0 µS MitW/400/NbgH//2	Type Phasor Phas	Unit A A A V V V V A A A V V V V V V V V V V V V V	
		Nsb/1400/BitW-Apha/3 Nsb/1400/BitW-Apha/3 Nsb/1400/BitW-Apha/12 Nsb/1400/BitW-Apha/12 Nsb/1400/BitW-Apha/12 Nsb/1400/BitW-Beta/13 Nsb/1400/BitW-Beta/13 Nsb/1400/BitW-Beta/13 Nsb/1400/BitW-Beta/13 Nsb/1400/BitW-Beta/12 Nsb/1400/BitW-Beta/12 Nsb/1400/MitW-Beta/12 Nsb/1400/MitW-Beta/12 Nsb/1400/MitW-Bta/12 Nsb/1400/MitW-Bta/12 Nsb/1400/MitW-Bta/12 Nsb/1400/MitW-Bta/12 Nsb/1400/MitW-Bta/12 Nsb/1400/MitW-Bta/12 Nsb/1400/MitW-12 Nsb/1400/MitW-12 Nsb/1400/MitW-12 Nsb/1400/MitW-12	Phasor Phasor	A V V A A A V V V A A A V V V V Hz/s	>
Project validation					

Figure 4-26 Parameters of the Application VSCs with Input Measurands (1 PMU) and Line Parameter



NOTE

Empty entry fields are highlighted in red. Enter a value.

In the following table, the setting options of the properties/parameters of the application **VSCs** are explained with input measurands.

Table 4-26 Parameters of the Application VSCs

Element	Explanation
1 PMU	This check box is selected when the voltage stability curve is supposed to be calculated with an input measurand and the line parameters.
Name	In this field the name of the voltage stability curve is entered, changed, or displayed for an existing voltage stability curve.



4.7 Applications

Element	Explanation
P _{max}	Entry of the maximum active power for the observed line in megawatts (MW).
V _{max}	Entry of the maximum voltage for the observed line in kilovolts (kV).
V _{in}	Measurand of the voltage at the input of the line from Available mea- surements
l _{in}	Measurand of the current at the input of the line from Available mea- surements
R	Resistance of the line in ohms
Х	Reactance of the line in ohms
G	Conductance of the line in micro-siemens
В	Susceptance of the line in micro-siemens

When you have selected the application VSCs in the window section **Existing Applications** and marked the check box **2 PMU**, the following middle window section is displayed.

💐 SIGUARD PDP Engineer Project: "	Netomac Testnet"			_ = ×
Project Edit Help				
📑 🖬 🔒 📭 🐚 🖓 (주) 📇 🖾)				
PMU Calculation Graphics Appl	ication Communication			
Existing applications	Voltage-stability curves		Available measurements	
Existing applications Signature Signature For Si	Voltage-stability curves 0 1 PMU Name 2 PMU Pmax Vin lin Vout IOut	MINM -> NbgH 1500 MW 500 kV MINM-400/NbgH/U1 MM/400/NbgH/U1 MbgH/400/MinM/U1 NbgH/400/MinM/11	Available measurements Name Crick/4002Brw/11 Crick/4002Brw/12 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/14 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/13 Crick/4002Brw/14 Crick/4002Brw/14 Crick/4002Brw/14 Mith/4002Nbg/17 Mith/4002Nbg/17 Mith/4002Nbg/17 Mith/4002Nbg/17 Mith/4002Nbg/17 Mith/4002Nbg/11 Mith/4002Nbg/12 Mith/4002Nbg/12	Type Unit ▲ Phasor A Phasor A Phasor A Phasor A Phasor A Phasor A Phasor V Phasor A Phasor A Phasor A Phasor A Phasor A Phasor A Phasor A Phasor V Phasor C Phasor V Phasor C Calculat Degree Analog H2/s Analog H2/s Analog H2/s Phasor A Phasor A Phasor A Analog H2/s Phasor A Phasor A Phasor A Phasor A Phasor A Phasor A Phasor V Phasor V Phasor V Phasor N Phasor A
Project validation			Ngbr/400/Biw/Apha/13 Ngbr/400/Biw/Apha/13 Ngbr/400/Biw/Apha/U2 Ngbr/400/Biw/Apha/U2 Ngbr/400/Biw/Beta/1 Ngbr/400/Biw/Beta/1 Ngbr/400/Biw/Beta/1 Ngbr/400/Biw/Beta/1 Ngbr/400/Biw/Beta/1 Ngbr/400/Biw/Beta/1 Ngbr/400/Mih/1 Ngbr/400/Mih/1 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13 Ngbr/400/Mih/13	Phasor A Phasor V Phasor V Phasor V Phasor A Phasor A Phasor A Phasor V Phasor V Phasor V Phasor A Phasor V Phasor V Pha

Figure 4-27 Parameters of the Application VSCs with Input and Output Measurands (2 PMU)



NOTE

Empty entry fields are highlighted in red. An entry is required.



In the following table, the setting options of the properties/parameters of the application **VSCs** are explained with input and output measurands.

Element	Explanation
2 PMU	This check box is selected when the voltage stability curve is supposed to be calculated with an input and output measurand.
Name	In this field the name of the voltage stability curve is entered, changed, or displayed for an existing voltage stability curve.
P _{max}	Entry of the maximum active power for the observed line in megawatts (MW).
V _{max}	Entry of the maximum voltage for the observed line in kilovolts (kV).
V _{in}	Measurand of the voltage at the input of the line from Available mea- surements
l _{in}	Measurand of the current at the input of the line from Available mea- surements
V _{out}	Measurand of the voltage at the output of the line from Available mea- surements
l _{out}	Measurand of the current at the output of the line from Available mea- surements

 Table 4-27
 Parameters of the Application VSCs



4.8 Communication

4.8.1 Overview

To configure and set the communication interface parameters, the following requirements must be met:

- An existing project or a new project must be open.
- The tab Communication must be selected.

The Communication Tab Is Selected

When you have selected the tab **Communication**, the layout for adding and editing communication interfaces is displayed.



Figure 4-28 Selected Tab Communicated

Available communication interfaces

In the left window section, all available communication interfaces are displayed as folders:

- C37.118
- ICCP
- OPC

Selected Application

In the middle window section, the parameter data for the selected communication interfaces are shown.



Available measurements

In the right window section, all available values **Available measurements** are displayed with name, type, and unit, which are used for the input measurands within the configuration of the applications.

4.8.2 Protocol C37.118

The function of the PDC server is the following:

SIGUARD PDC sends data in the IEEE C37.118 protocol to other PDCs. In this way, the data from SIGUARD PDP can also be used by other PDCs.

To configure the communication interfaces, the folder C37118 is selected, and a name for the folder C37118 is assigned.

💐 SIGUARD PDP Engineer Project: "Neto	macTestnet" 🗕 🗖 🗙
Project Edit Help	
🖻 🗟 🔂 🔽 🕒 🖓 (여) 📕 🖾 🛛	
PMU Calculation Graphics Application	Communication
Available communication Communication C	37118
Name for all PDCSe	rvers all PDC Servers
P C C C C C C C C C C C C C C C C C C C	
Project validation	
	3

Figure 4-29 Name for Folder C37118

Next, the C37118 folder is opened and an interface is selected.



4.8 Communication

Functions

The following functions can be performed when the folder C37118 is selected:

Element	Explanation
1	Click the button New , in order to create a new PDC server. or
	in the case of a selected PDC server to set up a subordinate logical PMU.
	Click the button Duplicate , in order to create a duplicate with the same name and subordinate logical PMUs for the selected PDC server. or to duplicate a selected logical PMU.
×	Click the button Del , in order to delete a selected PDC server with the subordinate logical PMUs or to delete a selected logical PMU.

Table 4-28	Functions for PDC Serv	ers and Logical PMUs
		olo alla Logioal i Moo

Parameters of the PDC Server

When you have selected a PDC server in the window section **PDCServers and logical PMUs**, the following middle window section is displayed.

💐 SIGUARD PDP Engineer	Project: "NetomacTestnet"		_ = ×
Project Edit Help			
ାଞ୍ଚି 🗟 🖥 🚺 🗐 🦳 📑	2		
PMU Calculation Grap	ohics Application Communication		
Available communication	Communication C37118		
📑 🗉 🗙	Name for all PDCServers all PDC Servers		
▼-10 C37118	PDCServer name Europe	PDCServer ID 100	
ICCP	Legal IP address 157 162 57 92	Legal part 5000	
	Hemote IP address 157.163.57.94	Internal name PDCServer Europe	
	Reporting rate 10	Communication type tcp	
Project validation			
L			3

Figure 4-30 Parameters of the PDC Server

In the following table, the setting options of the properties/parameters of a PDC server are explained.

	Table 4-29	Parameters of the PDC Server
--	------------	------------------------------

Element	Explanation
PDC server name	You can freely select the name of the PDC server. This name is entered as PDC Server Name in the protocol IEEE C37.118 and is agreed with the communication partner. It does not need to be unique (see Internal name), for example: <i>SIGUARD</i> .
PDC server ID	ID of the connected PDC server This name is entered as PDCID in the protocol IEEE C37.118 and is agreed with the communication partner, for example: <i>111</i> .
Local IP address	IP address at which the PDC server can be reached from the outside. This IP address helps to define the LAN interface to be used for communication to the outside. If there is only one interface, then enter the IP address of the server, for example, <i>55.26.213.186</i> .
Local port	Port number at which the PDC server can be reached from the outside, for example: 4712.
Remote IP address	IP address of the outside PDC servers (a client from the perspective of the SIGUARD PDC server). Only one PDC server with this IP address can establish a connection with the local SIGUARD PDC server.
Internal name	This name must be unique and may not occur in the case of other objects (for example, measured value, calculation, etc.).
Reporting rate	Number of telegrams that can be transferred per second by the PDC server. The Reporting rate must be agreed with the communication partner. CAUTION Note that not all combinations are possible. Which value in allowed depends on the Reporting rate of the values to be transferred. You can set the value via a list box from 10 up to 60 frames/second. If the value does not agree with the configuration of the PDC server, an error message appears and no transfer takes place.
Communication type	Via a list box the communication type tcp or udp can be selected.



NOTE

In case of missing entry, the entry field is highlighted in red. Enter a value.



Parameters of a Logical PMU

When you have selected a logical PMU in the window section **PDC servers and logical PMUs**, the following middle window section is displayed.

\land SIGUARD PDP Engineer I	Project: "NetomacTestnet"	_ = ×
Project Edit Help		
PMIL Calculation Gran	hice Application Communication	
Available communication	Communication C37118	Available measurements
🕐 🖹 🗙	Name for all PDCServers all PDC Servers	Name ^
CS7118	Name for all PDC Server all PDC Servers PDCServer name Europe PDCServer ID 100 Local IP address 157.163.57.93 Local port 5000 Remote IP address 157.163.57.94 Internal name PDCServer Europe Reporting rate 0 Communication type teps Station name Copenhagen Nominal frequency 50 log. PMU ID 100 Channel Name Measurement Measurement Measurement Measurement CpHS V1 CphS/400/RhW Image: CopeS/400/RhW Image: CopeS/400/RhW CpHS MIHM 11 CphS/400/RhW Image: CopeS/400/RhW Image: CopeS/400/RhW CpHS MIHM 11 CphS/400/RhW Image: CopeS/400/RhW Image: CopeS/400/RhW CpHS MIHM 11 CphS/400/RhW Image: CopeS/400/RhW Image: CopeS/400/RhW Image: CopeS/400/RhW Image: CopeS/400/RhW Image: CopeS/400/RhW Image: CopeS/400/RhW Image: CopeS/400/RhW Image: CopeS/400/RhW	Name ▲ Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/ElwW/12 Cp65/400/HlwM/12 Cp65/400/MlwM/12 Cp65/400/MlwM/12 Cp65/400/MlwM/12 Cp65/400/MlwM/12 Cp65/400/MlwM/13 Cp65/400/MlwM/14 Cp65/400/MlwM/13 Cp65/400/MlwM/14 Cp65/400/MlwM/14 Cp65/40/MlwM/14 Cp65/400/MlwM/14 Cp65/40/MlwM/14 Cp65/400/MlwM/14 Cp65/40/MlwM/14 MchP/400/MlwM/14 Che6/40/MlwM/14 </td
Project validation		MchP/400/NbgH/U2 MchP/400/NbgH/U3 MchP/400/NbgH/U3 MiM/ (40p/ MiM/400/NbgH/d1/dt MiM/400/NbgH/11 MiM/400/NbgH/12 ✓ ■ >

Figure 4-31 Parameters of a Logical PMU and the Measuring Channels

In the following table, the setting options of the properties/parameters of a logical PMU are explained.

Table 4-30 Parameters of a Logical PMU

Element	Explanation
Station name	You can freely select the name of a logical PMU. This name is entered as PDC Station Name in the protocol IEEE C37.118 and is agreed with the communication partner. It does not need to be unique (in contrast to Internal name), for example: <i>SIGUARD PMU1</i> .
Logical PMU ID	ID of the connected, logical PMU This ID is entered as PMUID in the protocol IEEE C37.118 and is agreed with the communication partner, for example: <i>112</i> .
Rated frequency	Rated frequency of the station, for example: 50 Hz.



NOTE

The remaining parameter fields are not active (colored gray), because they are not parameterizable here.



Editing Measuring Channels

• Add measuring channel

In order to add a measuring channel, add a measuring point from **Available measurements** in the last line of the column **Measurement**. An additional blank line is inserted, by which a further measuring channel can be defined.

• Delete measuring channel

To delete measuring channels, select the measuring channel (line) in the table and press the key **** or select the context menu **delete**.

• Sorting according to column contents

The list of measuring channels can be sorted according to the contents of the columns. Clicking the header sorts in ascending or descending list items.

Column sequence

You can move individual columns by dragging the header to another place in the table, and thereby change the column sequence.

Change column widths

All columns can be changed widthwise by dragging the column edge.

Parameters of a Measuring Channel

For every PMU server the measuring channels set up for this is displayed in the form of a table in the middle window section under the parameters of the PMU server and the selected logical PMU.

In the following table, the setting options of the properties/parameters of the measuring channels are explained.

Element	Explanation
Channel name	You can freely select the name of the measuring channel. Since it is entered into the protocol IEEE C37.118, the Channel name may not exceed a length of 16 characters, for example: <i>MchP/400/NbgH/U1</i> .
Measurement	Definition of the measuring point from Available measurements . The values measured here are transferred via this measuring channel.
Meas. Mode	 Definition of the method of measurement for analog values except frequency and rate of frequency change The following parameters are displayed on the basis of the measuring point: S (Single point) Measurement of the current value R (RMS = root mean square) Measurement of the quadratic mean (RMS value) P (peak) Measurement of the maximum value
Subst Magn	Definition of a substitute value, which is transferred in place of the origi- nal measured value. If no value is entered the original measured value is transferred.
Subst Angle	Definition of a substitute value, which is transferred in place of the origi- nal measured value. An entry is allowed only in the case of phasors. If no value is entered the original measured value in transferred.





NOTE

The table of the measuring channels must be sorted according to column **Meas. Mode**, in order to warrant a correct transfer in accordance with the protocol IEEE C37.118.

Selected lines can be moved upward or downward via the context menu.

Further details see protocol IEEE C37.118.

4.8.3 ICCP

The Inter-Control Center Communications Protocol, also designated IEC 60870-6/TASE.2, is a communication protocol for the exchange of data between network control centers. SIGUARD PDP is able to send data to one or several control centers with this communication protocol.



NOTE

SIGUARD PDP cannot receive any data via ICCP.



NOTE

You need a corresponding SIGUARD PDP license for the ICCP to function. The existence of this license is not queried in the SIGUARD PDP Engineer.

To configure communication protocols, the folder **ICCP** is selected and a name for the folder **ICCP** is assigned:



🔊 SIGUARD PDP Engineer Project: "NetomacTestnet" 🗕 🗖 🗙			
Project Edit Help			
PMU Calculation Graphics	Application Communication		
Available communication Com	mmunication - ICCP		
27 🗐 🗙 Nam	me for all ICCPs ICCP Main		
Project validation			
			3

Figure 4-32 Assignment of Name to the ICCP Folder

Next, the **ICCP** folder is opened and a protocol is selected.

Functions

The following functions can be performed when the folder **ICCP** is selected.

able 4-32	Functions for ICCP	

Element	Explanation
*	Click the button New , in order to create a new protocol with the appropri- ate subdirectories Measurements and Groupindication .
	Click the button Duplicate , in order to create a duplicate with a new name for the selected protocol.
×	Click the button Del in order to delete a selected protocol with the associated subdirectories.



ICCP Communication settings

If you have selected an ICCP_Main in the window section **Available communication interfaces**, the following middle window section **Communication - ICCP** is displayed.

🗟 SIGUARD PDP Engineer	Project: "NetomacTestnet"				_ = ×
Project Edit Help					
📑 🖻 🖥 🖓 🖓 ମିକ୍ର 🖓	2				
PMU Calculation Grap	phics Application Communication				
Available communication	Communication - ICCP				
🕐 🗒 X	Name for all ICCPs ICCP Main				_
	Local Settings				
OPC	Name	ICCPMAIN	📃 initiator		
	Local Domain Name	nbgdom	Local AR Name	LocalTolCCPREM	
	Remote Settings				
	Remote Domain Name	nbgdom			
	1st Remote AR Name	ICCPREMAddress1	2nd Remote AR Name	ICCPREMAddress2	
	3rd Remote AR Name	ICCPREMAddress3	4th Remote AR Name	ICCPREMAddress3	
	Version				
	ICCP Version	2000-08	Bilateral Table ID	version1	
	Heartbeat				
	🛃 Link Heartbeat		Link Heartbeatinterval (msec)	120	
	Data Package Parameters	3			
	Max MM SPDUSize (bytes)	32000	Client Response Timeout (s)	30	
	Association Request Timeout (s)	60	Association Request Retry (s)	10	
	Server Settings				
	Server Response Timeout (s)	10	Server Reply Timeout (s)	30	
	Shortest Periodic Interval (s)	1			
Project validation					
					э

Figure 4-33 ICCP Communication Settings

The setting options for the properties/ICCP communication settings are explained in the following table.

Table 4-33ICCP Communication Settings

Element	Explanation
Local Settings	
Name	Definition of the name of the ICCP interface.
initiator	If the check box is selected, then SIGUARD PDP is the initiator of the communication.
Local Domain Name	Definition of the local domain name
Local AR name	Local application reference name
Remote Settings	
Remote Domain Name	Domain name of the partner
1st Remote AR name	1st application reference name of the partner Up to 4 names (corresponding to 4 computers at the partner) are support- ed.
2nd Remote AR name	2nd Application reference name of the partner Up to 4 names (corresponding to 4 computers at the partner) are support- ed.
3rd Remote AR name	3rd Application reference name of the partner Up to 4 names (corresponding to 4 computers at the partner) are support- ed.



Element	Explanation
4th Remote AR name	4th Application reference name of the partner Up to 4 names (corresponding to 4 computers at the partner) are support- ed.
Version	
ICCP Version	The ICCP version with which this protocol is supposed to be compatible is set in this list box. The versions 1996-08 and 2000-08 are supported.
Bilateral table ID	Identification of the bilateral table In this table, the information exchanged via the protocol is listed and as- signed an agreed name. Various versions of this table should show dif- ferent identifications.
Heartbeat	
Link heartbeat	If the check box is selected, then test telegrams are exchanged for veri- fication of the functionality of the communication link.
Link heartbeat interval (msec)	Interval between 2 verification telegrams
Data Package Parameters	
Max MM SPDU Size	Maximum size of the PDU for MMS reports, in bytes. The current PDU size is determined between the communicating peers and can be below the maximum size. The PDU size determined is used in order to divide large data volumes into smaller units for delivery.
Client Response Timeout (s)	When the ICCP client receives a select or operate request from a moni- toring unit and sends the request to the ICCP server, this timer starts. The ICCP server must confirm the request before this time runs out.
Association Request Timeout (s)	After this time elapses, the time for a connection attempt has been exceeded. This means that, if your system initializes the connection, then it sends it a message to the peer in order to establish a connection. If no answer arrives within the time set under Association Request Time-out , then your system interprets it as a failed connection establishment. The system then waits for the time set under Association Request Retry , before it tries again to establish a connection. This is only significant if the parameter Association Initiator is set on Yes .
Association Request Retry (s)	This is the number in seconds that must elapse between connection attempts. This means that, after a failed connection attempt, the system may not start a new connection attempt until this time has elapsed. See also Association Request Time-out . This is significant only if the parameter Association Initiator is set on Yes .
Server Settings	
Server Response Timeout (s)	This time-out value is used only by the ICCP server. The ICCP client sends a select or operate request. The ICCP server receives this request and sends it to a supervisory control. The counter does not start until af- terward. The supervisory control must confirm the request within this time. For problem-free operation with ICCP, Siemens recommends setting a value below the Client Response Timeout for this value.



Element	Explanation
Server Reply Timeout (s)	If a message has been sent to a server (peer), time-out does not occur until this number of seconds has passed. When this time runs out and the peer does not answer, then the communication with the remote peer is interrupted.
Shortest Periodic Interval (s)	For an ICCP-Peer, periodic data transmissions in intervals that were pre- viously determined remotely can be necessary. This parameter is the shortest time interval, in seconds, that your system accepts. This param- eter prevents an incorrectly configured Remote-ICCP-Peers from over- whelming your system with data requests. Example: You have set this value, for example, to 30 s. A client creates a transmission group with a periodicity of 10 s. ICCPNT recognizes that this value is too small, creates a protocol entry, and automatically adapts the periodicity of the transmission group to 30 s.

ICCP Measurements

If you have selected the subdirectory **Measurements** of an ICCP protocol, the following middle window section **Communication - ICCP** is displayed.

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Project Edit Help													
📑 🖻 🔒 🖓 🏷 (격 昌	21												1
PMU Calculation Grap	hics	Application Comm	unication										
Available communication	Commu	unication - ICCP Mea	asurements								Default setting	s for drag an	d drop operat
·····································		Measurement		Server objects	\$	Туре	Invert	Slope	Offset Gl	loba	📃 Magnitude	Min1	Max1
•-10 C37118	*										Angle	Min2	Max2
												- Mino	Maxo
											Available meas	urements	
Groupindication										14	Name CohS/400/BlnW/	11	~
											CphS/400/BlnW/	12	=
											CphS/400/BlnW/	U1	
											CphS/400/BlnW/ CphS/400/BlnW/	U2 U3	
											CphS/400/MlhM/ CphS/400/MlhM/	11	
											CphS/400/MlhM/	13	
											CphS/400/MIhM/ CphS/400/MIhM/	P PowerFactor	
											CphS/400/MlhM/ CphS/400/MlhM/	Q 111	
											CphS/400/MlhM/	U2	
											CphS/400/MihM/ CphS/400/NbgH/	U3 /df/dt	
											CphS/400/NbgH/ MobB/400/NbgH	/f /Alarro	
											MchP/400/NbgH	/AT	
											MchP/400/NbgH MchP/400/NbgH	/dt/dt /ET1	
											MchP/400/NbgH	/ET2	
											MchP/400/NbgH	/11	
											MchP/400/NbgH MchP/400/NbgH	/12 /13	
											MchP/400/NbgH	/LET1	
											MchP/400/NbgH MchP/400/NbgH	/LS /SST1	
	<									>	MchP/400/NbgH MchP/400/NbgH	/SST2 /SST3	
	Modify	vevents by clicking the re	espective checkb	x							MchP/400/NbgH	/U1	
	Ma Ma	ignitude M Angle	Min I	Min2	Min3	MaxI	💌 Ма	x2 💌	Max3		MchP/400/NbgH MchP/400/NbaH	/02 /113	¥
										•	(>
Project validation													~
L													3
													4, 4, 4, 4, 4

Figure 4-34 ICCP Measurements

For the definition of the measuring points, defaults must be selected so that only these specific parameters are accepted.

The window section **Default settings for drag and drop operation** contains several check boxes with which it is possible to select which information is transferred over ICCP via drag and drop.

Next, the measuring points are pulled into the middle window section via drag and drop. For every measuring point, a row is created in accordance with the defaults (parameters).

The setting options for the parameters of the measuring points are explained in the following table.

Table 4-34ICCP Parameters for the Measuring Points

Element	Explanation
Server objects	Here, measured values from the Available measurements are saved via drag and drop. Note that, depending on the selection of the Default settings for drag and drop operations , several server objects can be created with one drag and drop operation.
invert	If the check box is selected, then digital values of 1 are transmitted as 0 and vice versa.
Slope	Values from SIGUARD PDP can be adapted in their size with a slope. For example, the voltages in SIGUARD PDP are processed generally in V. If the destination system is supposed to receive the values in kV, then enter a slope of 0.001 here.
Offset	Using the offset, values from SIGUARD PDP can be adapted to the des- tination system by adding the offset to the output value.
Global	If the check box is selected, the destination system can distribute this data via ICCP. If the check box is not selected, then transmission through the destination system is not allowed.

There are 2 options for modifying the events:

- Globally changing the parameters according to the selection in the lower part of the middle window section.
- Manually changing the parameters that cannot be changed globally.

For this, a row of the measuring point is selected. The default parameters are now also selected in the lower part of the window section. Remove the selection, for example, for **Max1**. The corresponding parameters for this row are deleted.



4.8 Communication

\land SIGUARD PDP Engineer I	Projec	t: "NetomacTestnet"								_	-	∎ ×
Project Edit Help												
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PMU Calculation Grap	hics	Application Communi	cation									
Available communication	Comm	unication - ICCP Measu	urements								Default settings for drag and drop	operat
· · · · · · · · · · · · · · · · · · ·		Measurement		Server objects		Туре	Invert	Slope	Offset	Globa	Magnitude Min1	Max1
C37118	•	CphS/400/BlnW/U1				Measu					Angle Min2 Min2	Max2 Max3
				CphS_400_Bln	w_U1_PDPLimitHigh1Vi	Max1						
				CphS_400_Bln	W_U1_PDPLimitLow1Vic	Min1					Available measurements	
Groupindication		CphS/400/MlhM/U1				Measu					CohS/400/BlnW//11	
				CphS_400_MIH	M_U1_PDPLimitLow1Vic	Min1					CphS/400/BlnW/I2	=
				CphS_400_MIH	M_U1_PDPLimitHigh1Vi	Max1					CphS/400/BlnW/U1	
	*										CphS/400/BlnW/U2	
											CphS/400/MIM/J3 CphS/400/MIM/P CphS/400/MIM/PoweFactor CphS/400/MIM/U2 CphS/400/MIM/U2 CphS/400/MIM/U3 CphS/400/MbgH/d/ CphS/400/MbgH/d/ MchP/400/NbgH/d/ MchP/400/NbgH/d/ MchP/400/NbgH/d/ MchP/400/NbgH/d/	
							Drag a	o fill the and drop o	grid conti bjects (me	rol asureme	ents) from the right-hand control into th	he gridvi
	< Modif	y events by clicking the resp	ective checkbo	X Min2	III			~~2	Mw2	>	MchP400/NbgH/12 MchP400/NbgH/13 MchP400/NbgH/L51 MchP400/NbgH/L51 MchP400/NbgH/S511 MchP400/NbgH/S513 MchP400/NbgH/S513 MchP400/NbgH/12	
	M	agnitude 🛃 Angle	Mini	Min2	Min3	MaxI	M 10	axz 👱	j Max3		MchP/400/NbgH/02 MchP/400/NbgH/13	* >
Project validation												•

Figure 4-35 ICCP Measurements with a Hidden Parameter

ICCP Group Indication

With this editor, you can communicate monitoring notifications created through SIGUARD PDP, for example, a communication error to a PMU or an error in the archive, to a SCADA system and display them there. You can select individual messages or entire groups out of a large number of SIGUARD PDP messages and assign them to one or several ICCP events.

If you have selected the subdirectory **Group indication** of an ICCP protocol, the following middle window section **Communication - ICCP - ICCP measurements** is displayed.



Figure 4-36 ICCP Group Indication

Various events are selected that are pulled into the middle window section via drag and drop.



4.8 Communication

💐 SIGUARD PDP Engineer Project: "NetomacTestnet" 💦 🗖 🗙									
Project Edit Help									
📑 🖻 🔒 🗘 🔊 여 昌	2								
PMU Calculation Grap	hics	Application Communication	1						
Available communication	Com	munication - ICCP Groupindic	ation					Ev	ents
* 目 ×		Group indication	Incidencekey	Elementtype	Origin	Invert	Global	Fathe	isD1
▶- <u>1</u> C37118								2	
			PSRError	PSR	PSR Main			2	ISD application
Measurements			PSRError	PSR	PSR common			2	ISD1
Groupindication	•	Test						1	✓ ↓ ISD stopped due to errc
			CommFail	PMUdevice	Muelheim			1	
			CommFail	PMUdevice	Vienna			1	
			CommFail	PMUdevice	Copenhagen			1	+ PSR error
			CommFail	PMUdevice	Munich			1	
			CommFail	PMUdevice	Nuemberg			1	PSB common
			CommFail	PMUdevice	Paris			1	
			CommFail	PMUdevice	Rome			1	
	*								PSBLodampedCriticalPowe
	<							۶	PSR undamped critical PSR Main PSR Distincte/PowerSwing PSR Distinct/PowerSwing PSR Distinct powers win PSR Distinct
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 Project validation 									
									9

Figure 4-37 ICCP Group Indication with Inserted Events

Individual events can be assigned to an existing group (insertion in a gray field under the object name).

Cumulative events are created after insertion as a group with a new object name (insertion in a white field in the row **Object name**).

The setting options for the parameters of the events are explained in the following table.

Table 4-35	ICCP Parameter for Group In	dication
------------	-----------------------------	----------

Element	Explanation
Object name	Name of the ICCP event object
Incidence key	The SIGUARD PDP events selected for transmission to the ICCP desti-
Element type	nation system are identified by Incidence Key and Element Type. Several SIGUARD PDP events can be linked to an ICCP event.
ID	ID is the name of the object that is the reason for the event. You see the same name on the corresponding pages of Engineer on which you parameterize the object. If there is no object that is associated with this event, you have no ID.
invert	This check box controls whether a 0 or a 1 is transmitted with SIGUARD PDP events. If the check box is selected, then a 1 is transmitted by SIGUARD when an event occurs.
Global	If the check box is selected, the destination system can distribute this data via ICCP. If the check box is not selected, then transmission through the destination system is not allowed.


4.8.4 OPC

SIGUARD PDP includes an OPC server that allows access to the data from SIGUARD with the Data Access Profile version 3.



NOTE

You need a corresponding SIGUARD PDP license for the OPC to function. The existence of this license is not queried in the SIGUARD PDP Engineer.

To configure the measuring points for the OPC server, the folder **OPC** is selected.



Figure 4-38

To configure the measuring points for the OPC server, the folder **OPC** is selected and a new OPC server is created.

You can find further information in the Administrator Manual in chapter OCP.



Functions

The following functions can be performed when the folder **OPC** is selected.

Table 4-36	Functions for PDC Servers	and Logical PMUs

Element	Explanation						
*	Click the button New , in order to define a new OPC server and assign measuring points to the OPC server						
×	Click the button Del , in order to delete an existing OPC server.						

OPC Parameters

If you have created a new OPC server, the following middle window section **Communication - OPC** is displayed.

🗟 SIGUARD PDP Engineer	Project: "NetomacTestnet"			_ ■ ×
Project Edit Help				
19 R R V 9 C 4	2			
PMU Calculation Gran	hies Application Communication			
Available communication	Communication - OPC	Available measurements		
* • ×	Glabal same for OPC OPC Clabal	Name	Type	Unit 🔨
		CphS/400/BlnW/I1	Phasor	A
	Server name Port	CphS/400/BlnW/12	Phasor	A
		Cph5/400/BinW/13	Phasor	A
	Measurement	CphS/400/BlnW/U2	Phasor	v III
	*	CphS/400/BlnW/U3	Phasor	∨ ∎
		CphS/400/MlhM/I1	Phasor	A T
		Colors / 400 / MINM / 12	Phasor	A
		CphS/400/MinM/IS CphS/400/MibM/L1	Phasor	Ϋ́ .
		CohS/400/MIhM/U2	Phasor	ý
		CphS/400/MlhM/U3	Phasor	Ý.
		CphS/400/NbgH/df/dt	Analog	Hz/s
		CphS/400/NbgH/f	Analog	Hz
		MlhM < NbgH	Calculat	Degree
		MihM/4UU/NbgH/dt/dt	Analog	Hz/s
		MINM/400/NDgH/r	Phaser	H2
		MINM/400/NDgH711 MINM/400/NDgH711	Phasor	Ä
		MIbM/400/NbgH/13	Phasor	â
		MlhM/400/NbgH/P	Calculat	Ŵ
		MIhM/400/NbgH/U1	Phasor	V
		MIhM/400/NbgH/U2	Phasor	V
		MIhM/400/NbgH/U3	Phasor	V
		NbgH/400/BlnW-Alpha/I1	Phasor	A
		NbgH/400/BlnW-Alpha/I2	Phasor	A
		NBgH/400/BinW-Alpha/13	Phasor	A V
		NboH/400/BinW-Alpha/01	Phasor	v –
		NbgH/400/BlnW-Alpha/U3	Phasor	Ý
		NbgH/400/BlnW-Beta/I1	Phasor	A
		NbgH/400/BlnW-Beta/12	Phasor	A
		NbgH/400/BlnW-Beta/13	Phasor	A
		NbgH/400/BlnW-Beta/U1	Phasor	Y.
		NDgH/4UU/BinW-Beta/U2	Phasor	¥.
		NbgH/400/binw-beta/03	Phasor	Å
		NbaH/400/MlhM/12	Phasor	Â
		NbgH/400/MlhM/13	Phasor	A
		NbgH/400/MlhM/U1	Phasor	V
		NbgH/400/MlhM/U2	Phasor	V
Project validation				
				э

Figure 4-39 Define OPC Server



The setting options for the OPC server are explained in the following table.

Table 4-37	OPC communication settings
------------	----------------------------

Element	Explanation
Server name	Definition of the name of the OPC server.
Port	Port to which the OPC server is connected.
Measurement	Using drag and drop, the measured values from the list Available measurements that are intended to be transmitted through the SIGUARD PDP OPC server can be inserted here.
invert	This setting is active only in the case of digital measured values. If the check box is selected, then the display of the binary signal is invert- ed, that is, a 1 is transmitted as 0 and vice versa.



Figure 4-40 OPC Server with Assigned Measuring Points

You can find further information on saving, activating, and validating the project in chapter 4.9 Shared Functions.



4.9 Shared Functions

For all editors in SIGUARD PDP Engineer, the following shared functions are available.

Entries

An entry field is highlighted in red if an entry is required. Entries are transferred into the configuration by:

- Operating the <Enter> key
- Operating the <Tab> key
- Moving the cursor from out of the entry field

Entries of decimal numbers are only valid if they are entered with a period (for example, 0.01).

Saving a Project

The data of a project should be saved after every change or reconfiguration (local copy of the configuration). A configuration that is not yet valid can be saved but not activated.

Validation

Current errors can be displayed in tooltips during entry. A complete validation takes place via the menu Project

> Validate or via the corresponding icon . If error messages are displayed, re-edit the configuration. If the validation is free of errors, the project can be activated for the runtime process.

Current error messages

For every element that is marked with a warning symbol, 🛃 a quick info (tooltip) can be shown. Point to the element with the cursor. The quick info contains the element type and a description of the error that has appeared.



Figure 4-41 Current Errors in Tooltip

• Error messages after Validation

In the lower window section **Project validation - Errors** error messages are shown based on the validation, for example:

- Info (tab name): Description
- Error (tab name): Error description



4.9 Shared Functions

SIGUARD PDP Engineer Project:	"Testnet"				- 1	r X
Project Edit Graphics						
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PMU Calculation Graphics Ap	olication Communication					
Calculated measurements	Selected calculated measuremen	t	Available measurements			
📑 🖹 🗙	Name	Factor Formula	Name	Туре	Unit	^
A calculated elects Losses NogH MIM Losses NogH MIM Mont Med NogH Mont Med Mont Med NogH Mont Med Mont Med NogH Mont Med Mont	Save results to archive	E X Undefined	1) 1) 1) 1) 1) 1) 1) 1) 1) 1)	Undefin Calculat Digital	? Binayu Binayu Hizayu Hizayu Hizayu Hizayu Binayu V V V V Dibinayu Binayu V V V V V V V V V V V A A A A A V V V V A A A A A A A A A A A A A	10 m
Project validation - Errors: 4 Error (Calculation) Type of the calculation [1] is u Error (Calculation) Factor value of calculation [1] Error (Calculation) Factor value of calculation [1] Error (Calculation) Name of the calculation [1] m	ndefined. is undefined. s undefined. s be changed.		Nood ATTALAN Just	Apples		
	-					

Figure 4-42 Example of an Error Message

This window section can be hidden so that only the header is visible. The number of error messages is dis-

played in the header. If error messages occur, a red warning symbol also appears 🙂 in the header (for example, in the tree structure of **Calculated measurements**), in order to clarify which configuration triggered the error message.

After processing the error messages and a revalidation, no more messages should be displayed. The project is valid.

Activation of a Project

After successful validation, an opened and saved project can be made available to the runtime process. This

takes place via the menu **Project > Activate** or via the corresponding icon **I**. At the same time, the configuration is written to a defined position in SIGUARD PDP UI or an existing configuration with the local copy from SIGUARD PDP Engineer is overwritten. SIGUARD PDP UI must then be restarted.

SIGUARD PDP Phasor Data Processing, Manual E50417-H1076-C419-A3, Release



5 Working with SIGUARD PDP Engineer

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5.1 Overview

With the help of examples, the use of SIGUARD PDP Engineer shall be demonstrated to you.

The suggested procedure is to illustrate the individual steps for parameter assignment with SIGUARD PDP Engineer.



5.2 Example: Project, PMU

Proceed as follows:

- Create a new project.
- Create a new, physical PMU.
- Create a new, logical PMU.
- Define the measuring points for this logical PMU.
- Save the project.
- Perform the validation.
- Activate the project for the runtime process when the configuration is complete.

Creating a New Project

 $\Rightarrow \quad \text{Click the button} \stackrel{[]}{\blacksquare} \text{ in order to create a new project.}$

The dialog for entering the project name appears.

Create New	Project			X
New Project:		 		
		Create	Cancel	

Figure 5-1 Dialog Create New Project

- ♦ Enter the name for the new project.
- ♦ Confirm the entry with the button Create.



5.2 Example: Project, PMU

Opening an Existing Project

♦ Click the button in order to open an existing project.

The dialog for opening the project appears.

Open						? X
Look jn:	🚞 Testnet		-	3 🕫	• 🖽 💙	
. 🎦	Testnet.sef					
Recent						
876						
My Computer						
vly Network Place:	File <u>n</u> ame:	Testnet.sef				<u>O</u> pen
	Files of type:	SIGUARD Engineering File	:			Cancel

Figure 5-2 Dialog Open

- ♦ Select the directory in which the file type **SIGUARD Engineering File** is found.
- ♦ Select the SIGUARD PDP Engineer file (SEF format).
- ♦ Confirm the entry with the button **Open**.

The project data are loaded.



Creating a New, Physical PMU

- ♦ Go to the PMU tab.
- ♦ Select the directory All PMUs.
- ♦ Click the button in the window section **Available PMUs** in order to create a new, physical PMU.

The window for entering the parameters for a physical PMU is displayed.

SIGUARD PDP Engineer Pr	oject: "Testnet'														- 7
i i i i i i i i i i i i i i i i i i i	8 I														
PMU Calculation Graphic	* Application	Communication													
Available PMUs	Selected PMU de	tails													
📑 🗄 🗙	PMU device name			PMU device	e ID D										
🛨 🛄 All PMUs	IP address	255.255.255.255		Port	0										
Vienna	Reporting rate			Timeout	0		sec								
Munich Muelheim	Communication type	tcp 💌													
Paris				-				1	1			1		1	
Rome	Name	PMU dev name	Log PMU ID	Index	Туре	Unit	Archive	Nominal	Min3	Min2	Min1	Max1	Max2	Max3	Factor PSS
			_	_			_	_							
Project Validation															

Figure 5-3 Parameters of a Physical PMU

Fill out the required entry fields marked in red.

♦ Enter the name in the field **PMU device name** and confirm with the **<Enter>** key.

The name will be inherited in the overview Available PMUs.

- ♦ Enter the **PMU device ID** (inherit from the PMU).
- ♦ Enter the IP address (inherit from the PMU).
- ♦ Enter the **Port** (inherit from the PMU).



Creating a New, Logical PMU

Every physical PMU must always have a logical PMU created under it. The new, physical PMU is still marked.

♦ Click the button ¹ in the window section Available PMUs in order to create a new logical PMU.

The window for entering the parameters for a logical PMU is displayed.



Figure 5-4 Parameters of a Logical PMU

Fill out the required entry fields marked in red.

♦ Enter the name in the field Logical PMU name and confirm with the <Enter> key.

The name will be inherited in the overview Available PMUs.

♦ Enter the Logical PMU ID (inherit from the PMU).



Defining Measuring Points

♦ Select the field Name in the table.

The name of the **PMU device** and the **Logical PMU ID** are inherited from the text boxes above.

♦ Enter a name for the measuring point.

A second row is inserted into the table. The line can be used for the definition of a further measuring point.



Figure 5-5 Name of the Measuring Point

- ♦ Enter the **Index** (inherit from the PMU).
- ♦ Enter the type of measuring point via the list box Type (inherit from the PMU).

The selected parameter is inherited.



5.2 Example: Project, PMU

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Project Edit Graphics														
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PMU Calculation Graphic	s A	pplication	Communication											
Available PMUs	Selec	ted PMU de	etails											
_* ■ ×	Logica	I PMU name	Test11		Logical PMU	JID 4								
▼ ☐ AII PMUs			192.168.0.109			4712								
			10 💌			2	sec							
Munich			tep 💌											
Paris														
- Rome		Name	PMU dev name	Log PMU ID	Index	Туре	Unit Arch	ve	Nominal	Min3 Min2	Min1	Max1	Max2	Max3
Test1	1	Nümberg	Test1	4	7	Phasor 💌	?		0	0 0	0	0	0	
	*					Analog	-							
						Digital								
	<													>
Project validation														
L					_				_		_			
	_													



 \diamond Enter the unit of the measuring point via the list box **Unit** (inherit from the PMU).

The selected parameter in inherited.

🔅 SIGUARD PDP Engineer P	roject:	"Testnet												_ • ×
Project Edit Graphics														
達 🔁 🔒 🗘 🔊 (여) 📇 🗄	2													
PMU Calculation Graphi	cs /	Application	Communication											
Available PMUs	Selec	cted PMU d	etails											
📑 🗐 🗙	Logica	al PMU name	Test11		Logical PMU	ID 4								
- 🔄 All PMUs			192.168.0.109			4712								
Vienna			10 -			2								
- Munich														
- Muelheim			tcp 💌											
Rome		Name	PMU dev name	Log PMU ID	Index	Туре	Unit	Archive	Nominal	Min3 M	lin2 Min1	Max1	Max2	Max3
Test1	•	Nümberg	Test1	4	7	Analog	- 7		0		0	0	0	0
lest11	*					-	- ?					8	8	
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Project validation														
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- Select the corresponding check box Archive, if the measured values of the measuring point should be saved in the archive.
- ♦ Enter the rated value in the column Nominal.
- ♦ Enter the lower limiting values (Min1 to Min3) and select the corresponding check box.
- Enter the upper limiting values (Max1 to Max3) and select the corresponding check box.
- \Rightarrow Enter the **Factor PSS** (Standard = 1).
- ♦ Select the check boxes for the values that should be included in the measurement.

Saving a Project

♦ Click the button in order to save a project.

Perform Validation

♦ Click the button in order to check the project for validation.

If errors are still present, these are shown as Error (Project):

If the validation is faulty, it is shown as information Info (Project):



5.2 Example: Project, PMU

SIGUARD PDP Engineer Pi	oject: "Testne	:t"													_ • ×
Project Edit Graphics															
🥶 😼 🔒 🗘 🔊 여기 📇 🗄	2														
PMU Calculation Graphic	s Application	Communicatio	n												
Available PMUs	Selected PMU	details													
<u>™ ∎ ×</u>	Logical PMU name	e Test11		Log	jical PMU ID	4									
AIPMUs AIPMUs Vienna Murich Mucheim Ais Paris	IP address 192.168.0.109 Pot 4712 Reporting rate 10 Tressuit 2 Communication type top • Name PMU dev name Loo PMU ID Index Type Index Type Unit											Factor PSS			
Test1	// Jiimberg	Teel1	4	7	Pharor -	V -		400000	360000	290000	290000	410000	430000	460000	1
-	* vanbeig	Testi	4	1	r nasur	v .		400000	- 30000	- 30000	33000	410000	430000	+00000	
Project Validation Info (Graphics): No Graphic Data is Lo	¢.								8						>
Figure 5-8	Info (P	roiect):													

Activating Project

♦ Click the button in order to save a project for the runtime process.

NOTE

Activate the project only after the configuration is complete.



5.3 Example: Calculated Values

Proceed as follows:

- Create a new project (see 5.2 Example: Project, PMU).
- Create a new calculated value.
- Set the parameters for this calculated value.
- Save the project.
- Perform the validation.
- Activate the project for the runtime process when the configuration is complete.

Create New, Calculated Values

- Select the Calculation tab.
- Select the directory All calculated objects.
- \diamond Click the button 2 in order to create a new calculated value.

The window for entering the parameters is displayed.

Project Edit Graphics						
i 🔁 📑 😳 🕒 🦳 📑 🔽 I						
PMU Calculation Graphics Ap	pplication Communication					
alculated measurements	Selected calculated measurement			Available measurements		
* 🗉 🗙	Name	Factor	Formula	Name	Type	Unit
Alculated measurements Alculated measurements Alculated abjects Alculated abjects Alculated abjects Mink (Ng)H Mink (Ng)	Selected calculated measurement Name Save results to archive	Factor ×	Fonde	Avdiable measurements Name [1] Lones Nigh MiM McF/400/Nigh/Malm Nigh/400/Rim/Aipha/Malm Nigh/400/Rim/Aipha/M	Type Undefn Digital Analog Digital Analog Phasor	Unit ? W Binagy Hi2/s Disbinagy Hi2/s A A A Binagy Hi2/s Binagy V Disbinagy V Disbinagy V Disbinagy V V V Disbinagy V V V V V V V V V A A A A A A V V V V A A V V A A V V A A V V A A V V A A V V A A V V
				NbgH/400/VieB-Alpha/df/dt NbgH/400/VieB-Alpha/f	Analog	Hz
					Dissource	۵.

Figure 5-9 Parameters for a Calculated Value

Fill out the required entry fields marked in red.

♦ Enter the name of the new, calculated value and confirm with the **<Enter>** key.

The name will be changed in the overview accordingly.



 \Rightarrow Enter the **Factor** (Standard = 1).

♦ Enter a formula via the list box Formula (for example, Add two analogs).

The selected formula is inherited.

💐 SIGUARD PDP Engineer Project:	"Testnet"						-	∎ ×
Project Edit Graphics								
🥂 🔁 🔂 🗘 🏷 (적) 📇 🔛 [
PMU Calculation Graphics A	opplication Communication							
Calculated measurements	Selected calculated measurement				Available measurements			
* = ×	Name	Factor	Formula		Name	Туре	Unit	^
PMU Calculation Graphics / Colculated measurements Colculated measurements Colculated measurements Colculated measurements Colculated beforeds A Leak-Valded beforeds Mither N NbgH Mither NbgH Mither NbgH Mither NbgH Mither NbgH Mither	ppleiden Communication Selected calculated measurement I est2 Save results to archive	Factor = 1 x	Formula Income Income Judit real Adde to possible Adde to pos	Y	Name Losses Night MM MdePA00Nbg/rAlam MedPA00Nbg/rAlam MedPA00Nbg/rAlam	Type Calculat. Digital	$\label{eq:constraints} \begin{array}{ c c c c c } \hline Unit & \forall & \forall & \\ \hline & \forall & \forall & \\ \hline & & \forall & \forall & \\ \hline & & \forall & & \\ \hline & & \forall & & \\ \hline & & & & \\ \hline & & & & \\ \hline & & & &$	н
					NbgH/400/MINH/1 NbgH/400/MINH/12 NbgH/400/MINH/12 NbgH/400/MINH/12 NbgH/400/MINH/12 NbgH/400/MINH/12 NbgH/400/MIS-Ajbha/12 NbgH/400/MIS-Ajbha/1 NbgH/400/MIS-Ajbha/1 NbgH/400/MIS-Ajbha/1	Phasor Phasor Phasor Calculat Phasor Phasor Analog Analog Phasor Phasor	A A W V V Hz/s Hz A A	2
Project validation						. 110001		
Info (Graphics) :No Graphic Data is Loaded								

Figure 5-10 Selection of the Formula

Select the check box Save results to archive, if the calculated measurement should be saved in the archive.

Saving a Project

 \diamond Click the button \square in order to save a project.

Perform Validation

 \diamond Click the button \square in order to check the project for validation.

If errors are still present, these are shown as Error (Calculation):



Figure 5-11 Missing Input Measurand

The missing input measurand is shown as an error (fields are highlighted in red).

Drag the input measurands from Available measurements (Type: Analog) into the fields Input measurements.

The error messages are no longer shown.

Activating Project

 \diamond Click the button in order to save a project for the runtime process.



NOTE

Activate the project only after the configuration is complete.





Working with SIGUARD PDP Engineer

5.3 Example: Calculated Values



Literature

/1/ Siemens AG; SIMEAS R-PMU, Digital Fault Recorder, Manual; E50417-H1000-C360-A2



Literature



Glossary

Google Earth

Google Earth is software from the company Google Inc. and displays a virtual globe. It can overlay satellite and aerial images of different resolutions with geodata and show them on a digital elevation model of the earth.

In SIGUARD PDP, the map that is displayed in the window section **SIGUARD PDP UI - Map** is created based on maps from Google Earth.

SIGUARD PDP (Phasor Data Processing)

Software for monitoring the status of power distribution in extensive power-supply systems.

SIMEAS R-PMU

SIMEAS R-PMU is a device that, in addition to writers, contains an integrated **Phasor Measurement Unit** (**PMU**). The PMU measures phasors and makes them available in a database. This is a highly accurate measurement of the vector quantities of voltage and current in terms of amplitude, phase angle, and time synchronization.



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