ABB

RELION® PROTECTION AND CONTROL

REF615R
Engineering Manual

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Conformity

This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2006/95/EC). This conformity is the result of tests conducted by ABB in accordance with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the product standards EN 60255-1 and EN 60255-27 for the low voltage directive. The product is designed in accordance with the international standards of the IEC 60255 series and ANSI C37.90. This product complies with the UL 508 certification.

Safety information

Dangerous voltages can occur on the connectors, even though the auxiliary voltage has been disconnected.

Non-observance can result in death, personal injury or substantial property damage.

Only a competent electrician is allowed to carry out the electrical installation.

National and local electrical safety regulations must always be followed.

The frame of the protection relay has to be carefully grounded.

When the plug-in unit has been detached from the case, do not touch the inside of the case. The relay case internals may contain high voltage potential and touching these may cause personal injury.

The protection relay contains components which are sensitive to electrostatic discharge. Unnecessary touching of electronic components must therefore be avoided.

Whenever changes are made in the protection relay, measures should be taken to avoid inadvertent tripping.

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Section 1   Introduction

1.1   This manual

The engineering manual contains instructions on how to engineer the protection relays using the different tools in PCM600. The manual provides instructions on how to set up a PCM600 project and insert relays to the project structure. The manual also recommends a sequence for engineering of protection and control functions, LHMI functions as well as communication engineering for IEC 61850 and other supported protocols.

1.2   Intended audience

This manual addresses system and project engineers involved in the engineering process of a project, and installation and commissioning personnel, who use technical data during engineering, installation and commissioning, and in normal service.

The system engineer must have a thorough knowledge of the application, protection and control equipment and the configured functional logic in the relays. The installation and commissioning personnel must have a basic knowledge of handling electronic equipment.

1.3 Product documentation

1.3.1 Product documentation set
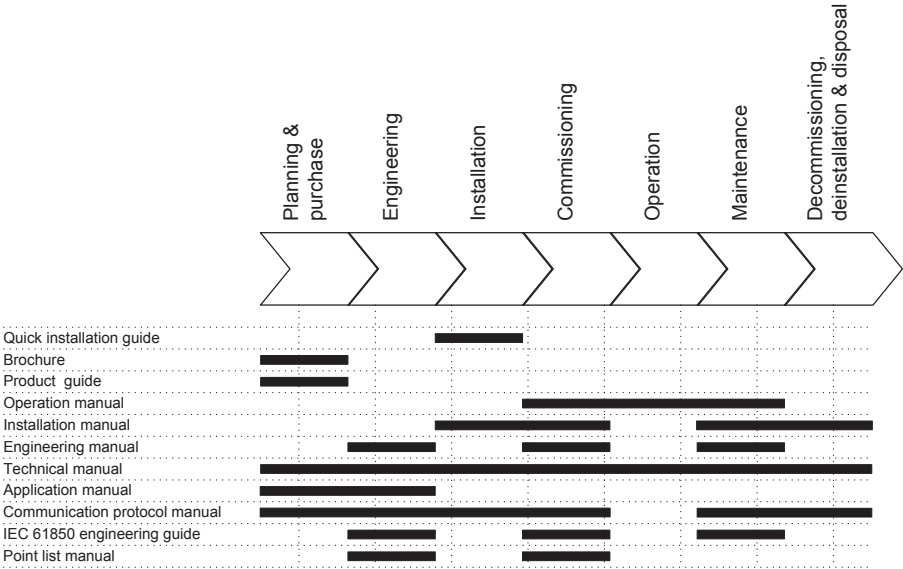
Figure 1: The intended use of documents during the product life cycle

1.3.2 Document revision history

Document revision/date	Product version	History
A/2013-11-22	4.0	First release
B/2019-07-02	4.1	Content updated

Download the latest documents from the ABB Web site
http://www.abb.com/substationautomation.

1.3.3 Related documentation

Product series- and product-specific manuals can be downloaded from the ABB Web site
http://www.abb.com/substationautomation.

1.4 Symbols and conventions

1.4.1 Symbols

The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.

The information icon alerts the reader of important facts and conditions.

The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although warning hazards are related to personal injury, it is necessary to understand that under certain operational conditions, operation of damaged equipment may result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warning and caution notices.

1.4.2 Document conventions

A particular convention may not be used in this manual.

- Abbreviations and acronyms are spelled out in the glossary. The glossary also contains definitions of important terms.
- Push button navigation in the LHMI menu structure is presented by using the push button icons.
  To navigate between the options, use ⬆ and ⬇.
- Menu paths are presented in bold.
  Select **Main menu/Settings**.
- WHMI menu names are presented in bold.
  Click **Information** in the WHMI menu structure.
- LHMI messages are shown in Courier font.
  To save the changes in nonvolatile memory, select `Yes` and press ⏎.
- Parameter names are shown in italics.
  The function can be enabled and disabled with the *Operation* setting.
- Parameter values are indicated with quotation marks.
  The corresponding parameter values are "Enabled" and "Disabled".
- Input/output messages and monitored data names are shown in Courier font.

When the function picks up, the `PICKUP` output is set to TRUE.
- Dimensions are provided both in inches and mm. If it is not specifically mentioned, the dimension is in mm.

1.4.3   Functions, codes and symbols

All available functions are listed in the table. All of them may not be applicable to a specific configuration.

Table 1:   Functions included in the protection relay

Function	IEC 61850	IEC 60617	REF615R
Protection			
Three-phase non-directional overcurrent protection, low stage, instance 1	PHLPTOC1	3I> (1)	51P-1
Three-phase non-directional overcurrent protection, high stage, instance 1	PHHPTOC1	3I>> (1)	50P-1
Three-phase non-directional overcurrent protection, high stage, instance 2	PHHPTOC2	3I>> (2)	50P-2
Three-phase non-directional overcurrent protection, instantaneous stage, instance 1	PHIPTOC1	3I>>> (1)	50P-3
Three-phase non-directional long time overcurrent protection, low stage, instance 1	PHLTPTOC1	3I> (3)	51LT
Three-phase directional overcurrent protection, low stage, instance 1	DPHLPDOC1	3I> -> (1)	67/51P
Three-phase directional overcurrent protection, high stage, instance 1	DPHHPDOC1	3I>> -> (1)	67/50P-1
Three-phase directional overcurrent protection, high stage, instance 2	DPHHPDOC2	3I>> -> (2)	67/50P-2
Non-directional earth-fault protection, low stage, instance 1	EFLPTOC1	Io> (1)	51G
Non-directional earth-fault protection, low stage, instance 2	EFLPTOC2	Io> (2)	51N-1
Non-directional earth-fault protection, low stage, instance 4	EFLPTOC4	Io> (4)	50SEF
Non-directional earth-fault protection, high stage, instance 1	EFHPTOC1	Io>> (1)	50G-1
Non-directional earth-fault protection, high stage, instance 2	EFHPTOC2	Io>> (2)	50G-2
Non-directional earth-fault protection, high stage, instance 3	EFHPTOC3	Io>> (3)	50N-1
Non-directional earth-fault protection, high stage, instance 4	EFHPTOC4	Io>> (4)	50N-2
Non-directional earth-fault protection, instantaneous stage, instance 1	EFIPTOC1	Io>>> (1)	50G-3
Non-directional earth-fault protection, instantaneous stage, instance 2	EFIPTOC2	Io>>> (2)	50N-3
Directional earth-fault protection, low stage, instance 1	DEFLPDEF1	Io> -> (1)	67/51N
Directional earth-fault protection, high stage, instance 1	DEFHPDEF1	Io>> -> (1)	67/50N-1
Directional earth-fault protection, high stage, instance 2	DEFHPDEF2	Io>> -> (2)	67/50N-2
Three phase directional power protection, instance 1	DPSRDIR1	I1-> (1)	32P-1
Ground directional power protection, instance 1	DNZSRDIR1	I2 ->, Io-> (1)	32N-1
Negative-sequence overcurrent protection, instance 1	NSPTOC1	I2> (1)	46-1
Negative-sequence overcurrent protection, instance 2	NSPTOC2	I2> (2)	46-2
Phase discontinuity protection	PDNSPTOC1	I2/I1>	46PD
Table continues on next page			

Function	IEC 61850	IEC 60617	REF615R
Residual overvoltage protection, instance 1	ROVPTOV1	Uo> (1)	59G
Residual overvoltage protection, instance 2	ROVPTOV2	Uo> (2)	59N-1
Three-phase undervoltage protection, instance 1	PHPTUV1	3U< (1)	27-1
Three-phase undervoltage protection, instance 2	PHPTUV2	3U< (2)	27-2
Three-phase overvoltage protection, instance 1	PHPTOV1	3U> (1)	59-1
Three-phase overvoltage protection, instance 2	PHPTOV2	3U> (2)	59-2
Negative-sequence overvoltage protection, instance 1	NSPTOV1	U2> (1)	47-1
Negative-sequence overvoltage protection, instance 2	NSPTOV2	U2> (2)	47-2
Frequency protection, instance 1	FRPFRQ1	f>/f<,df/dt (1)	81-1
Frequency protection, instance 2	FRPFRQ2	f>/f<,df/dt (2)	81-2
Voltage per hertz protection, instance 1	OEPVPH1	U/f> (1)	24
Three-phase thermal protection for feeders, cables and distribution transformers, Instance 1	T1PTTR1	3Ith>F (1)	49F-1
Numerical stabilized low impedance restricted earth-fault protection	LREFPNDF1	dIoLo>	87LOZREF
Circuit breaker failure protection, instance 1	CCBRBRF1	3I>/Io>BF (1)	50BF-1
Three-phase inrush detector, instance 1	INRPHAR1	3I2f> (1)	INR-1
Master trip, instance 1	TRPPTRC1	Master Trip (1)	86/94-1
Master trip, instance 2	TRPPTRC2	Master Trip (2)	86/94-2
Arc protection, instance 1	ARCSARC1	ARC (1)	AFD-1
Arc protection, instance 2	ARCSARC2	ARC (2)	AFD-2
Arc protection, instance 3	ARCSARC3	ARC (3)	AFD-3
High impedance fault detection	PHIZ1	PHIZ1	HIZ
Load shedding and restoration, instance 1	LSHDPFRQ1	UFLS/R (1)	81LSH-1
Load shedding and restoration, instance 2	LSHDPFRQ2	UFLS/R (2)	81LSH-2
Loss of phase, instance 1	PHPTUC1	3I< (1)	37-1
Control			
Circuit-breaker control, instance 1	CBXCBR1	I <-> O CB (1)	52-1
Auto-reclosing	DARREC1	O -> I	79
Synchronism and energizing check	SECRSYN1	SYNC	25
Condition monitoring			
Circuit-breaker condition monitoring, instance 1	SSCBR1	CBCM (1)	52CM-1
Current circuit supervision	CCRDIF1	MCS 3I	CCM
Fuse failure supervision, intance 1	SEQRFUF1	FUSEF (1)	60-1
Cable fault detection	RCFD1	RCFD	CFD
Measurement			
Three-phase current measurement, instance 1	CMMXU1	3I	IA, IB, IC
Sequence current measurement, instance 1	CSMSQI1	I1, I2, I0	I1, I2, I0
Table continues on next page			

Function	IEC 61850	IEC 60617	REF615R
Residual current measurement, instance 1	RESCMMXU1	Io	IG
Three-phase voltage measurement, instance 1	VMMXU1	3U	VA, VB, VC
Residual voltage measurement, instance 1	RESVMMXU1	Uo	VG
Sequence voltage measurement, instance 1	VSMSQI1	U1, U2, U0	V1, V2, V0
Single-phase power and energy measurement, instance 1	SPEMMXU1	SP, SE	SP, SE-1
Three-phase power and energy measurement, instance 1	PEMMXU1	P, E	P, E-1
Current total demand distortion, instance 1	CMHAI1	PQM3I	PQI-1
Voltage total harmonic distortion, instance 1	VMHAI1	PQM3U	PQVPH-1
Voltage variation, instance 1	PHQVVR1	PQ 3U<>	PQSS-1
Voltage unbalance, instance 1	VSQVUB1	PQMUBU(1)	PQVUB-1
Load profile	LDPMSTA1	-	LoadProf
Frequency measurement, instance 1	FMMXU1	f	f
Other			
Minimum pulse timer (2 pcs), instance 1	TPGAPC1	TP (1)	TP (1)
Minimum pulse timer (2 pcs), instance 2	TPGAPC2	TP (2)	TP (2)
Minimum pulse timer (2 pcs), instance 3	TPGAPC3	TP (3)	TP (3)
Minimum pulse timer (2 pcs), instance 4	TPGAPC4	TP (4)	TP (4)
Minimum pulse timer (2 pcs, second resolution), instance 1	TPSGAPC1	TPS (1)	62CLD-1
Minimum pulse timer (2 pcs, minute resolution), instance 1	TPMGAPC1	TPM (1)	62CLD-2
Pulse timer (8 pcs), instance 1	PTGAPC1	PT (1)	PT-1
Pulse timer (8 pcs), instance 2	PTGAPC2	PT (2)	PT-2
Time delay off (8 pcs), instance 1	TOFGAPC1	TOF (1)	TOF-1
Time delay off (8 pcs), instance 2	TOFGAPC2	TOF (2)	TOF-2
Time delay on (8 pcs), instance 1	TONGAPC1	TON (1)	TON -1
Time delay on (8 pcs), instance 2	TONGAPC2	TON (2)	TON -2
Set reset (8 pcs), instance 1	SRGAPC1	SR (1)	SR-1
Set reset (8 pcs), instance 2	SRGAPC2	SR (2)	SR-2
Set reset (8 pcs), instance 3	SRGAPC3	SR (3)	SR-3
Set reset (8 pcs), instance 4	SRGAPC4	SR (4)	SR-4
Move (8 pcs), instance 1	MVGAPC1	MV (1)	MV-1
Move (8 pcs), instance 2	MVGAPC2	MV (2)	MV-2
Move (8 pcs), instance 3	MVGAPC3	MV (3)	MV-3
Move (8 pcs), instance 4	MVGAPC4	MV (4)	MV-4
Move (8 pcs), instance 5	MVGAPC5	MV (5)	MV-5
Move (8 pcs), instance 6	MVGAPC6	MV (6)	MV-6
Move (8 pcs), instance 7	MVGAPC7	MV (7)	MV-7
Table continues on next page			

Function	IEC 61850	IEC 60617	REF615R
Move (8 pcs), instance 8	MVGAPC8	MV (8)	MV-8
Generic control points, instance 1	SPCGGIO1	SPC(1)	CNTRL-1
Generic control points, instance 2	SPCGGIO2	SPC(2)	CNTRL-2
Generic control points, instance 3	SPCGGIO3	SPC(3)	CNTRL-3
Remote Generic control points, instance 1	SPCRGGIO1	SPCR(1)	RCNTRL-1
Local Generic control points, instance 1	SPCLGGIO1	SPCL(1)	LCNTRL-1
Programmable buttons(16 buttons), instance 1	FKEYGGIO1	FKEY	FKEY
Generic Up-Down Counters, instance 1	UDFCNT1	CTR(1)	CTR-1
Generic Up-Down Counters, instance 2	UDFCNT2	CTR(2)	CTR-2
Generic Up-Down Counters, instance 3	UDFCNT3	CTR(3)	CTR-3
Shift register, instance 1	SHFTGAPC1	SHFT(1)	SHFT-1
Shift register, instance 2	SHFTGAPC2	SHFT(2)	SHFT-2
Shift register, instance 2	SHFTGAPC3	SHFT(3)	SHFT-3
Logging functions			
Disturbance recorder	RDRE1	-	DFR
Fault recorder	FLTMSTA1	-	FR
Sequence event recorder	SER	-	SER
Fault location	DRFLO1	FLO	FLO

Section 2   IED engineering process

PCM600 is used for various tasks in the IED engineering process.

- IED engineering management

  - Organizing the bay IEDs in the structure of the substation by defining voltage levels and bays below the substation. PCM600 manages the project.
  - Configuring the IED functions (for example, protection and control functions) by using the Application Configuration tool.
  - Configuring the parameters and setting values for the IED itself and for the process functions by using the Parameter Setting tool.
  - Drawing single-line diagrams and making links to dynamic process values by using the Graphical Display Editor. The single-line diagrams are displayed in LHMI on the bay IED.
  - Configuring connections between the application configuration function blocks and physical hardware input and outputs by using the Signal Matrix tool.

- Communication management

  - IEC61850 station communication engineering can be done with the IEC61850 Configuration tool within PCM600 for small to moderate station level projects including only Relion products. A separate tool like IET600 is required for integration with non-Relion products as well as for large projects. PCM600 interacts with IET600 or any external tool by importing and exporting SCL files.
  - Configuring the GOOSE receive data connections to the IED's application configuration function blocks by using the Application Configuration tool and the Signal Matrix tool.
  - Configuring protocol data mapping for Modbus or DNP3 with the Communication Management tool.

- Disturbance record management

- Generating overviews on the available (digital fault) recordings in all connected protection IEDs by using the Disturbance Handling tool.
- Manually reading the recording files (in the COMTRADE format) from the protection IEDs by using the Disturbance Handling tool or automatically by using the PCM600 Scheduler.
- Managing recording files with the Disturbance Handling tool.
- Creating recording file content overview reports for fast evaluation with assistance of the Disturbance Handling tool.

- Service management

   - Monitoring the selected signals of an IED for commissioning or service purposes by using the Signal Monitoring tool.

IED Engineering Management

Project ACT SMT PST GDE

Communication Management

ACT CMT SMT

Disturbance Record Management

DHT

Service Management

MON EVT

Station Engineering Management
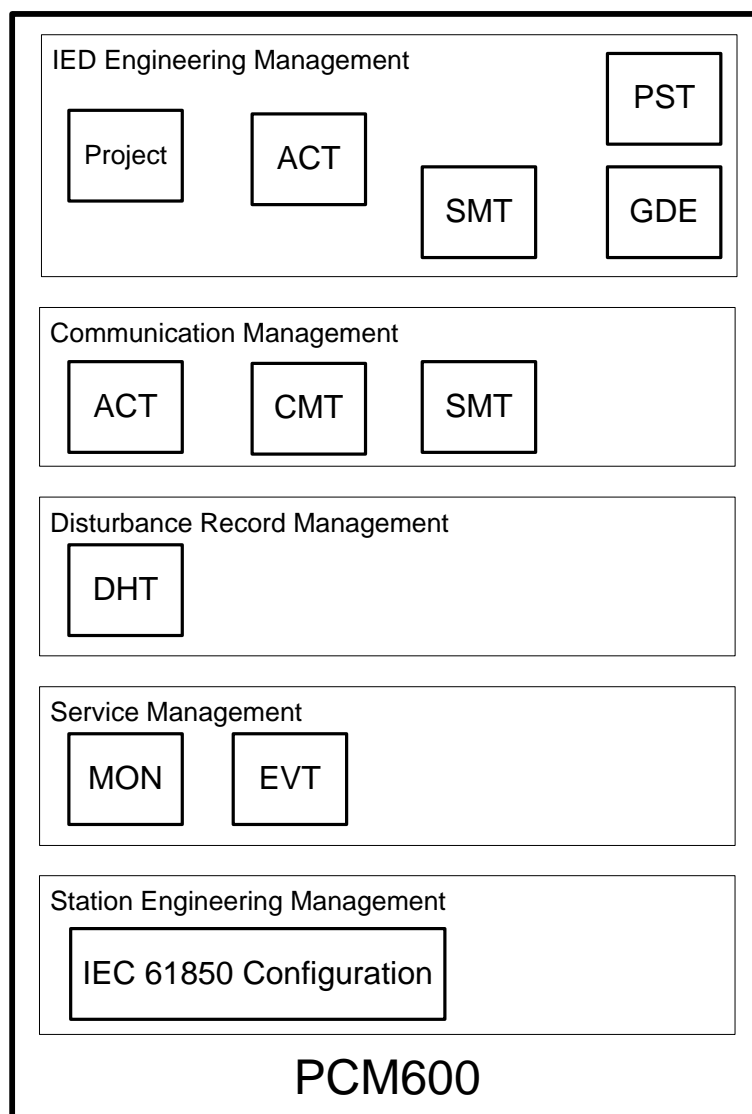
IEC 61850 Configuration

PCM600

Figure 2:   Organization of PCM600 in different management tasks

There are also additional functions for managing projects and organizing user rights.

- PCM600 user management
  - Organizing users regarding their rights, profiles and passwords to use different tools and functions in the tools.
  - Defining allowed activities for user profiles to use tools in PCM600.

Once the engineering of the IED is finished, the results must be written to the IED.

The connection between the physical IED and PCM600 is established via an Ethernet link on the front or rear port on the IED.

2.1 Monitoring and control system structure

The monitoring and control system for electrical substations contains a number of devices for various purposes.

> See PCM600 documentation for the recommended size of a project. Larger projects can be divided into several PCM600 projects.
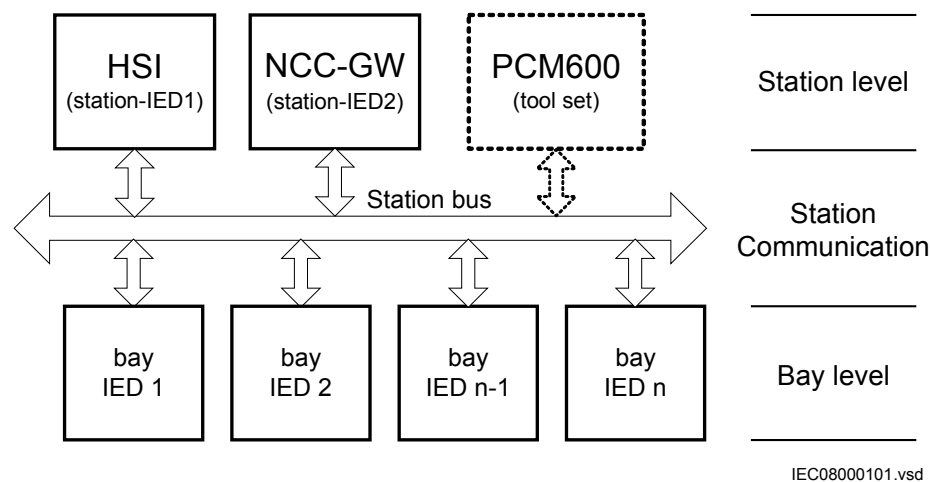

IEC08000101.vsd

Figure 3:   Principle structure of a monitoring and control system for a substation

The monitoring and control system can be divided into three main parts.

*   Bay level devices
*   Station communication
*   Station level devices

All three parts require specific engineering and configuration.

A plant structure is used to identify each device in its location within the substation organization. The plant structure is a logical image of the substation and the bays within the substation. The organization structure for the devices may differ from the structure of the primary equipment in the substation.

In PCM600 it is possible to set up a hierarchical structure of five levels for the device identification.

- Project
- Substation = name of the substation
- Voltage level = identifies to which grid type or part the device belongs in the substation
- Bay = bay within the voltage level
- IED = the selection of the IED that is used in the bay; it is possible to insert several IEDs within a bay, for example, one control device and two protection relays

2.2 Standard configuration concept

The product series covers protection relays developed for the protection of medium voltage applications. Every product has predefined application-specific software called standard configuration that contains protection, control, supervision and measurement function blocks and default logical connections; for more information, see the application manuals. The product also includes the standard configuration specific default single-line diagram.

The standard configuration software consists of connections between an application's functions developed according to the needs of a particular functional application. The inputs and outputs are similarly assigned to a default set of connections such as position indication and Master trip. The alarm LEDs are assigned to default connections based on the order number.

> Current and voltage channels for protection and measurement functions are fixed as a part of standard configuration and cannot be reassigned with Signal Matrix or Application Configuration in PCM600.

The single-line diagram consists of an application-specific general arrangement of a single-line diagram that includes position indications and the selection of controllable objects and measurements.

The content of the standard configuration depends on the intended functional application. The standard configurations also have selectable software options, which are selected when ordering the protection relay. Some of the software options are related to the protection relay hardware.

The standard configurations can be used as is, but they can also be modified by using the PCM600. The standard configuration itself can be modified or extended by using the Application Configuration tool, the Signal Matrix tool and the communication

configuration tools. The single-line diagram can also be modified with Graphical Display Editor.

All functions and application logic included in a standard configuration of the protection relay can be in use at the same time.

However, by removing unused function blocks from the configuration with the Application Configuration in PCM600, more resources in the protection relay become available for other purposes.

- More advanced user application logic with Application Configuration
- Extensive use of GOOSE sending and receiving
- Increasing the amount of data reported for IEC 61850 clients

2.3 Workflow
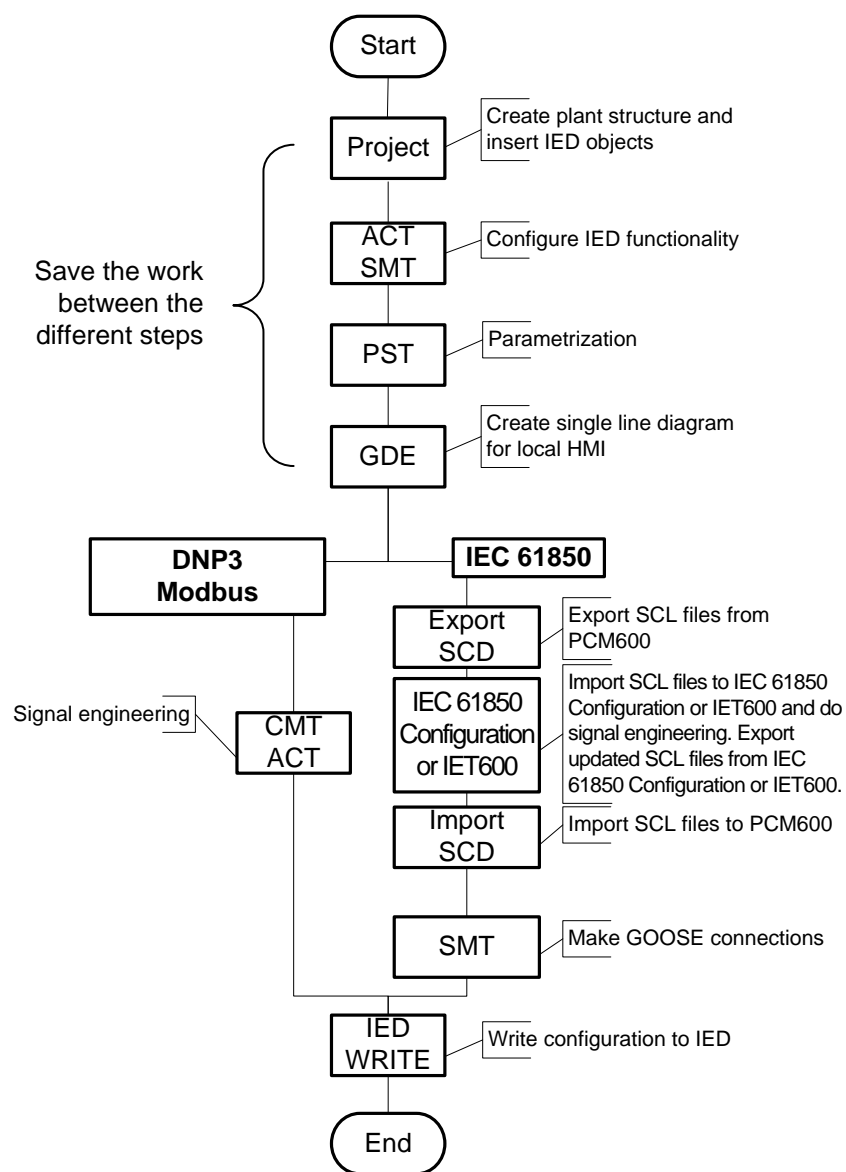
Figure 4: *IED engineering workflow proposal based on practical experience and dependencies of the steps*

It is possible to make a different kind of a sequence based on the information available at the time when the project is started. This means that several iterations may be needed to complete the project.

Setting up a PCM600 project

- The plant structure is built according to the substation structure.

> See PCM600 documentation for the recommended size of a project. Larger projects can be divided into several PCM600 projects.

- In order to add an IED to a project, a suitable ConnPack is needed. IEDs can be added either while connected, disconnected or through other means such as an IED template.
- IED objects are uniquely named within the PCM600 project.

Application configuration in the Application Configuration tool

- Protection and control functions can be configured as needed.
- The configuration made in the Application Configuration tool is saved to make the interfaces and signals available for other engineering tools within PCM600, for example, for the Parameter Setting tool.

Parameter setting and configuration in the Parameter Setting tool

- Configuration parameters such as CT and VT conversion values of the transformer module are checked by the tool.
- If needed, the setting values are checked and adjusted with the Parameter Setting tool.

Single-line diagram configuration in the Graphical Display Editor

- It is possible to create a single-line diagram for the switching devices in the bay.
- Measurements can be included when needed.
- The dynamic elements are linked to the functions created in the Application Configuration tool; for example, a breaker object is linked to the circuit breaker control function.

LHMI engineering

- The LED behavior is defined with Parameter Setting.
- The LEDs are configured with Application Configuration.

Communication protocol engineering

- The communication engineering details are protocol dependent.
- The connectivity package creates the IEC 61850 configuration for vertical communication automatically and it is directly suitable, in most cases, for IEC 61850

client configuration. In smaller projects, when Relion series of IEDs are involved, the internal IEC 61850 configuration tool can be used for horizontal communication. When non-Relion IEDs are involved or when the projects are bigger, a tool like IET600 can be used.
- The Communication Management tool is used for communication protocols; for example, Modbus and DNP3.

The IED restarts automatically when writing an IED configuration where changes have been made. It is not possible to communicate with the IED during restart.

Section 3   PCM600 tool

Protection and Control IED Manager PCM600 offers all the necessary functionality to work throughout all stages of the protection relay life cycle.

*   Planning
*   Engineering
*   Commissioning
*   Operation and disturbance handling
*   Functional analysis

With the individual tool components, you can perform different tasks and functions and control the whole substation. PCM600 can operate with many different topologies, depending on the customer needs.

PCM600 is used to conduct complete engineering and configuration activities needed for the bay level IEDs.

Connectivity Packages are separate software packages that provide type and version information to PCM600. Further Connectivity Packages assist the tool with communications.

PCM600 uses IEC 61850 over Ethernet to communicate with bay IEDs. This communication allows PCM600 to configure and monitor the IEDs. In addition to IEC 61850 the IEDs have optional communications protocols and hardware to connect to station engineering tools. PCM600 provides the ability to export the configuration of the IEDs or entire substation in a standard file format which allows for station engineering.

A PC with PCM600 can be connected to any REF615R IED within a station by using the Ethernet connection. The connection can also be used for service and maintenance purposes. In addition, the connection is used to handle digital fault records from the protection IEDs.

The modern-day IEDs are designed using the concept of the IEC 61850 standard. This is primarily in regards to how functions within the IED are modelled and how the IED is represented in the substation. See the IEC 61850 parameter list for the list of logical nodes available in the IED and observe how they follow the structure and rules as defined in part 7 of the standard.

The engineering of the used communication protocols is a separate task and an addition to the engineering of protection and control functions.

PCM600 can be used for different purposes throughout the IED life cycle. A set of special tools is available for different applications.

The applications can be organized into groups.

- IED product engineering
- IED communication engineering per protocol
- IED system monitoring
- IED product diagnostic

Symbol standard and naming style can be set in PCM600 by selecting **Tools/Options/ System Settings**. For further information regarding the system settings, see PCM600 online help.
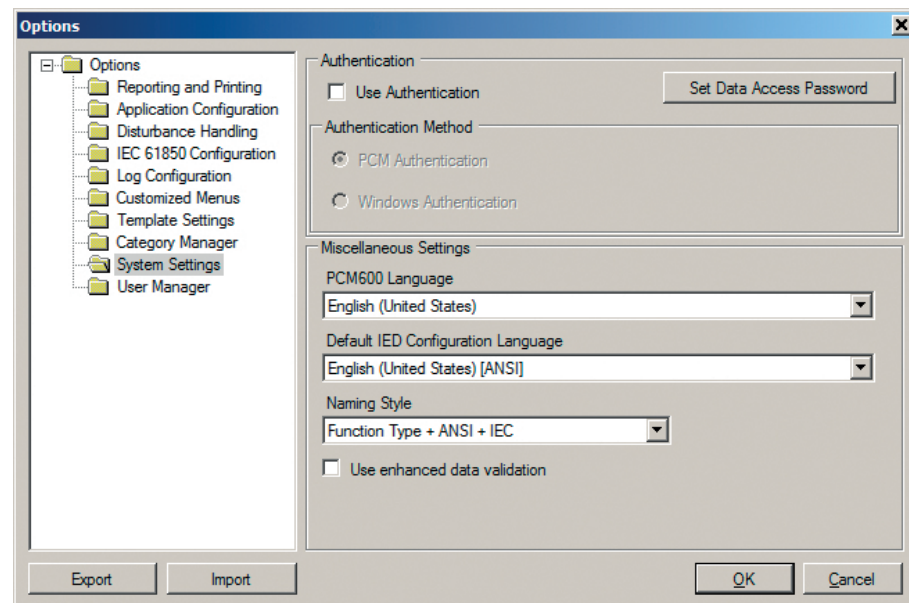

Figure 5:   *Symbol standard and naming options*

The system settings must be set before a new PCM600 project is started. For more information, see PCM600 documentation.

3.1 Connectivity packages

A connectivity package is a software component that consists of executable code and data which enables system tools to communicate with a protection relay. Connectivity packages are used to create configuration structures in PCM600. The latest PCM600 and connectivity packages are backward compatible with older protection relay versions.

A connectivity package includes all the data which is used to describe the protection relay. For example, it contains a list of the existing parameters, data format used, units, setting range, access rights and visibility of the parameters. In addition, it contains code which allows software packages that use the connectivity package to properly communicate with the protection relay. It also supports localization of text even when it is read from the protection relay in a standard format such as COMTRADE.

Update Manager is a tool that helps in defining the right connectivity package versions for different system products and tools. Update Manager is included with the products that use connectivity packages.

3.2 PCM600 and IED connectivity package version

- Protection and Control IED Manager PCM600 Ver.2.5 or later
- REF615R Connectivity Package Ver.4.0 or later

> Download connectivity packages from the ABB Web site
> http://www.abb.com/substationautomation

3.3 PCM600 projects

A typical project in PCM600 contains a plant structure including one or several IED objects, where each IED object contains the engineering data created or modified using the different PCM600 tools.

Several projects can be created and managed by PCM600, but only one project can be active at a time.

With PCM600, it is possible to do various tasks.

- Open existing projects
- Import projects
- Create new projects
- Export projects
- Delete projects
- Rename projects
- Copy and paste projects

The extension of the exported project file is .pcmp. The files are only used for exporting and importing projects between PCM600s.

3.4 Communication between PCM600 and the protection relay

The communication between the protection relay and PCM600 is independent of the used communication protocol within the substation or to the NCC.

All communication is done over Ethernet using the IEC 61850 protocol.

Each protection relay has an Ethernet interface connector on the front and optionally on the rear side as well. The Ethernet connector can be used for communication with PCM600.

When an Ethernet-based station protocol is used, the same Ethernet port and IP address can be used for PCM600 communication.

Two basic variants have to be considered for the connection between PCM600 and the protection relay.

- Direct point-to-point link between PCM600 and the protection relay's front port
- Indirect link via station LAN or from remote via network

1. If needed, the IP address for the protection relay is set.
2. A PC or workstation is set up for a direct link (point-to-point), or the PC or workstation is connected to the LAN/WAN network.
3. The protection relays' IP addresses in the PCM600 project are configured for each protection relay to match the IP addresses of the physical IEDs.
4. Technical keys of the IEDs in PCM600 project are configured for each protection relay to match the technical keys of the physical IEDs.

For successful protection relay engineering and usage, check the workstation firewall TCP and UDP port configurations, especially for IEC 61850 and FTP. Other protocols are not used for engineering and/or they are optional.

Table 2:   *Ports that must be open in the firewall for different protocols*

Protocol	TCP port
File Transfer Protocol (FTP)	20, 21
IEC 61850	102
Web Server HTTP	80
Simple Network Time Protocol (SNTP)	123
Modbus TCP	502
DNP TCP	20000

Section 4   Setting up a project

4.1   Installing connectivity packages

- Install connectivity packages either by running the installer which can be downloaded on the ABB Website or by using Update Manager when a network connection is available.

> Download connectivity packages from the ABB Web site http://www.abb.com/substationautomation or directly with Update Manager in PCM600.

4.1.1   Installing connectivity packages by using the connectivity package installer

1. Close PCM600.
2. Run the **ABB IED Connectivity Package REF615R Ver.n.msi** installer. (n = version number)
3. To install the connectivity package, follow the steps in the connectivity package installation wizard.

4.1.2   Installing connectivity packages by using the Update Manager

1. In PCM600, click **Help** and select **Update Manager**.
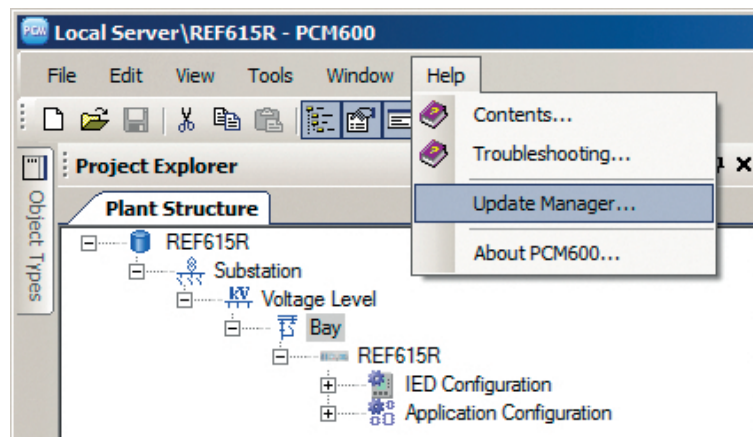
Figure 6: Help menu – Update Manager

2. Select **Show All Available Updates** from the drop-down list in the top left corner.
3. Browse for the required connectivity package.
4. Click **Download**.
5. Click **Install** when the download is complete and follow the steps in the installation wizard.

4.2 Activating connectivity packages

The relay connectivity package has to be installed before activating the connectivity packages.

1. Activate the appropriate connectivity package in the **Update Manager** after the installation.
   The **Update Manager** shows the protection relays that are compatible with the installed PCM600 version.
2. Select **IED Connectivity Package REF615R Ver. n** (n = version number) to use REF615R.
   Always use the latest version of the connectivity package.
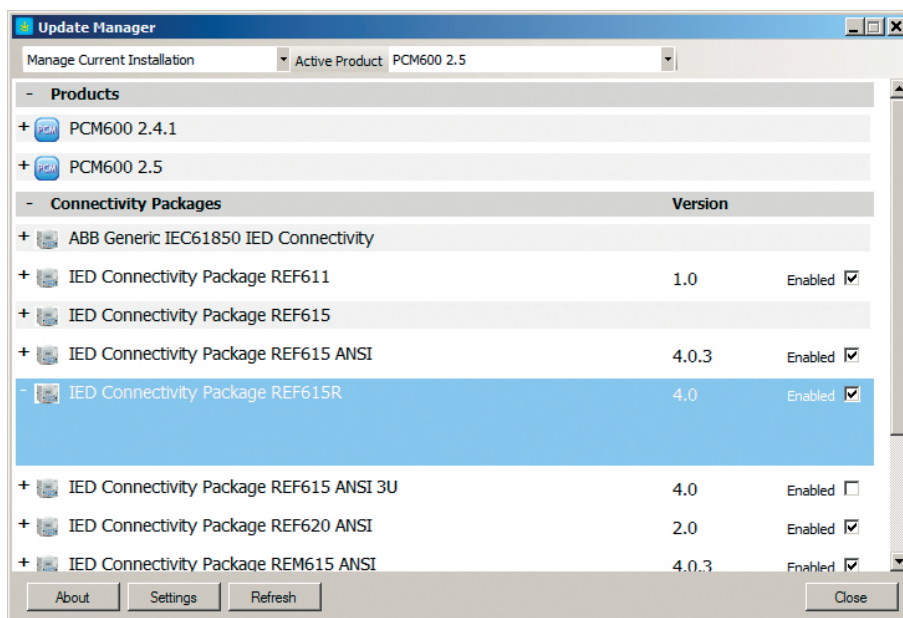
Figure 7:   Activating the connectivity package

PCM600 recognizes the installed connectivity package(s) during start-up and the corresponding IED types are available in PCM600 when starting a new project.

4.3   Setting up IP addresses

The IP address and the corresponding subnet mask can be set via LHMI for the rear Ethernet interface in the protection relay. Each Ethernet interface has a default factory IP address when the complete protection relay is delivered. The configured rear port IP address is preserved if a new communication card with Ethernet is installed or the communication card is replaced.

> The protection relay's front port IP address is fixed to "192.168.0.254" and it cannot be modified.

1.   Set the IP address for the protection relay's rear port and the corresponding subnet mask via the LHMI path **Configuration/Communication/Ethernet/Rear port**.

Table 3: *Default IP address for the rear port and the corresponding subnet mask*

IP address	Subnet mask
192.168.2.10	255.255.255.0

Communication fails if the IP addresses of the front and the rear port belong to the same subnet.

4.4 Creating a new project

1. Start PCM600.
2. To see the projects that are currently available in the PCM databases, select **File/Open/Manage Project** on the menu bar.
   The **Open/Manage Project** window is displayed.
3. Click **Projects on my computer**.
4. Click **New Project**.
5. If there are currently projects or object tools open, a confirmation dialog box opens.

   • Click **Yes** to close the open projects. A **Create New Project** dialog box opens.
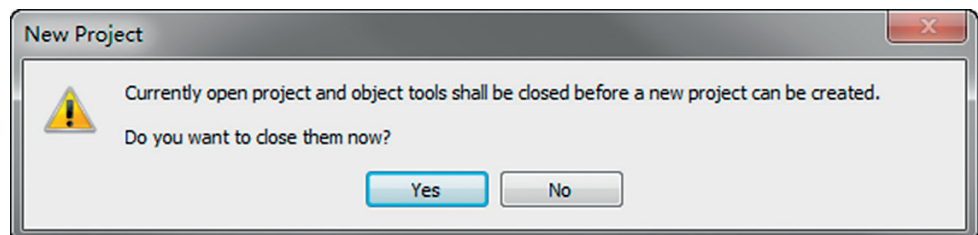
Figure 8: *New Project dialog box*
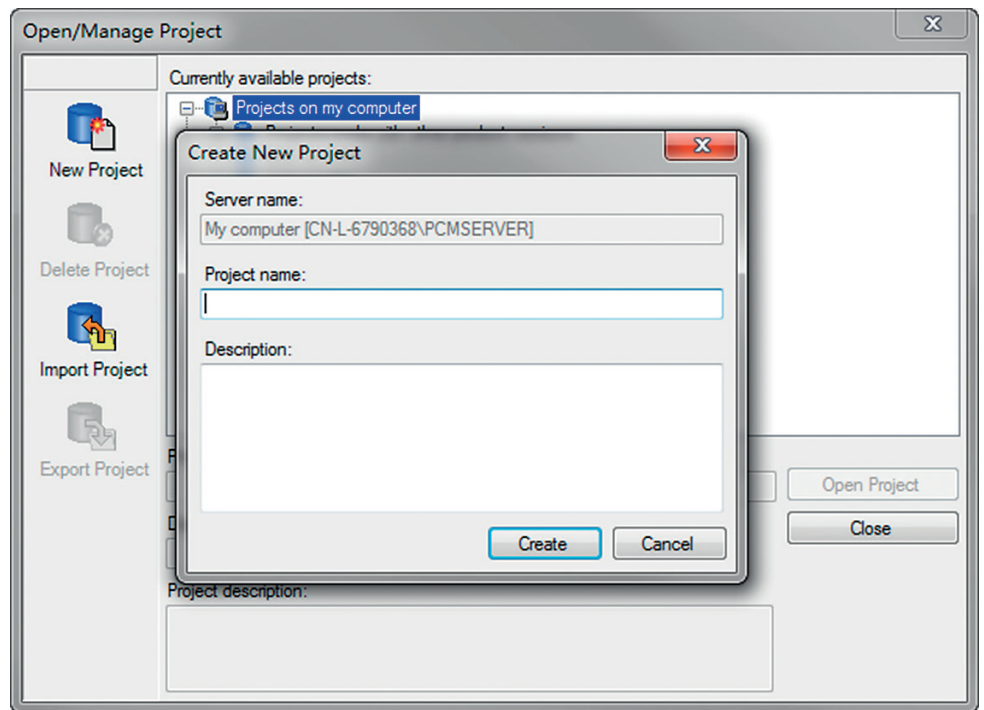
Figure 9:   *Creating a new project*

6.   In the **Project Name** box, give a name for the project.

> [i] The project name must be unique.

7.   Optionally, write a description of the project in the **Description** box.
8.   Click **Create**.

PCM600 sets up a new project that is listed under **Projects on my computer**.

4.5   Building the plant structure

> [i] Building a plant structure is useful when a complete grid with an essential number of IEDs has to be built.

1.   Create a new plant structure in one of the alternative ways.

- Right-click the **Plant Structure** view, point to **New** and select **Create from Template**.
- Right-click the **Plant Structure** view, point to **New** and select **General** and select the element either **IED Group** or **Substation**.

2. On the **View** menu, select **Object Types**.
3. Select the needed elements and drag them into the plant structure.
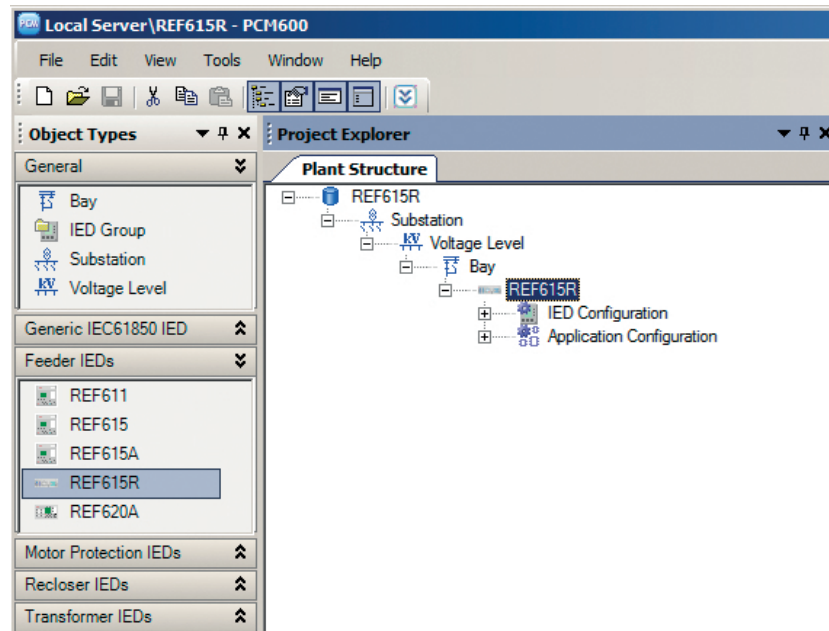
Figure 10:   *The start of a project with IEDs placed and renamed*

4. Rename each level in the structure by the names/identifications used in the grid.

- Right-click the level and select **Rename**.
- Rename the levels in the **Object Properties** view.

4.6 Inserting an IED

The context menu or the **Object Types** view shows the available IEDs that can be inserted, on the bay level, into the plant structure according to the installed connectivity package.

It is possible to do various tasks in the plant structure.

- Insert an IED to offline mode or online mode
- Import a template IED that is available in the template library as a .pcmt file
- Import a preconfigured IED available as a .pcmi file

4.6.1 Inserting an IED in online mode

When the protection relay is already connected to PCM600, PCM600 can read the order number directly from the relay. It is possible to read the full configuration from the relay by using the **Read from IED** function.

To set up an IED online, the protection relay must be connected to PCM600.

1. In the **Plant Structure** view, right-click the bay, point to **New**, point to the relay application area such as **Motor Protection IEDs** and select the protection relay type to be inserted.
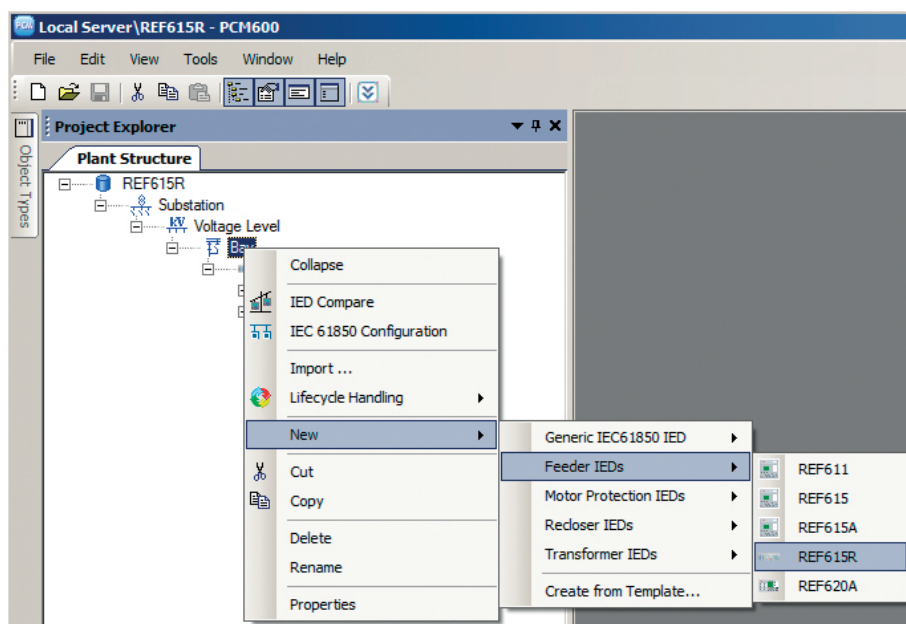
Figure 11:   *Selecting the protection relay type*

Alternatively, drag an IED from the **Object Types** view to the bay level.

The **Configuration Mode Selection Page** dialog box opens.
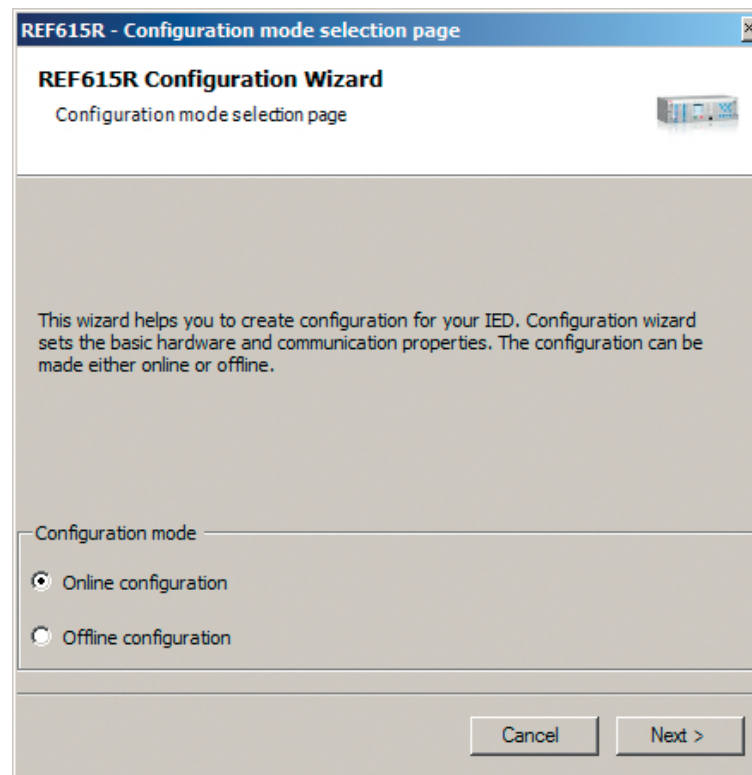
Figure 12:   PCM600: Configuration mode selection

2.   Select **Online Configuration** and click **Next**.
      The **Communication protocol selection page** is displayed.
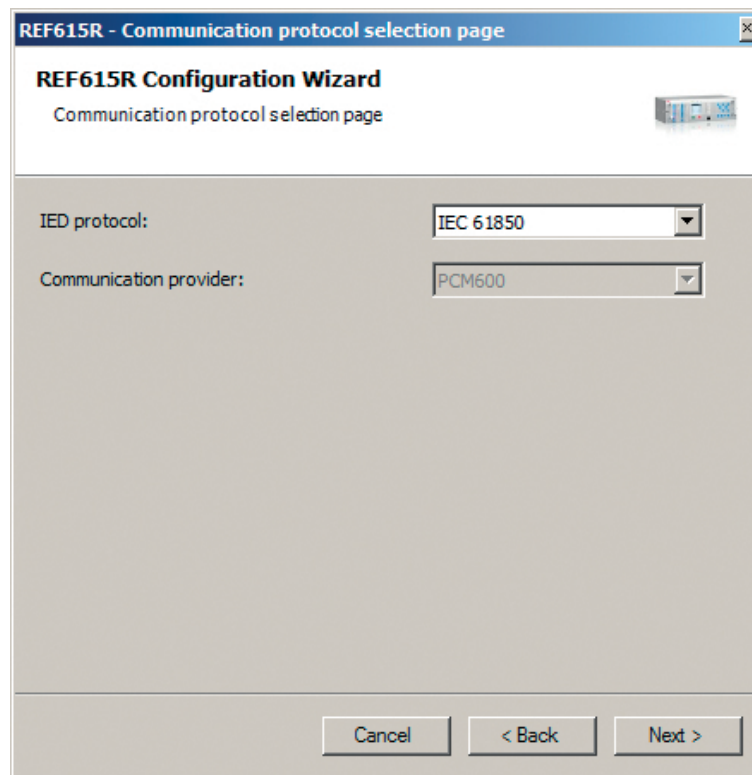
Figure 13:   Selecting communication protocol

3.   In the **IED protocol** list, select the communication protocol and click **Next**.
      The **Communication protocol** page is displayed.
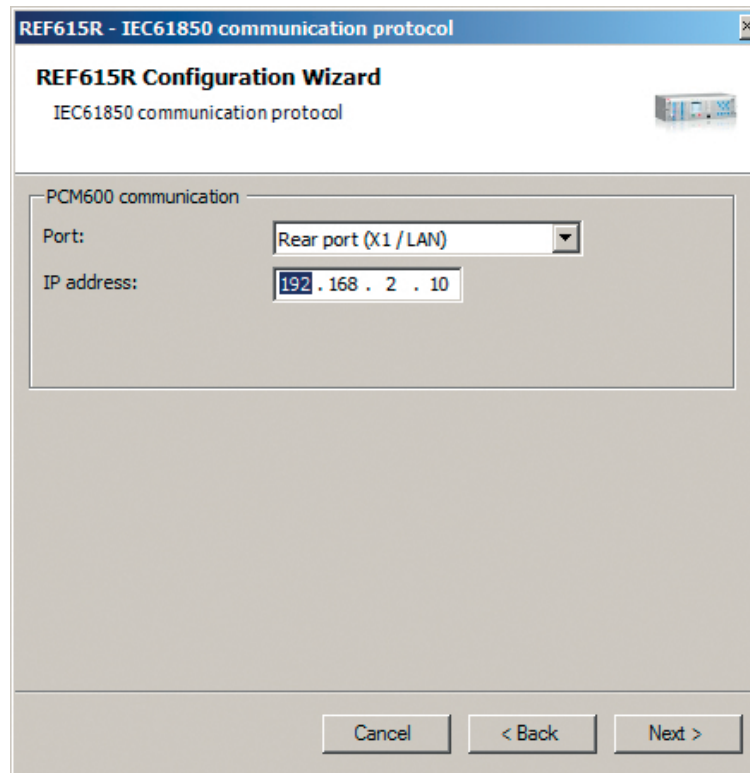
Figure 14:   PCM600: Communication port and IP address

4.   In the **Port** list, select the port.

- If the rear port is selected, insert the correct IP address (of the physical protection relay to be configured) into the **IP address** box.

Communication configuration is now defined.
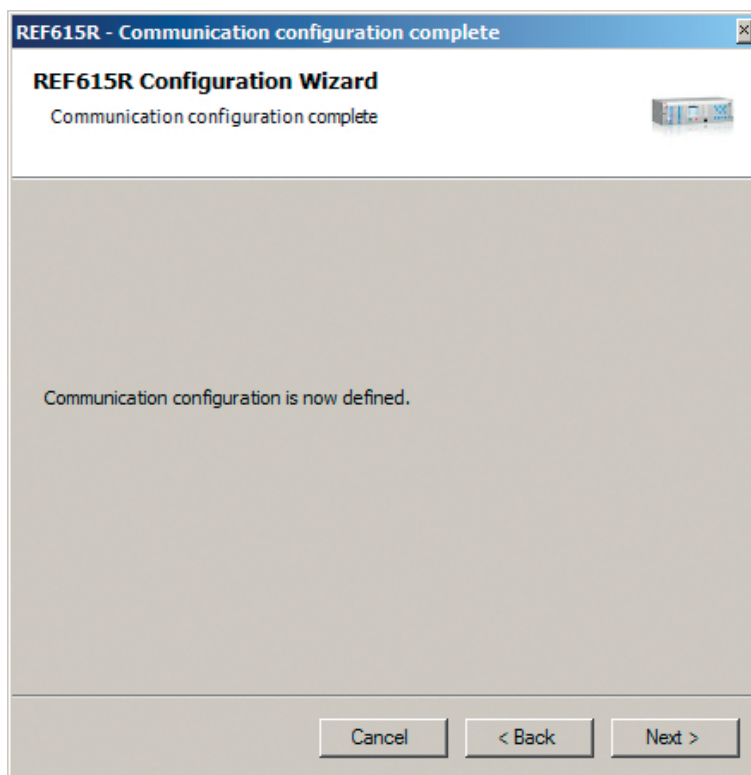
Figure 15:   Communication configuration defined

5.   Click **Next** in the **Configuration Wizard**.
6.   Click **Scan** to scan/read the order code of the protection relay.
     The **Order code detection page** is displayed.

Figure 16:   *PCM600: Order code detection page*

7.   Click **Next**.
      The **Setup Complete Page** dialog box shows the summary of the protection relay's
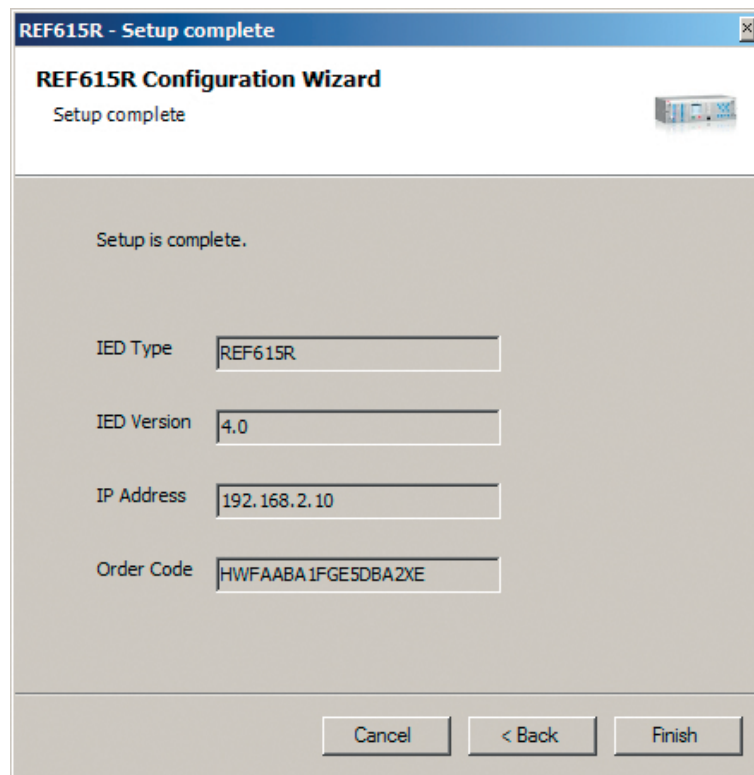   IED type, version, IP address and the selected order number.

Figure 17: *PCM600: Setup complete*

To cancel the insertion, click **Cancel**.

If an error is found on the **Setup Complete Page**, it is not possible to go back and make modifications. If an error is detected, cancel the insertion by clicking **Cancel** and insert the IED again.

8. Click **Finish** to confirm the configuration and conduct the insertion.
9. From the **Plant structure** view, check that PCM600 has turned online the IED that was inserted to the bay level.

Data cannot be scanned from the protection relay and proceeding is prevented if the IED is not online or if the IP address is not correct.

4.6.2 Inserting an IED in offline mode

When the IED is not available or is not connected to PCM600, engineering can be done offline. The offline configuration in PCM600 can be written to the IED later when it is connected.

Working in the offline mode has an advantage compared to online mode in that the preparation for the configuration can be started even though the IED is not available.

1. In the **Plant Structure** view, right-click the bay and from the list that appears, select **New** and the IED application area, for example, **Feeder IEDs**.
2. Select the IED type to be inserted.

> Alternatively, drag an IED from the **Object Types** view to the bay level.

The **Configuration Mode Selection Page** dialog box opens.
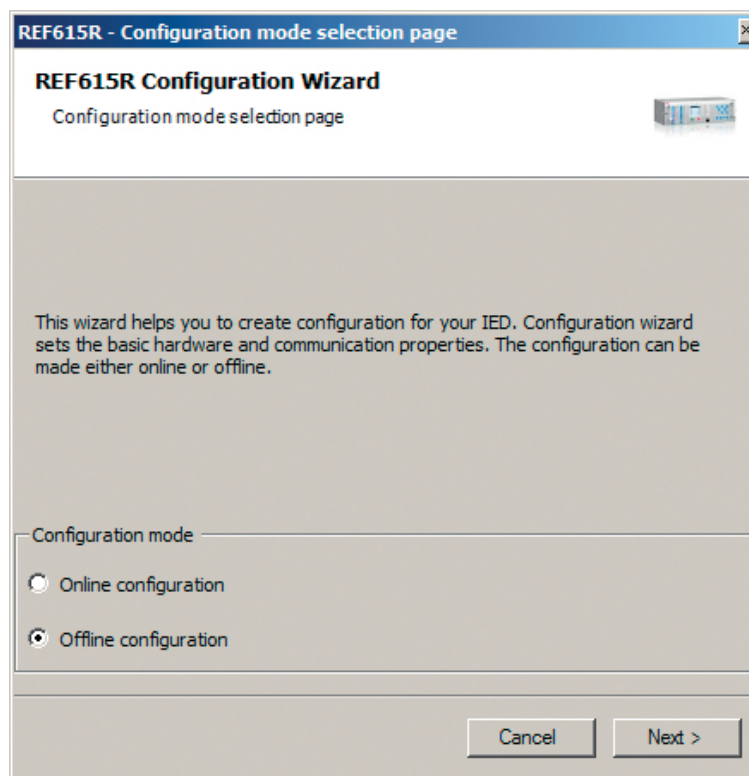

Figure 18:   PCM600: Configuration Mode Selection Wizard

3. Select **Offline Configuration** and click **Next**.

Setting up an IED in the offline mode is similar as in the online mode; however, with the offline mode it is not necessary to type the correct IP address in the **Communication port and IP address** dialog box.

4. On the order code selection page, select the correct order codes.
5. Click **Generate** to generate the functions for the selected order code.
    A **Function generation complete** dialog box is shown. Click **Close**.
6. Click **Next** on the **Setup Complete Page** that shows the summary of the IED type, version, IP address and the selected order number.
7. Click **Finish** to confirm the configuration and conduct the insertion.

4.6.3 Inserting an IED from the template directory

IED templates can be used for replicating IEDs with same order code in PCM600 projects. Template includes IED application configuration, graphical display configuration (single-line diagram), communication protocol mappings and parameters. An IED in the plant structure can be exported as a template (.pcmt file). The template library can be built from all the exported IED templates.

It is also possible to insert an IED from the template library to create a new IED in the plant structure. After a template IED has been imported, the *IP address*, the *Caption* in IED's **Object Properties** and the *Technical Key* that corresponds to the physical IED have to be changed.

> A template IED can be inserted only when the bay is selected in the plant structure.

1. In the **Plant structure** view, select the bay, right-click, point to **New** and select **Create from template**.
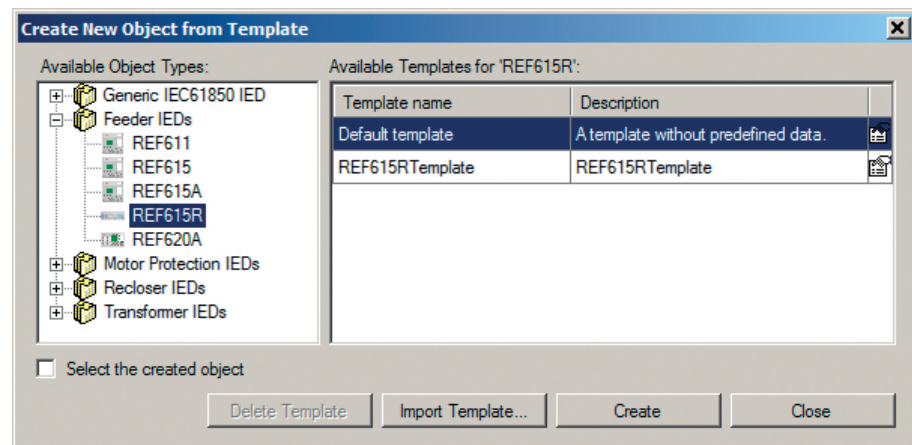   The **Create New Object from Template** dialog box opens.

Figure 19:   PCM600: Selecting an IED from the template library

2.   Select the IED from the list of available IEDs.
3.   Click the icon on the right column in the list of available templates.
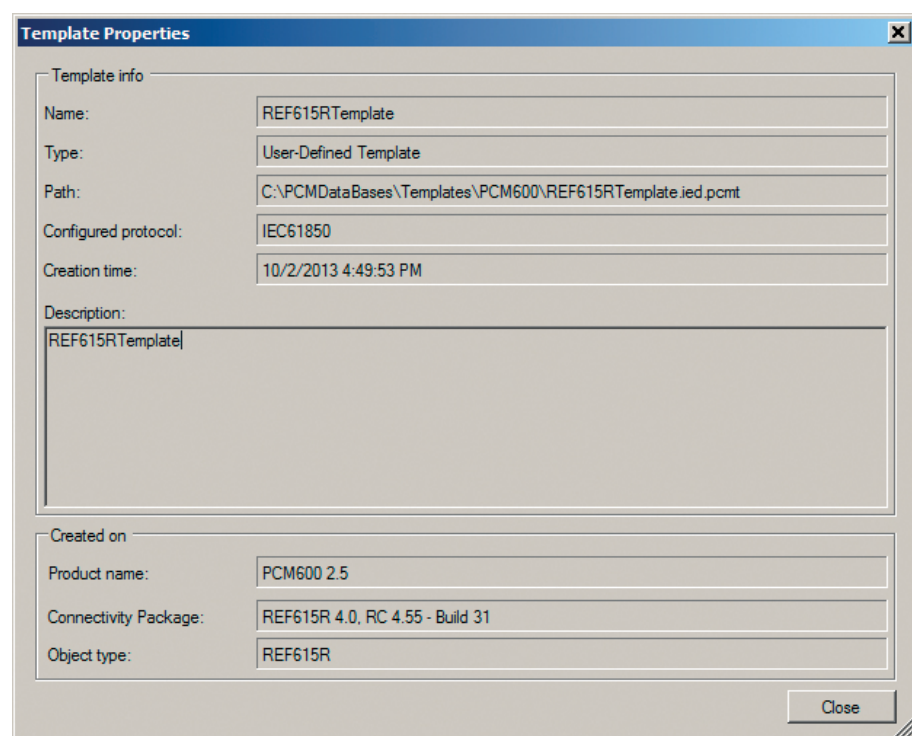   The **Template Properties** dialog box opens.

Figure 20:   PCM600: Template information

4.   Check and verify the template information and click **Close** to close the dialog box.

The **Create New Object from Template** dialog box is displayed.

5. Delete, import or create a template by clicking the corresponding button.

- To delete the selected template, click **Delete Template**.
- To import a template from the selection window, click **Import Template**.
- To insert the selected IED to the bay, click **Create**.

> It is possible to insert more than one IED from the **Create New Object from Template** dialog box. The dialog box remains open until **Close** is clicked .

6. Click **Close** when finished.

4.6.4 Inserting an IED by importing a .pcmi file

It is possible to create a new IED object in the plant structure by importing a .pcmi file.

1. In the **Plant Structure** view, right-click the bay and select **Import**.

> A .pcmi file can be imported only when the bay is selected in the plant structure.
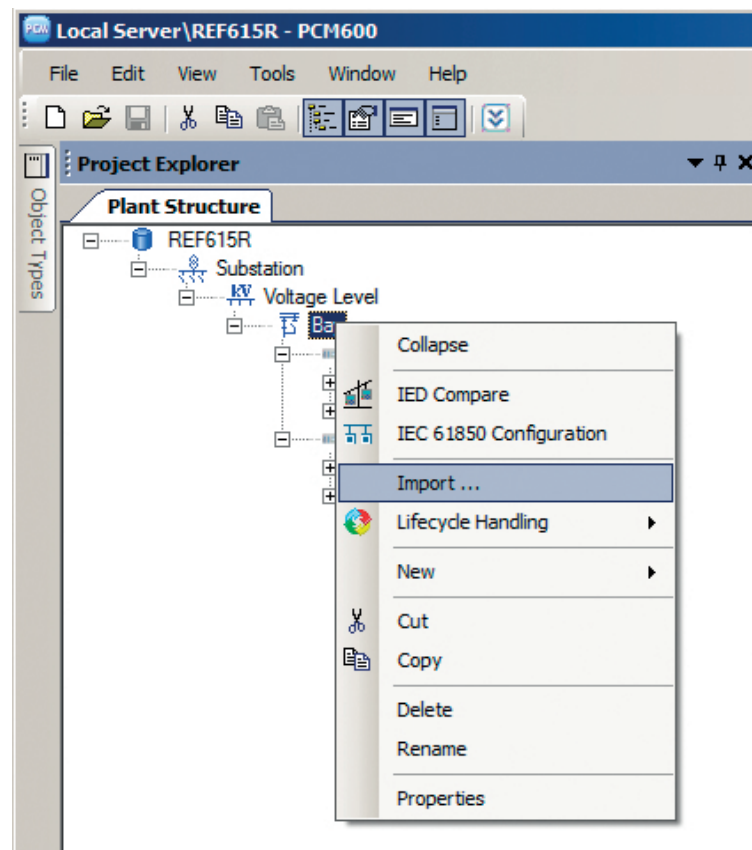
Figure 21:   Importing IED configuration

2.   In the **Import** dialog box, select the .pcmi file to be imported and click **Open**. After importing, the IED object is created in the plant structure.

After the .pcmi file has been imported, the IP address, the name and the technical key that correspond to the physical IED have to be changed.

4.7   Setting the IED IP address in a project

The IP address and subnet mask of the IED object in PCM600 must match the front and rear port of the protection relay (physical IED) to which the PC is connected. The IP address of the protection relay can only be set via the LHMI or Parameter Setting tool in PCM600. The PC and protection relay need to be on the same subnet.

There are two alternatives to set the IP address of an IED object in PCM600.

- On the first page of the wizard when including a new IED into a project.
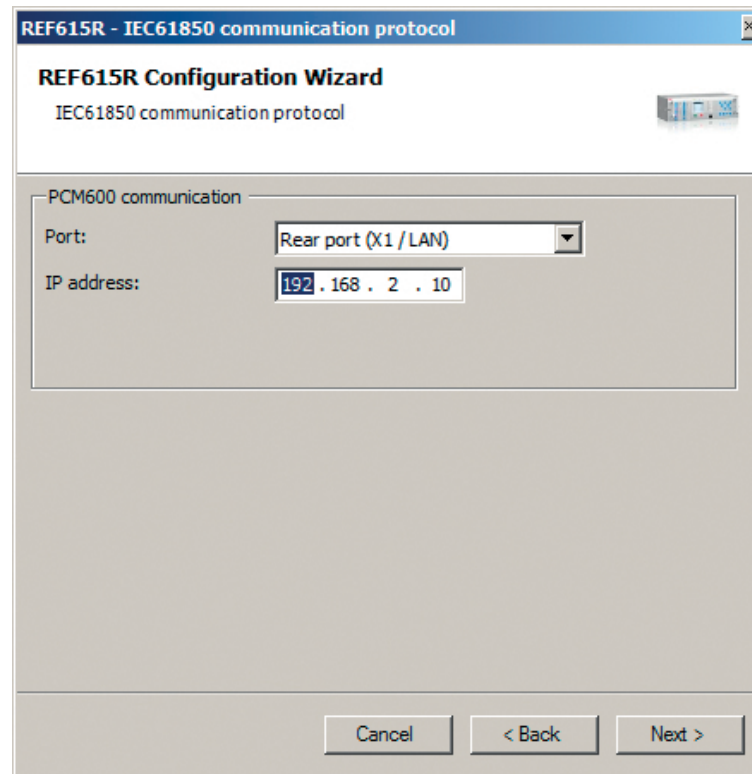- In the **IP address** box of the IED's **Object Properties** dialog box.

Figure 22:   Alternative 1: Setting the IP address on the first wizard page
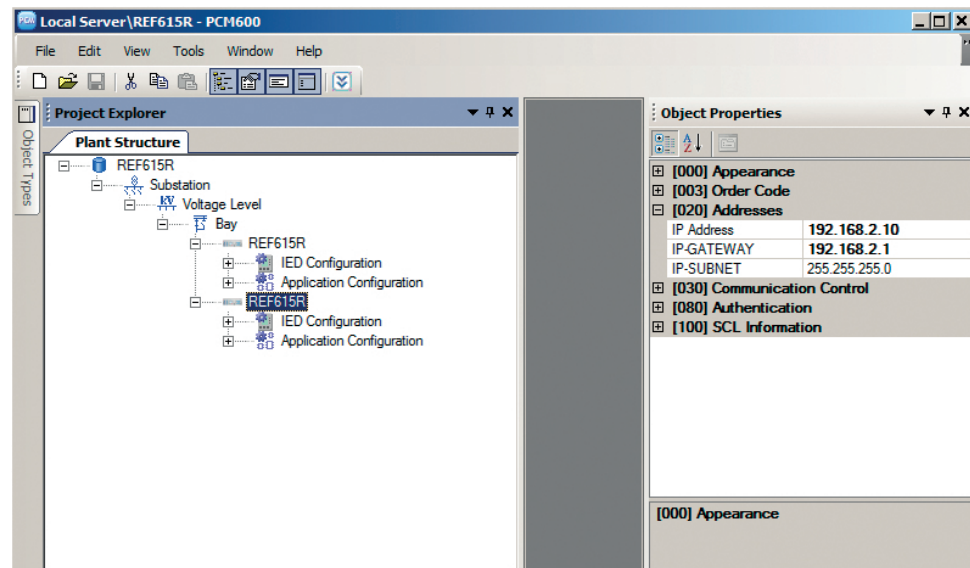
Figure 23: Alternative 2: Setting the IP address in IED's Object Properties dialog box

Choosing between the two ways depends on when the IP address is set. Typing the IP address via the IED's **Object Properties** dialog box is possible at any time while entering it via the configuration wizard can only be done when adding the IED object.

1. In the **Plant Structure** view, select the IED to which the IP address is to be entered.
2. On the **View** menu, select **Object Properties**.
    Object Properties dialog box is opened.
3. Type in the IP address to the **IP Address** row.

4.8 Technical key

Both a physical IED and an IED object in PCM600 have a technical key. The technical key in the protection relay and PCM600 must be the same, otherwise it is not possible to download a configuration.

Each IED in a PCM600 project must have a unique technical key. Therefore, it is not possible to set the same technical key for several IEDs in the same PCM600 project.

The protection relay is delivered with a factory default technical key. The validation of the technical keys between PCM600 and the protection relay does not occur if the protection relay contains the factory default technical key.

The technical key property in PCM600 corresponds to the IED name attribute in SCL files. Avoid changing the IED name attribute outside PCM600, because data in PCM600 may get lost when importing the SCL files.

The technical key must be the same for the communication between the protection relay and PCM600. The technical key can be read from the protection relay and updated to PCM600, or the PCM600 technical key can be written to the protection relay. Alternatively, a user-defined technical key can be defined.

When writing a configuration to the protection relay, PCM600 checks for a mismatch between the IED object and the physical IED technical key.
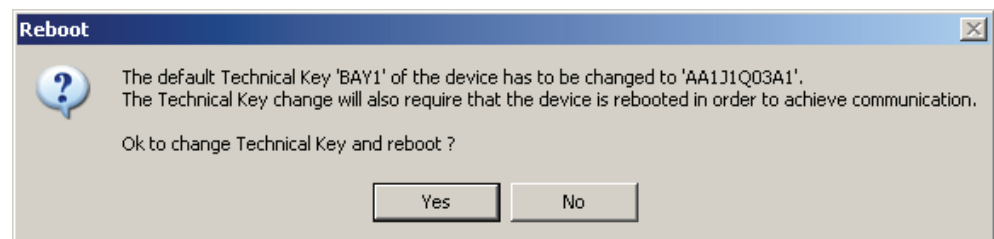
Figure 24:   *Reboot suggestion*

Ensure that the IED object in PCM600 has the same IP address as the physical IED that is intended to be connected through the technical key concept.

Change the technical key for an IED object in the **Object Properties** dialog box in PCM600.

4.8.1   IEC 61850 naming conventions to identify an IED

The IEC 61850 naming conventions to identify an IED are only valid when the IEC 61850 standard is used for station bus communication. According to IEC 61850-6, the SCL model allows two kinds of project designations in the object properties: a technical key and a user-oriented textual designation.

• Technical key is used in engineering drawings and for signal identifications. This is contained in the attribute name as an identification of each object. If the value is used as a reference to an object, it is contained in an attribute name starting with a string denoting the reference target object type and ending with the string *Name*. The

technical key is used within SCL for referencing to other objects. The name is a relative identification within a hierarchy of objects.

- User-oriented textual designation is contained in the *desc* attribute. Attributes are not allowed to contain carriage return, line feed, tab, greater than, less than, double quotes or ampersand characters. The semantics of *desc* must also be relative within an object hierarchy.

PCM600 takes care of these two possibilities. The two possible signal designations are available per object in the Object Properties for all the hierarchical levels beginning with the station as the highest level.

The technical key is automatically generated based on the rules and type specifications of IEC 61346 and the extended definitions assigned for substations by a technical committee. The technical key is shown in the Object Properties dialog box under SCL Technical Key or Technical Key.

- The station is predefined by "AA1" where 1 is the index. To get the real station name that is used, it is possible to rename the SCL Technical Key for the station as the name used by the project. To minimize the word length, a short form should be used, because this name is used also in the transmitted messages to identify the events, for example.
- The voltage level. In the example it is 20 kV and J1 is selected from the list below SCL Technical Key in the Object Properties dialog box.
- The bay and the IED are appended with the coding defined in the IEC 61346 standard and the substation definition lists. In the example, the Bay SCL Technical Key part is Q01 and IED is A1.

The user-oriented textual designation is visible in the Plant structure view for each object. It is the name given by default or changed by using the Rename function.
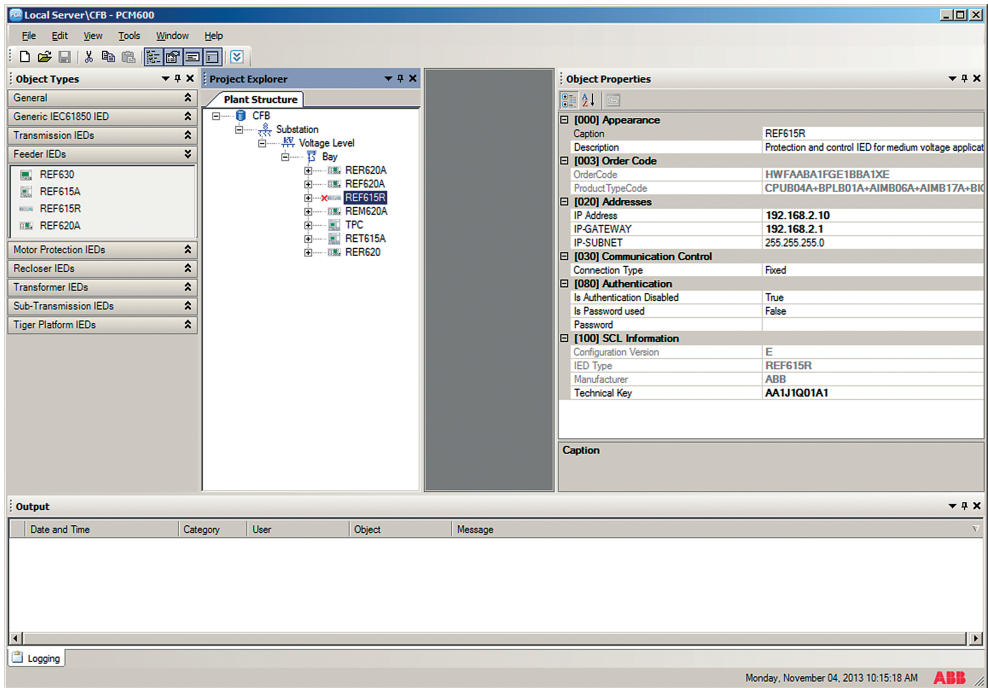
Figure 25:   *PCM600: IEC 61850 signal designation concept*

The created technical key for the full path name of the IED would be: AA1J1Q01A1.

- AA1 = substation in the project
- J1 = voltage level from 20 to 30 kV
- Q01 = the first bay in the voltage level
- A1 = first IED in the bay Q01

4.8.2   Setting the technical key

The maximum length of technical key is 20 characters. Technical key must begin with an alphabetic character (A-Z, a-z), but the remaining characters can be alphanumeric or underscore (A-Z, a-z, 0-9, _).

1. In the **Plant Structure** view, right-click the IED and select **Set Technical Key in IED**.
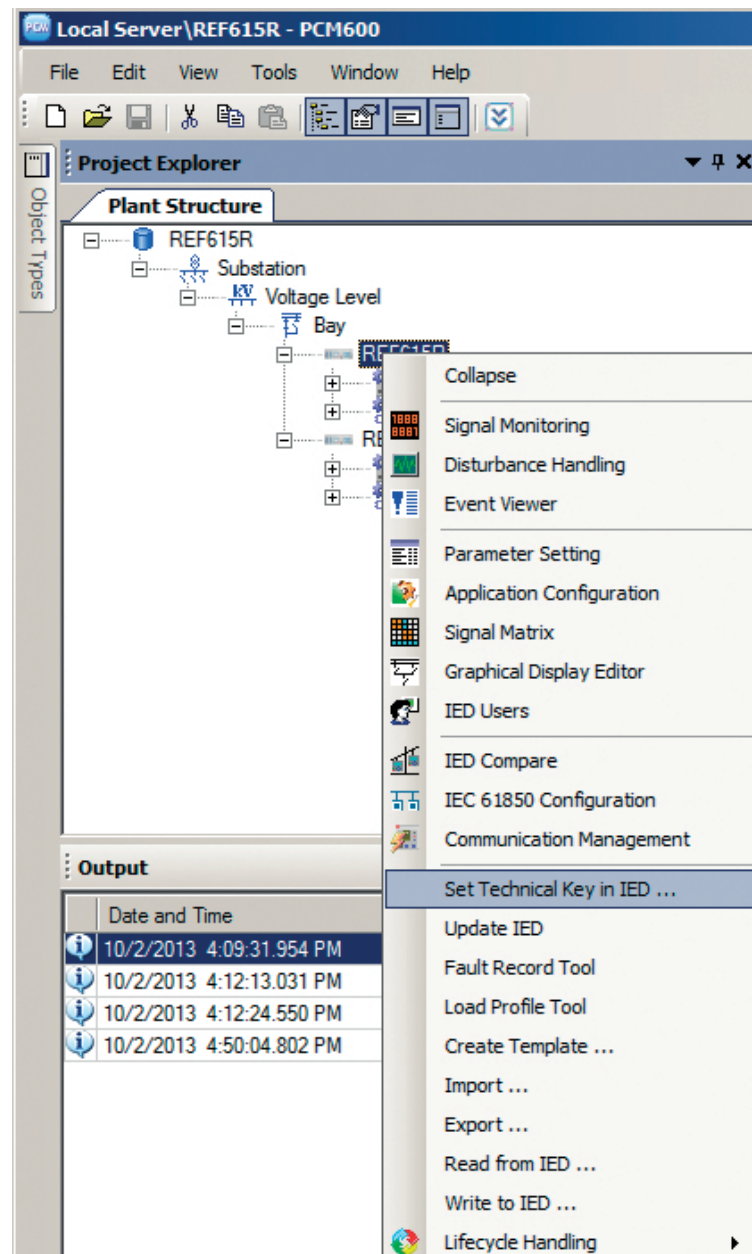
Figure 26:   PCM600: Setting the technical key on the IED level

A dialog box opens to inform about the technical key concept.
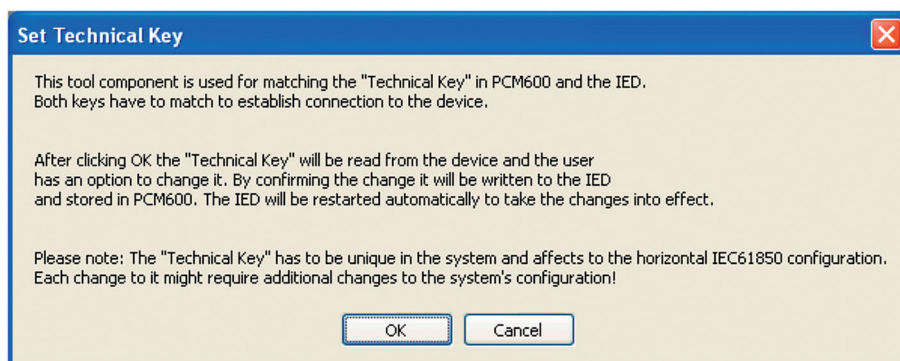
Figure 27:   Technical key information

2.   Click **OK**.
      The technical key is read from the IED and the **Set Technical Key** dialog box opens.
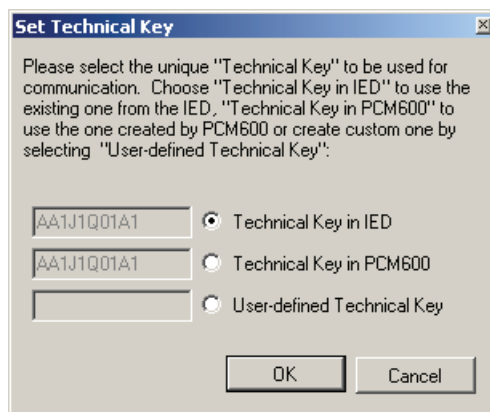

Figure 28:   Setting the technical key

3.   In **Set Technical Key** dialog box, select the technical key to be used. There are three alternatives.

      •   Use the existing technical key in the IED
      •   Use the existing technical key defined for the IED object in PCM600
      •   Set a user-defined technical key, which changes the technical key for both the physical IED and IED object in PCM600

4.   Click **OK** to confirm the selection.

      It is not possible to set a user-defined name or select the **Technical key in IED** if the value is the same as already given to another IED object in the PCM600 project. An error message is displayed if this happens.

4.9 COM600 project

REF615R connectivity package supports SAB600. The IED is imported as a REF615R device. It is also possible to import a full PCM600 project including several REF615R devices to SAB600. In this case, PCM600 project information is imported to SAB600 using a SCD file.

REF615R supports several functions in COM600.

- Controlling the switchgear
- Monitoring the measured values
- Reading digital fault recordings
- Setting parameters

4.9.1 Importing an IED in a COM600 project

1. Create a PCM600 project including several IEDs.
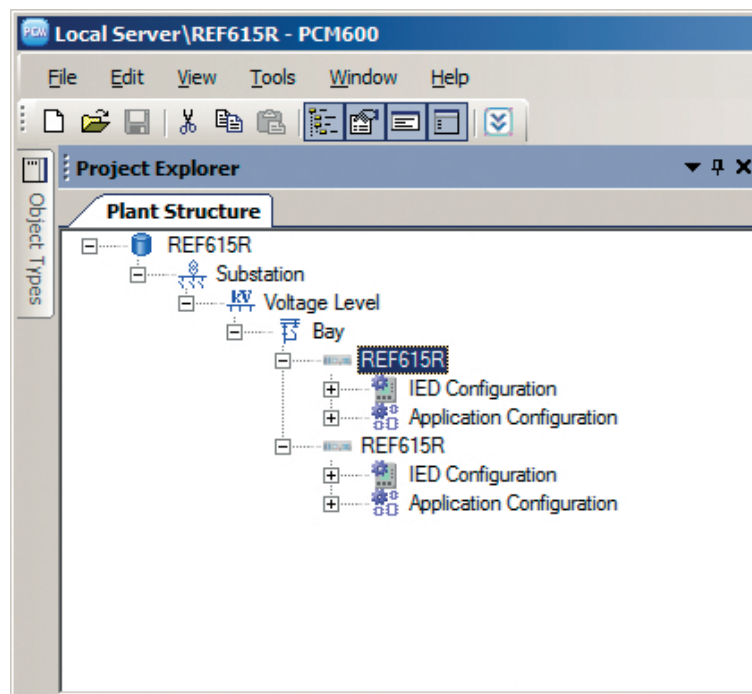
Figure 29:   Creating a PCM600 project including several IEDs

2. Export the SCD file from PCM600.
   In the **Plant structure** view, right-click the substation and select **Export**.
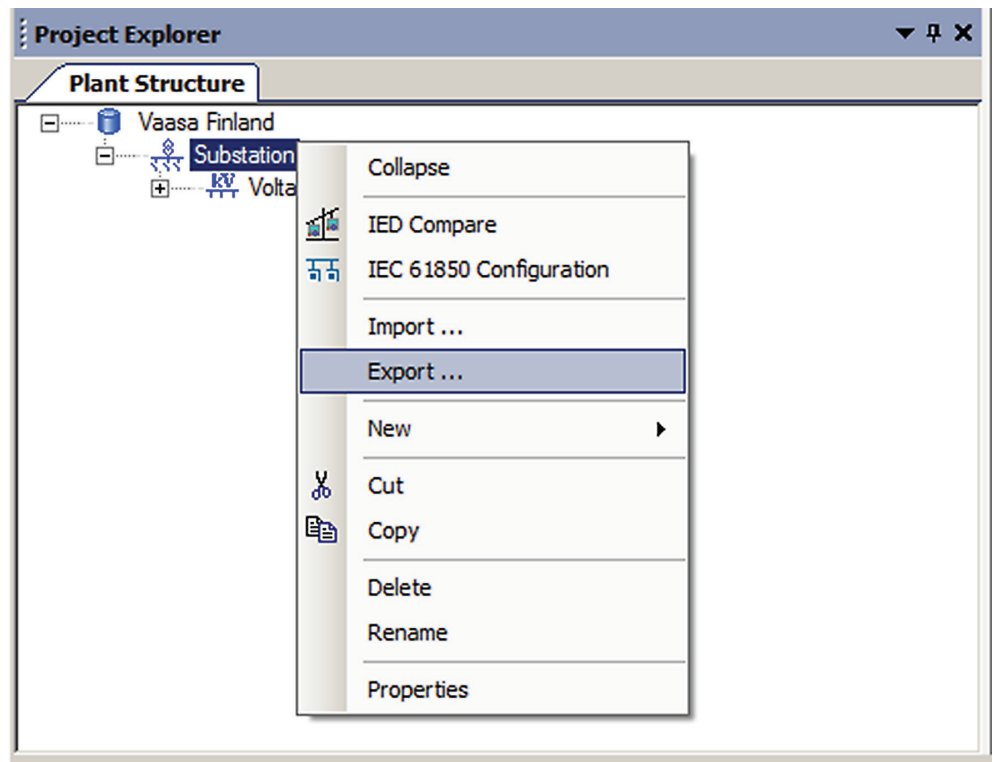
Figure 30:   *Exporting an SCD file from PCM600 and importing it to SAB600*

3.   Import the SCD configuration into the SAB600 project.
In the **Project Explorer** view, right-click the IEC61850 OPC Server object and
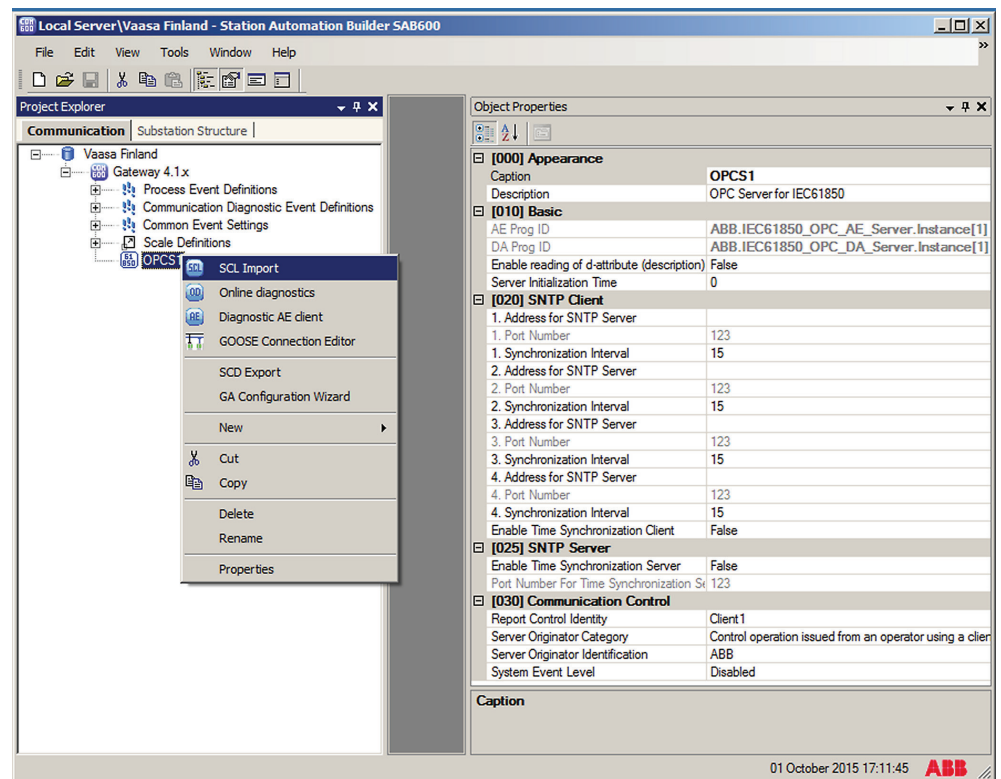select **SCL Import**.

Figure 31:   Importing the SCD configuration into the SAB600 project

4. In the **SCL Import** view, click **Select File** to select the SCD file exported from
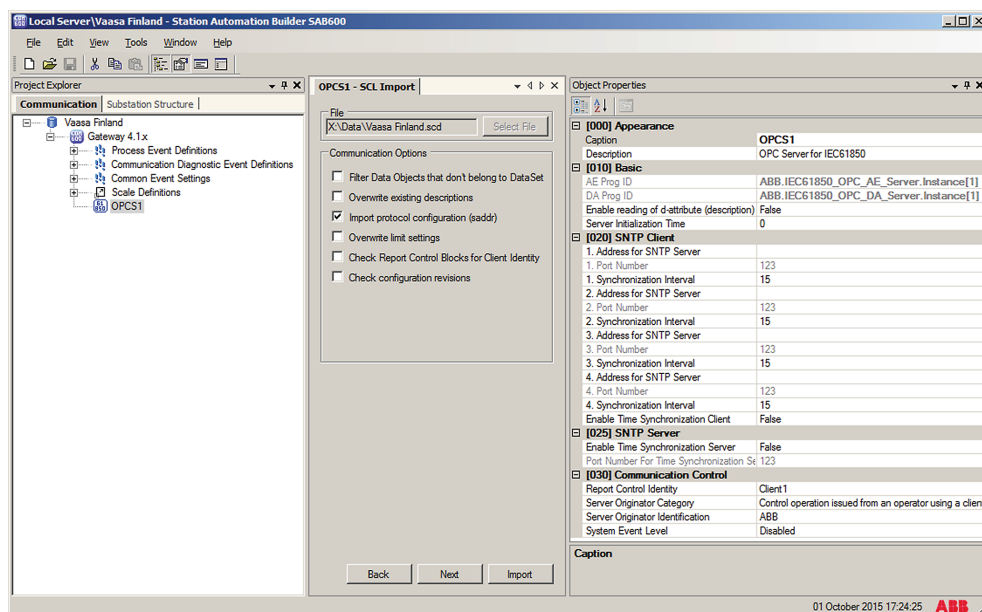   PCM600 and then click next on the following screen.

Figure 32:   Creating a new IED into the SAB600 project

5.   On the subsequent screens check the default settings in the **SCL Import** view,
       change the settings if they are not suitable and click **Next**.
       The default settings in the **SCL Import** dialog should be OK in most cases.
6.   Click **Import** to import the SCD file.
7.   Check the IP address on the IEC 61850 subnetwork and change it if needed.
       When the SCD file is directly exported from PCM600, it uses the IP address of the
       PCM600 computer, not the COM600.

The communication towards the protection relays is now ready. For information on how
to finalize the single-line diagram and enable parameter setting through COM600 HMI,
see the COM600 documentation.

4.10   Using the Web HMI

WHMI is enabled by default.

1.   To enable the WHMI, select **Main menu/Configuration/HMI/Web HMI mode**
       via the LHMI.
2.   Reboot the relay for the change to take effect.
3.   Log in with the proper user rights to use the WHMI.

To establish a remote WHMI connection to the protection relay, contact the network administrator to check the company rules for IP and remote connections.

Disable the Web browser proxy settings or make an exception to the proxy rules to allow the protection relay's WHMI connection, for example, by including the relay's IP address in **Internet Options/Connections/LAN Settings/Advanced/Exceptions**.

For more information on the WHMI, see the operation manual.

4.11 IED user management

IED user authorization is disabled by default and can be enabled at **Main Menu/ Configuration/Authorization** in LHMI or WHMI. IED user passwords can be changed in LHMI and using the IED Users tool in PCM600.
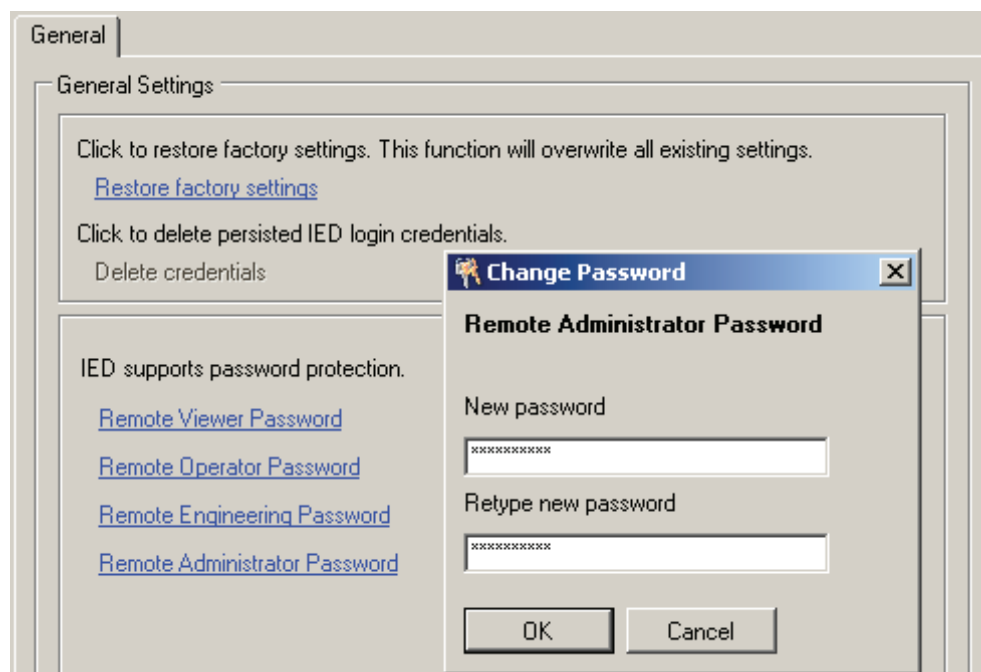
Figure 33:   *Changing the password using the IED User Management tool*

If the remote authentication has been enabled, changes have to be made in PCM600 to make the communication between the IED and PCM600 work.

Table 4:   *Object properties to change*

Object Properties field	Value
Is Authentication Disabled	False
Is Password used	True
Password	Write the correct password
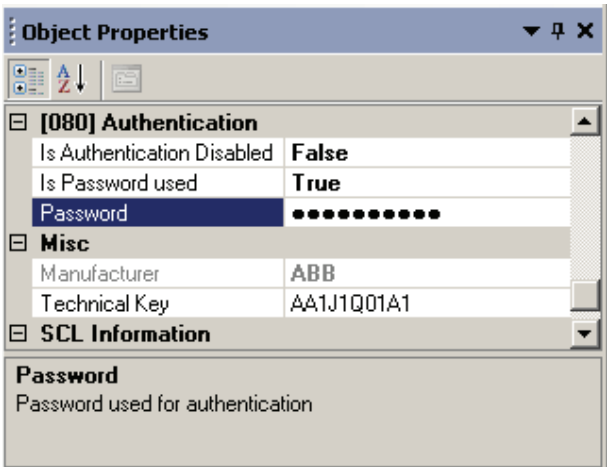
Figure 34:   *Object properties*

When communicating with the protection relay with PCM600 tools and with the relay authentication enabled, the relay username and password must be given when prompted. When setting the technical key, the username and password must be given twice.
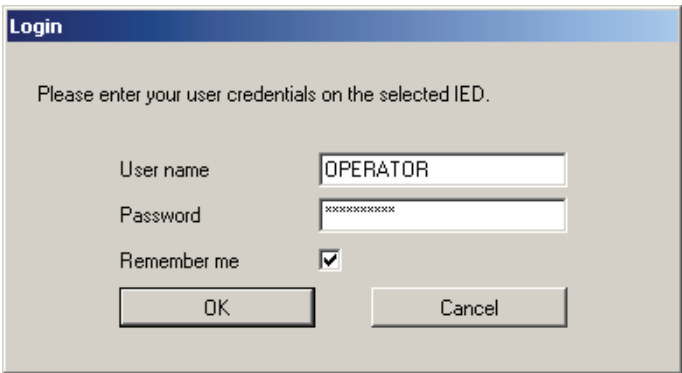

Figure 35:   *User login*

If the PCM600 authentication has been enabled in PCM600 System Settings, a relay user can be linked to the current PCM600 user by selecting the Remember me check box in the Login dialog. After that, the user credentials are no longer asked at tool communication as logging in PCM600 also provides the authentication credentials to the protection relay.

Audit trails (login, logoff events) can be monitored by using the Event Viewer tool. By default, the audit trails are not shown in the Event Viewer tool. To view them, change the default ADMINISTRATOR password by using the IED Users tool, and log in as ADMINISTRATOR user when opening the Event Viewer tool.

Section 5 Protection and control engineering

5.1 Application Configuration tool

Application Configuration tool is used to modify an application configuration for a protection relay and is based on IEC 61131-3 Function Block Diagrams.

The function blocks are dedicated to different functions.

- Control related functions
- Protection related functions
- Monitoring functions
- Communication

For more information on the function blocks, see the technical manual.

Most function blocks are mapped as logical nodes according to the IEC 61850 standard. See the IEC 61850 parameter list for more information.

> **i** If a function block is removed with Application Configuration, the function related data disappears from the menus as well as from the IEC 61850 data model, with the exception of some basic function blocks, which are mandatory and thus cannot be removed from the relay configuration by removing them from the Application Configuration.

Other function blocks are not mapped as logical nodes; for example, logical gates.

The basic features of Application Configuration tool include the ability to organize a configuration into several MainApplications as well as providing different application programming features.

- Organize an application configuration
  - Organize an application configuration into a number of logical parts (MainApplication)
  - Organize a MainApplication over a number of pages
- Features for programming an application configuration

- Insert function blocks, make connections and create variables
- Include the hardware I/O channels directly to the application configuration
- Calculate the execution order automatically by clicking **Calculate execution order** on the toolbar.
- Document the application configuration: such as, make printouts
- Save application configurations as templates in an application library to reuse them in other protection relays (Function blocks and related logic can be fully or partially reused depending on the functionality available in the other protection relay)
- Validate the application configuration during the configuration process on demand and while writing the application configuration to the protection relay

> For instructions on how to perform the different tasks in PCM600, see PCM600 online help.

5.1.1 Function blocks

Function blocks are the main elements of an application configuration. They are designed for a various number of functions and organized into groups according to type. The different function block types are shown in the **Object Types** view. Function block data can be modified with the Application Configuration tool.

- User-defined names can be given for function blocks and signals.

> Signals that have a user-defined name created with the Application Configuration tool are only visible in the Parameter Setting tool if the relay configuration is written to the protection relay and read back to PCM600. Otherwise, the default signal name is shown in the Parameter Setting tool.

> If possible, set the user-defined name to a signal before connecting the signal to other function blocks.

- IEC 61850, ANSI or IEC 60617 symbol standard can be set.
- IEC or ANSI naming style can be set.
- Function blocks can be locked.
- Visibility for execution order, cycle time and instance number can be set.
- Signals can be managed.
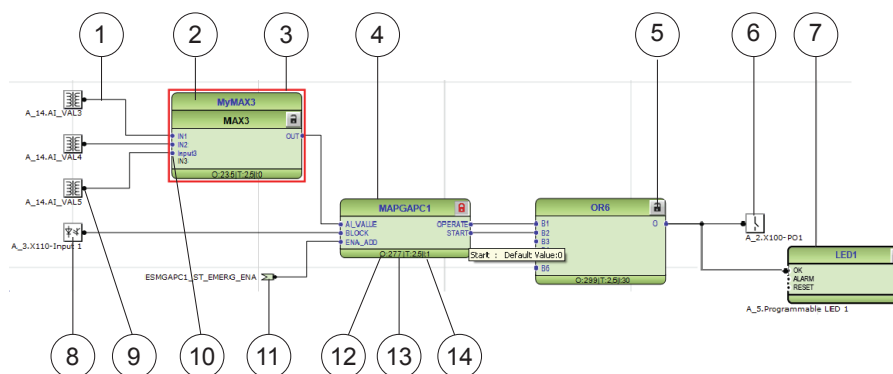- Boolean inputs and outputs can be inverted.

Figure 36:   Application Configuration tool: function block overview

1   Connection(s)

2   User-defined function block name

3   Function block, selected (red)

4   Function block name

5   Function block, locked

6   Hardware, binary output channel

7   Hardware, programmable LED

8   Hardware, binary input channel

9   Hardware, analog input channel

10   User-defined signal name

11   User-defined input variable

12   Execution order

13   Cycle time

14   Instance number

5.1.2   Signals and signal management

The function block has a set of input and output signals. The placement of function block signals is from left to right. Input signals are placed on the left and output signals on the right.

Function blocks can contain more signals than needed in that application part. Unused signals can be hidden to get a clear picture.

Signals are located up and down on both sides of the middle position. When there is space left, some signals may be moved up or down for better visibility and connection routing.

Boolean input and output signals may need to be inverted to fulfil the logic. The Application Configuration tool supports the adding of inversion logic to a binary signal.

All input signals have a default value that is used when the signals are not connected in the configuration.

> The input signal on glue logic function blocks can only be inverted if a glue logic function block with lower execution order in the same cycle time is available. Similar, the output signal can only be inverted if a glue logic function block with higher execution order in the same cycle time is available. Up to two input signals and two output signals can be inverted for glue logic blocks in the same cycle time.

5.1.3   Function block execution parameters

Three function block execution parameters have an influence on the runtime execution of the function block within the application configuration.

- Execution order
- Cycle time
- Instance number

Each time a new function block is selected, these parameters must be selected from the lists in the **Application Configuration** tool. Depending on the function block type, some of the three parameters are selectable and some not. The cycle time may be predefined to one value. The instance number is a counter for the total possible number of function blocks of that type used within the application configuration.

The **Execution Order** and **Instance Number** are a combination that is predefined within a product. It is possible to select a pair out of the list.
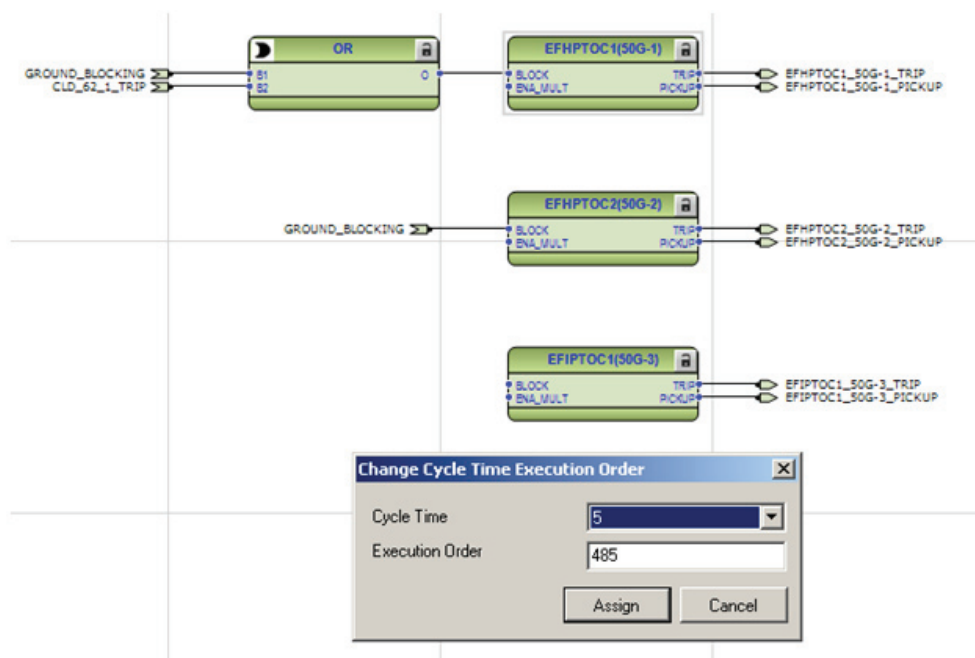
Figure 37:   *Application Configuration tool: an example of function block organization parameters*

The **Cycle Time** is automatically set to 2.5 ms (50 Hz) or to 2.083 ms (60 Hz) and it cannot be modified. Depending on the function block type, only one or both possibilities may be available.

To automatically calculate the execution order, click **Calculate Execution Order** on the tool bar.

5.1.4   Execution order and feedback loops

It is possible to draw multi-layer configuration logic that contains feedback loops with the Application Configuration tool. The execution order of logic functions is calculated automatically in the Application Configuration tool, but the execution order can also be set manually. If the automatically calculated value causes the function to be executed one task cycle time after the other logic functions in the same loop, the execution order number can be set manually to prevent delays, for example, in output activation.

Example shows a simple situation where the execution order causes one cycle time delay if the NOT port is executed in the order determined by the automatic calculation.
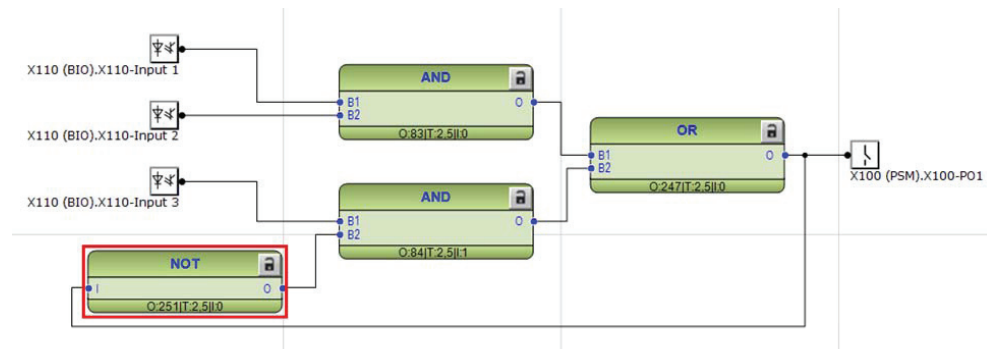
Figure 38:   Feedback loop situation with automatically calculated execution orders

By setting a smaller execution number than in the AND port to where the NOT port is connected, it is possible to fix the execution order of all functions in a loop so that they are handled in the same task.
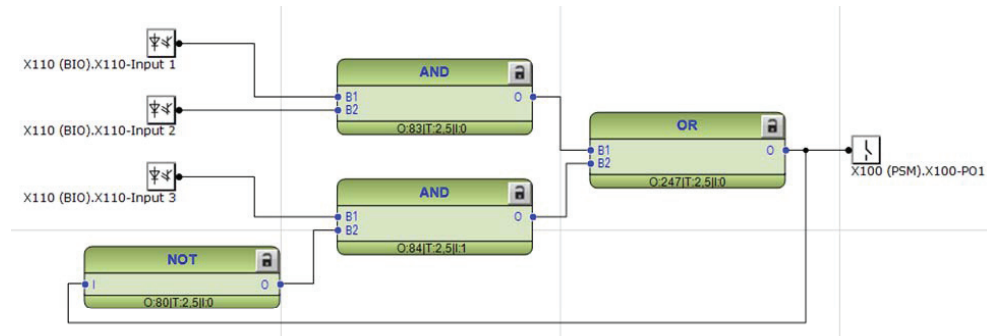

Figure 39:   Feedback loop situation with manually fixed execution order for NOT port

5.1.5   Configuration parameters

Configuration parameters can be viewed and set with the Parameter Setting tool.

5.1.6   Connections and variables

A connection is the link or "wire" between function block outputs and inputs.

There are rules and methods for making connections.

- Drag a line between two signals
- Link two signals by using variables

	It is possible to search and replace variable names in Application Configuration tool.

	Connect the variables to a destination, for example to a function block or a hardware output channel. The connectivity package automatically removes the orphan variables which are not connected to any destination.

Connection validation

A connection is only useful or even possible between two signals of the same base attribute type.
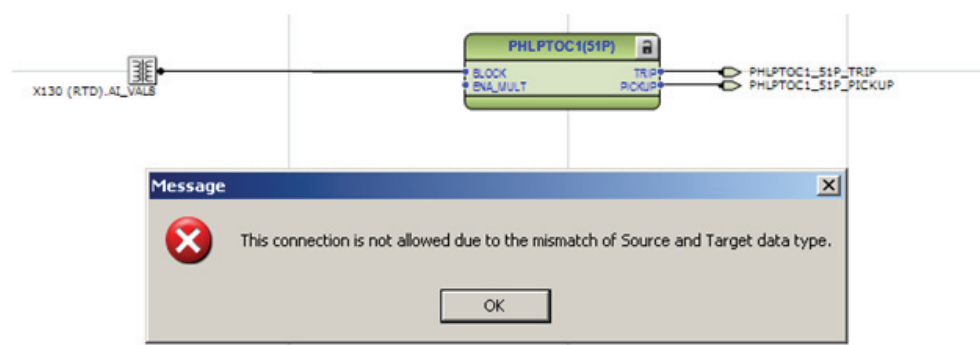
Figure 40:   *Application Configuration tool: an error message of a signal mismatch for a connection*

5.1.7   Hardware channels

Hardware channels can only be connected to a function block input or output. A hardware connection can be established with the Application Configuration tool or Signal Matrix tool.

When a hardware channel is connected, a graphical symbol appears in the Application Configuration tool. The connection is also displayed in the Signal Matrix tool with a cross mark. Hardware channels are always visible in the Signal Matrix tool.
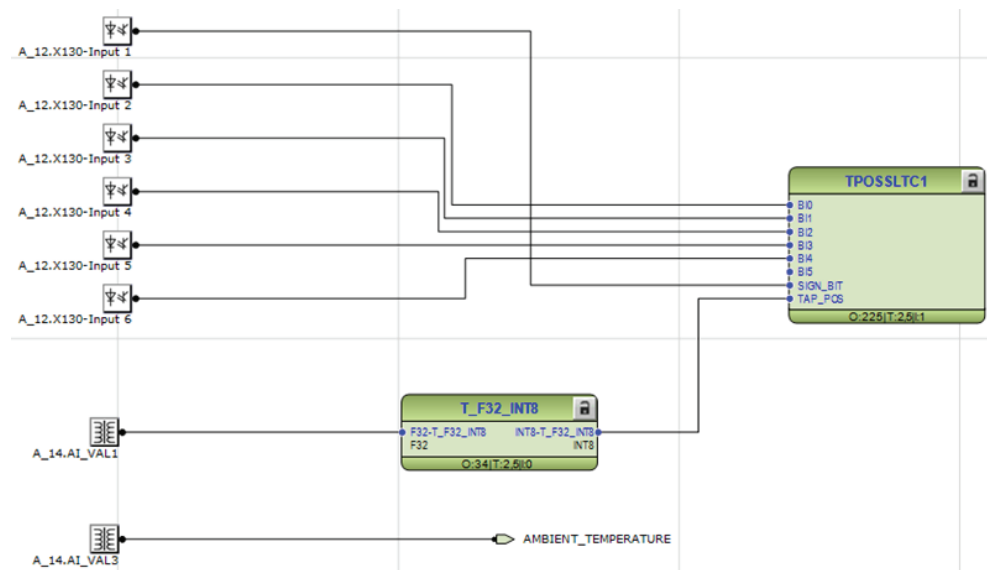
Figure 41:   Application Configuration tool: HW signal channels

There are three types of supported hardware channels.

- Binary input channels
- Binary output channels
- Analog input channels

Hardware input channel can be used as often as needed. A hardware binary output channel is taken from the list of available channels when a new channel is requested. This prevents using the same hardware binary output channel twice.

5.1.8   Validation

Validation checks the application configuration for errors based on the rules that govern the creation of the application at three different times.

- During the logic creation, while making a connection or placing a function block
- On demand by starting the validation
- When writing the application configuration to the protection relay

5.1.8.1   Validation when creating an application configuration

Validation is made when creating the application configuration.

- A connection between two input or two output signals is not possible
- A connection between two different data types is not possible: for example, from a binary output to an analog input

5.1.8.2 Validation on demand

The validity of an application configuration can be checked by clicking **Validate Configuration** in the toolbar. The Application Configuration tool checks the application configuration for formal correctness. The found problems are divided into warnings and errors.

- Warnings, marked with a yellow warning icon
    - Example: a variable connected to an output signal that is not connected
    - Example: if an output from a higher execution order function is connected to inputs of lower execution order function

- Errors, marked with a red circle with a cross
    - Example: unconnected hardware output

Warnings do not prevent writing to the protection relay. However, errors must be corrected before writing the application configuration to the protection relay. The application configuration can be saved and the Application Configuration tool can be closed with open errors, but the application configuration cannot be written to the protection relay.

These problems are listed in the **Output** view under the **Application Configuration** tab. Double-clicking the error or warning row navigates to the **MainApplication/Page/Area**, where the problem was identified.
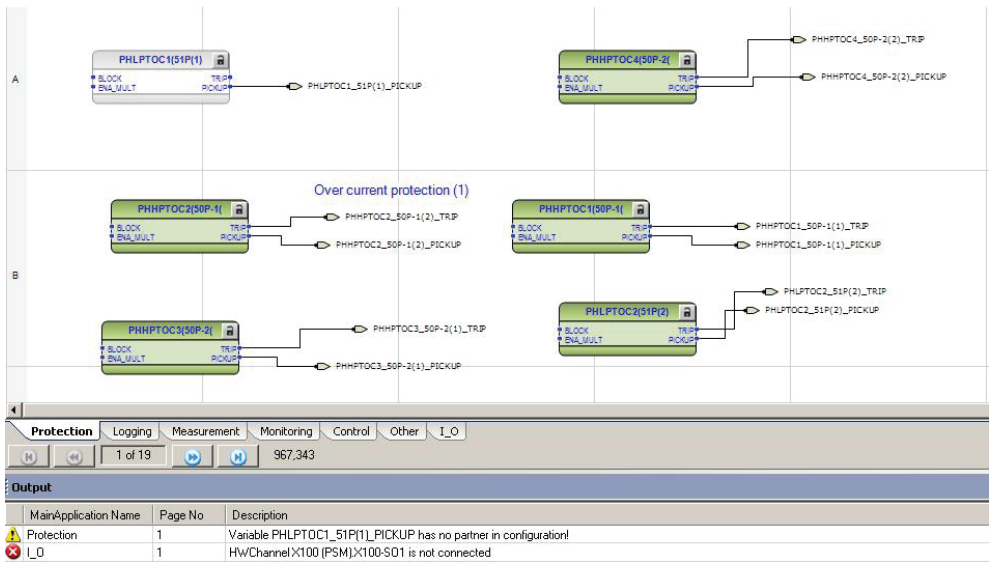
Figure 42:   Application Configuration tool: validation on demand

5.1.8.3   Validation when writing to the protection relay

When writing the application configuration to the protection relay, an automatic validation is performed. The validation is the same as the manually demanded validation. Errors abort the writing.

5.2   Parameter Setting tool

Configuration parameters and settings parameters can be changed with LHMI, WHMI or with the Parameter Setting tool in PCM600.

> Some parameters are only visible in the Parameter Setting tool and some only in LHMI.

> A common writing from PCM600 to the protection relay, where parameters are changed in the Parameter Setting tool, overwrites any parameter changes made locally with LHMI.

All parameters listed and displayed in the parameter list can be sorted into two groups.

- Configuration parameters
- Setting parameters

5.2.1 Configuration parameter

Configuration parameter specifies the operation mode of an application function or of the protection relay. These are basic configurations that are normally configured only once and then not modified again. The protection relay configures itself during start-up according to the given configuration parameter values.

5.2.2 Setting parameter

Setting parameter (short form: "setting") is a parameter that can be changed in the protection relay at runtime.

5.2.3 Setting group

Nearly all settings used by the protection relay for protection application functions are organized into a group of settings. Up to six setting groups can be configured with different values.

The protection relay supports the selection of a setting group at runtime.

5.2.4 IED parameter import and export

IED parameters can be imported and exported in XRIO file format. The parameter import/export functionality is available via the File menu when the Parameter Setting tool is open.
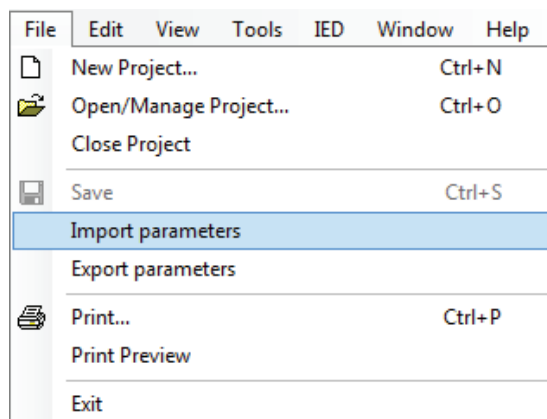
Figure 43:   Parameter import/export

5.2.5   Parameter organization

The organization of parameters into a tree structure becomes visible in the **Plant Structure** by expanding the setting tree.

5.3   Signal Matrix tool

The Signal Matrix tool is used to make cross-references between the physical I/O signals and function blocks and for the GOOSE signal input engineering.

> The Signal Matrix tool cannot be used for adding or removing function blocks, for example, GOOSE receive function blocks. The Application Configuration tool is used for this kind of operations.
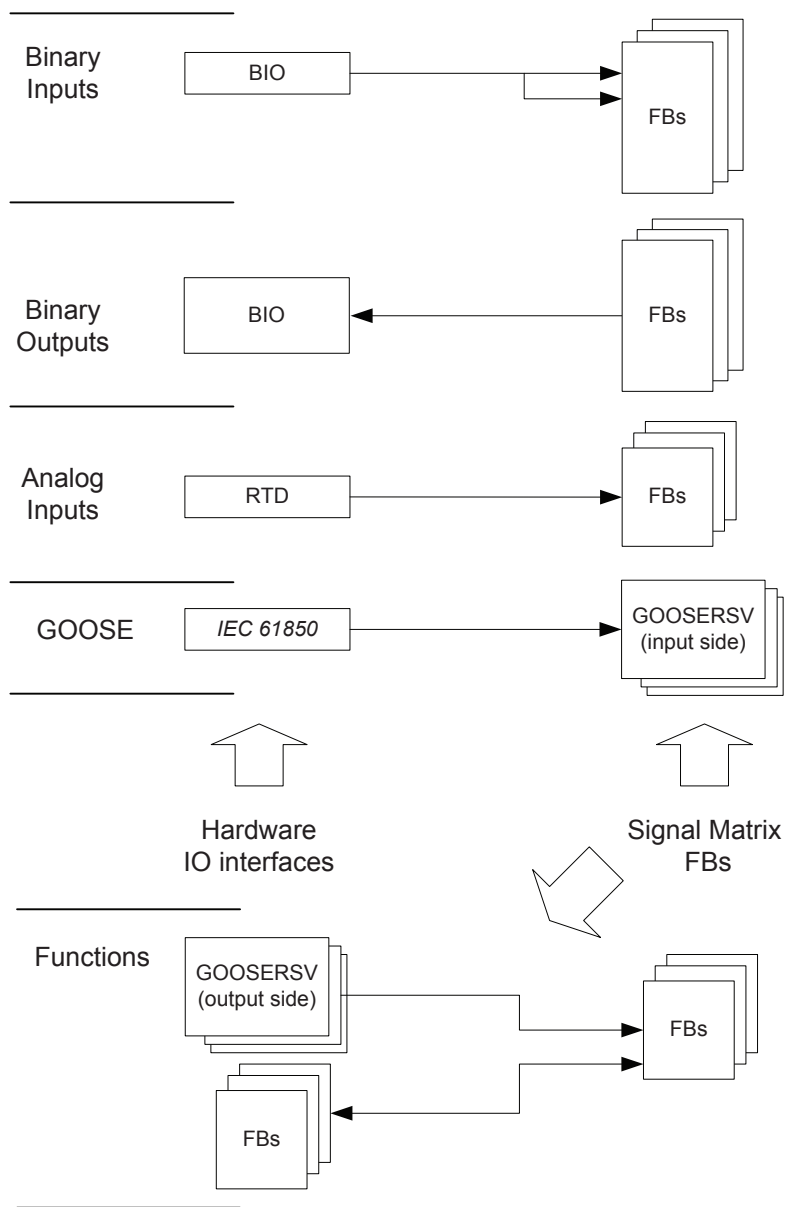
Figure 44: *Signal Matrix tool: operation principles*

A binary input channel can be connected to one or more function block inputs. If it is activated from more than one function block output, the glue logic has to be used.

A binary output channel can only be activated from one function block output. If it is activated from more than one function block output, the glue logic has to be used.

Glue logic means inserting a logical gate (OR and AND blocks) between the binary input and the function blocks or between the function blocks and the binary output channel. This can be engineered with the Signal Matrix tool.

Connections made with the Signal Matrix tool are automatically also shown in the Application Configuration tool.
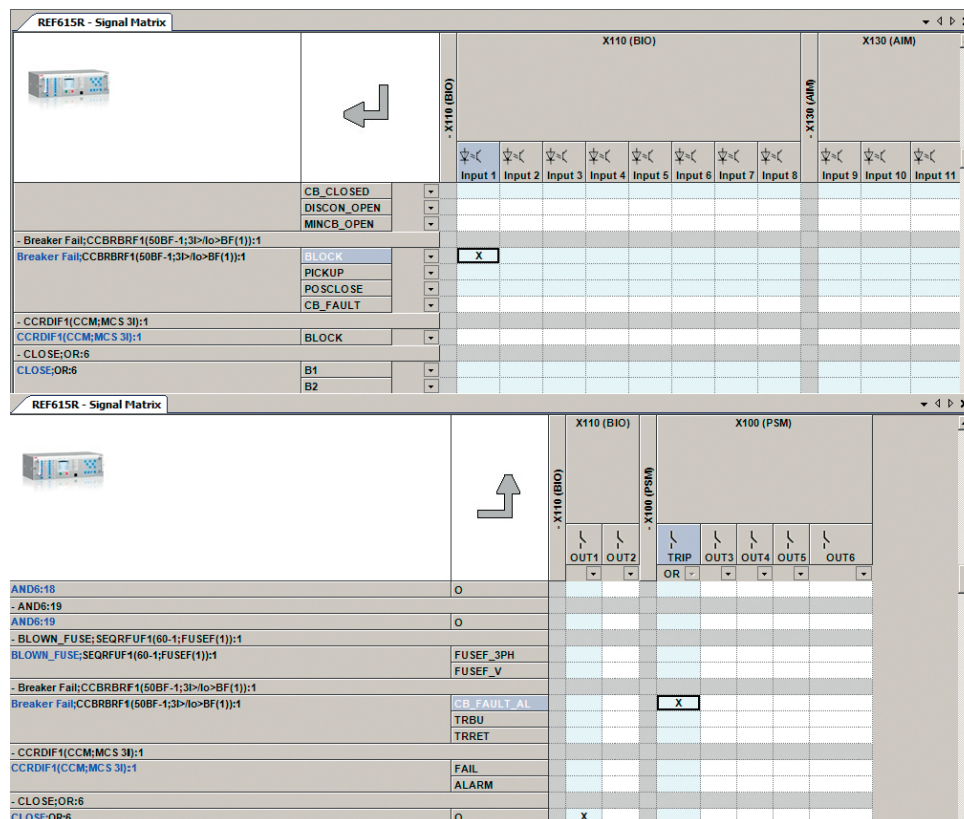
Figure 45: *Signal Matrix tool: a connection between binary input channels to binary input signals*

Depending on the IED capability, the Signal Matrix tool has a separate sheet for each possible combination.

The possible sheets are:

- Binary inputs
- Binary outputs
- Analog inputs
- Functions
- GOOSE

5.4 Load Profile tool

Load Profile tool is used for reading load profile records of COMTRADE format from a protection relay, clearing old records and viewing records via an external COMTRADE viewer. The default viewer included with PCM600 is Wavewin, but a third party viewer can be used.

5.4.1 Opening and closing Load Profile tool

- To open the Load Profile tool, click **Load Profile Tool** on the context menu of an IED node inside the PCM600 project tree.
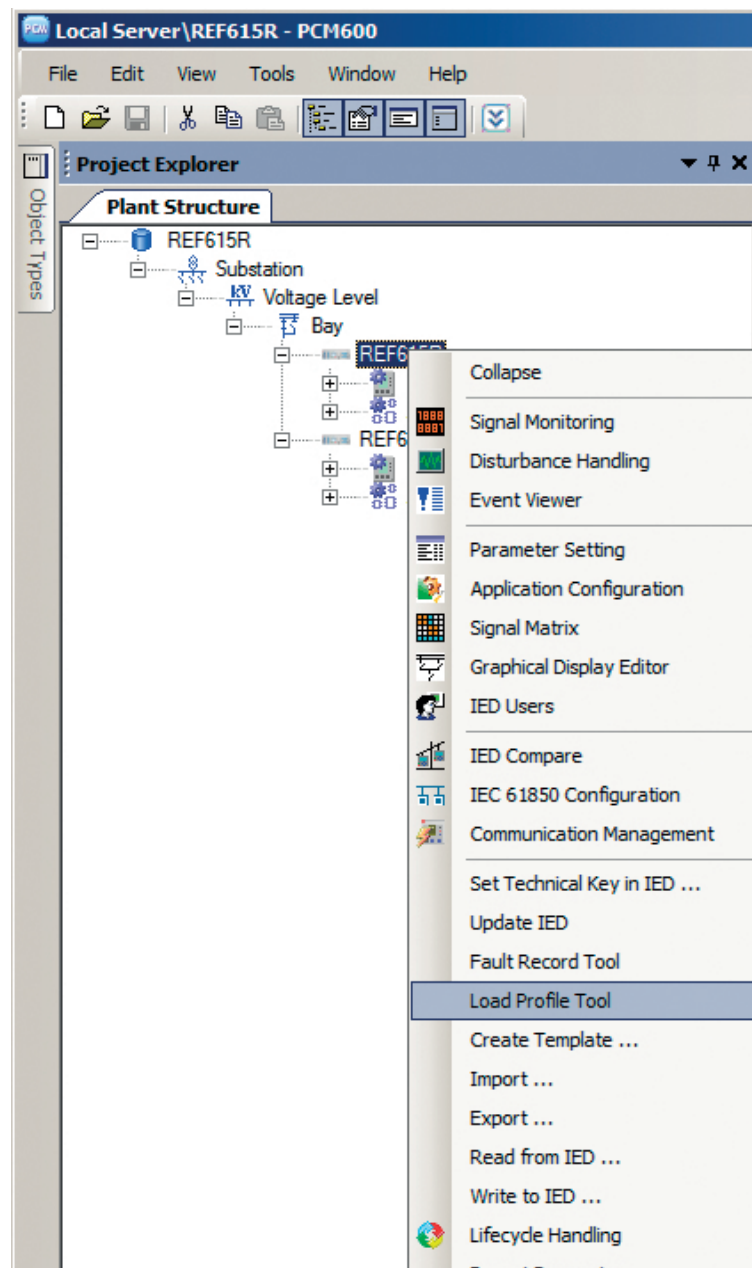
Figure 46:   Opening the Load Profile tool

- To close the Load Profile tool, click the **Close** button in the tool.
  The Load Profile tool runs in the same process as PCM600 but in a separate window.
  Multiple instances of the tool can be run at the same time. Any open tool instances are
  closed without confirmation when PCM600 is closed.
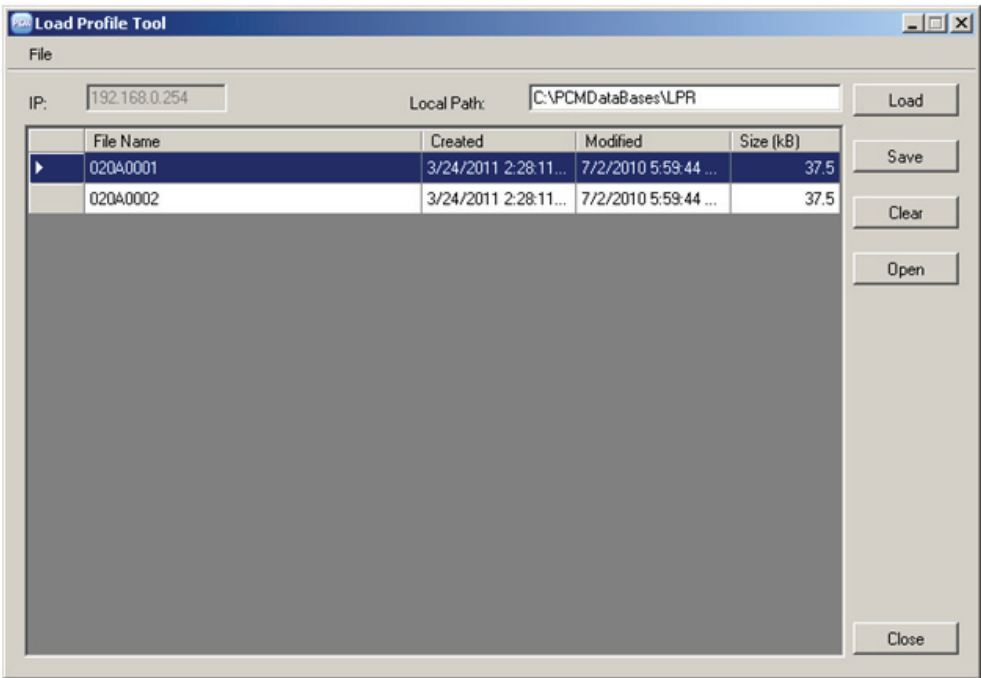
Figure 47: *Load Profile tool*

By default, the Load Profile tool uses the `\PCMDataBases\LPR` directory as a saving target directory.

5.4.2 Load Profile tool user interface
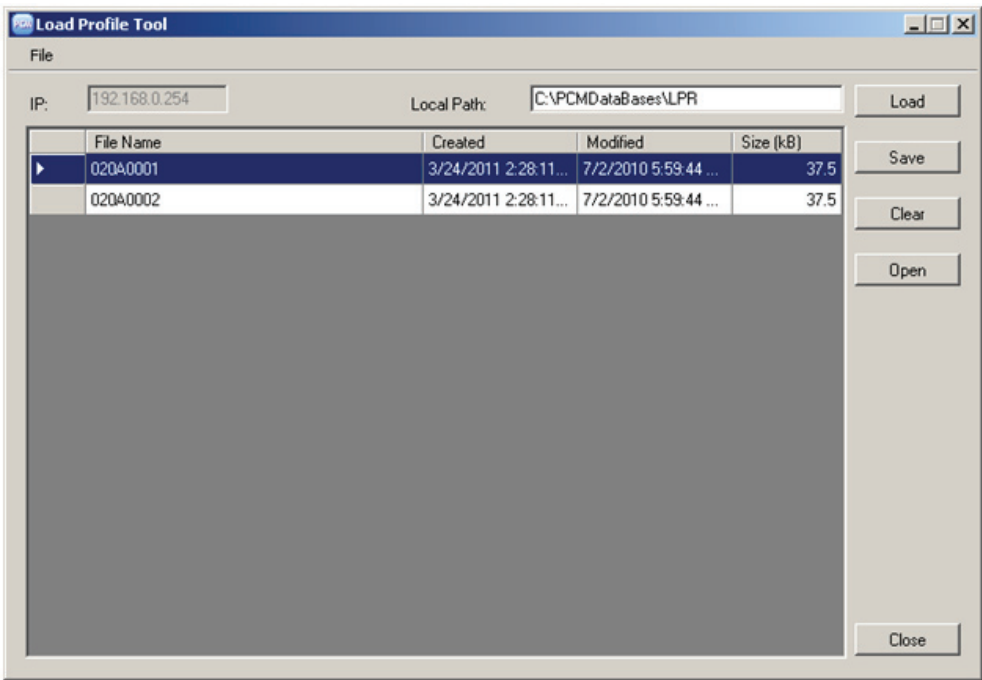
Figure 48:   Load Profile tool interface

Table 5:   Available actions on the user interface

Action	Description
Local Path	Default local path (`C:\PCMDataBases\LPR`) is the location from which the records are shown on the Load Profile tool. It is also the default path for saving records. **Local Path** field also allows the user to change the target location where the records are saved. The grid of the Load Profile tool shows only the records in the default local path including unsaved records in the temp path (`C:\Temp\Load\Profile Tool`) if there are any. Therefore changing the default local path allows the user to save records at the specified location on the local machine but the user is not be able to see those records in the grid of the Load Profile tool.
Load	Clicking the **Load** button downloads all available records from `C:\LDP\COMTRADE` directory in the protection relay to a temporary folder `C:\Temp\LoadProfileTool` on the local machine. In this temporary folder, the target file name is constant, and loading again overwrites the file. An unsaved record is deleted when the tool is closed.
Save	Clicking the **Save** button moves the records to the default or specified local path, **Load** transfers the records to a temporary folder. Each load profile record comprises two files with file extensions .dat and .cfg. Clicking **Save** adds a time stamp to the file names and moves the two files pertaining to the record to the default or specified folder. Saving another record creates a new record in addition to the old ones.
Clear	Clicking the **Clear** button clears record from either the Load Profile tool or protection relay or both. Before deleting the records, a confirmation dialog box is shown.
Table continues on next page	

Action	Description
Open	Select any record and click **Open** to view the record in Wavewin, provided that this external software is installed. Additionally, any record row can be double-clicked to view that record.
Sort	To sort the record rows by any column click a column header.
Close	Clicking the **Close** button closes this instance of the tool. Any open instance is finally closed when the whole PCM600 is closed.
File	All the actions are also available on the tool through **File** drop-down menu.

5.4.3 Information fields

The **IP** box shows the IP address of the selected IED and the **Local Path** box shows the selected location for reading or viewing records.

In the record grid, the name, creation time, modification time and size of each record are shown. The times and dates shown in the grid are the times when the files have been read rather than the original date stamps in the device.
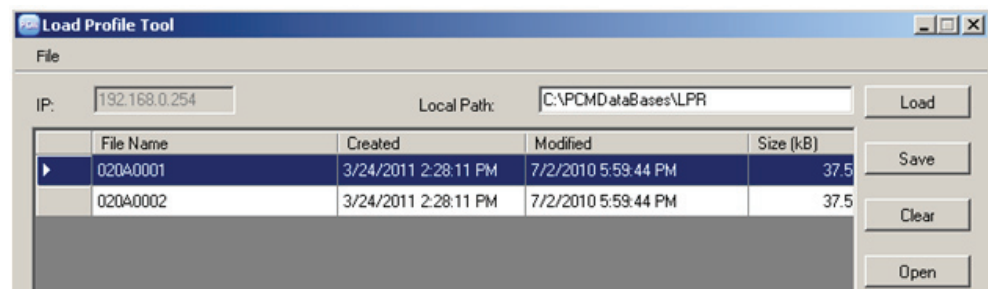
Figure 49:   Information fields

5.5 Fault Record tool

The Fault Record tool is used for reading the fault records from the protection relay and it is included in the connectivity packages. The tool makes analyzing the fault records easier by showing them separately in their own user control components. It also includes save, copy and clear functions where all the fault records are saved or copied in text format for later viewing or cleared from the protection relay or the tool.

5.5.1 Opening and closing Fault Record tool

- To open the Fault Record tool, right-click an IED node in the PCM600 project tree and select **Fault Record Tool**.
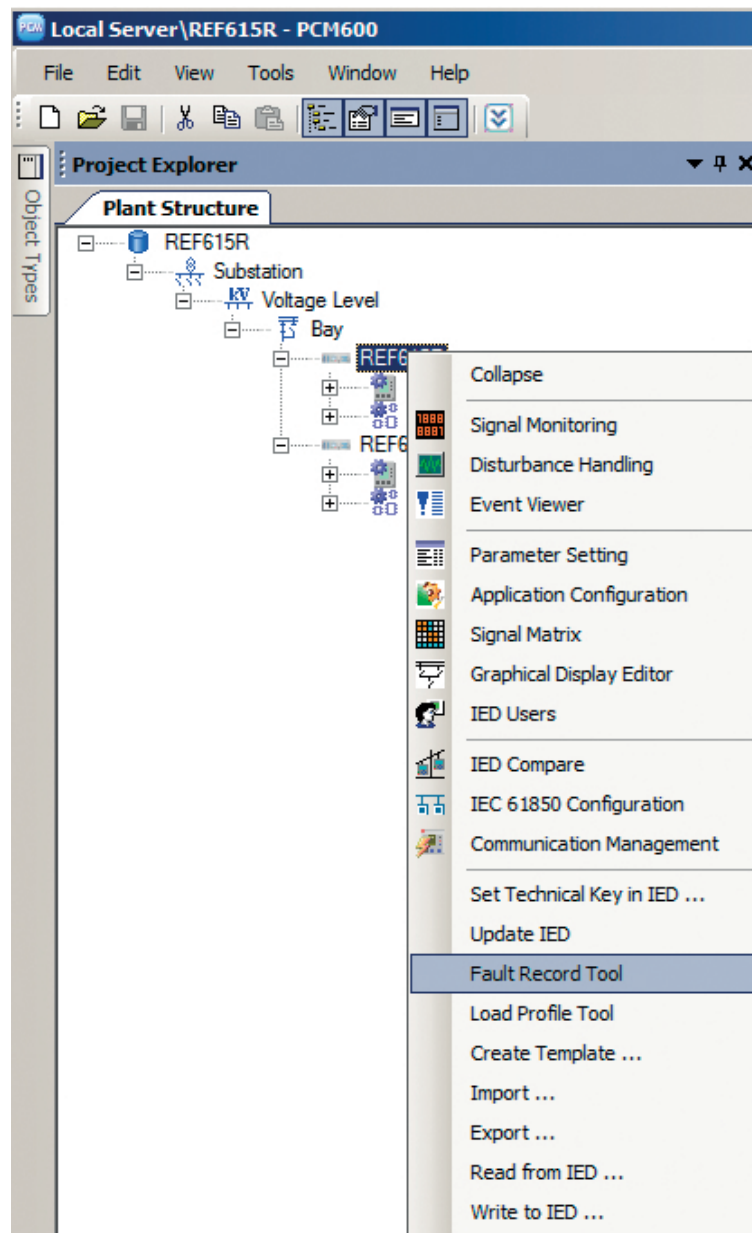
Figure 50:   *Opening the Fault Record tool*

- To close the Fault Record tool, click the **Close** button in the tool.
  The Fault Record tool runs in the same process as PCM600 but in a separate window. Multiple instances of the tool can be run at the same time. Any open tool instances are closed without confirmation when PCM600 is closed.

The Fault Record tool is a connectivity package tool. The main functionality is divided into three parts: reading the fault record parameters from the protection relay, displaying their names, values and units on the user interface and saving them to a text file. It is also possible to clear all the fault records from both the tool and the protection relay and copy the fault records either individually or all at once to a word processor.

5.5.2 Fault Record tool interface

Table 6:   *Available actions on the user interface*

Action	Description
Read	Clicking the **Read** button reads all available fault records from the protection relay into the tool. User has the option to read 1 fault record, 20 fault records or all fault records. The **Read** button opens up a progress bar to indicate an ongoing read operation. Click the **Cancel** button on the Read progress bar to cancel the read operation. On operation completion, the available fault records are shown in the record grid. Click the **+** icon to expand and view record details.
Save	Click **Save** to save the fault records on the local machine as .txt file.
Clear	Record can be cleared from either the Fault record tool or the protection relay or both. Before deleting the records, a confirmation dialog box is shown.
Close	Clicking the **Close** button closes this instance of the Fault Record tool. Any open instance is finally closed when the whole PCM600 is closed.
File	**File** menu for **Save** and **Exit** actions.
Edit	**Copy All** in the **Edit** menu allows to copy all the fault records which can then be pasted to a word processor and saved on the local machine without having to save the records as a .txt file. Additionally the user can select any particular fault record and right-click to copy the selected record.

Section 6   LHMI engineering

> For information on LED operation modes supported by the protection relay, see the technical manual.

6.1   Single-line diagram engineering

A single-line diagram of the protection relay can be designed by using the Graphical Display Editor tool of PCM600. The single-line diagram is modelled according to the IEC 61850 standard in the Graphical Display Editor.

6.1.1   Diagrams in Graphical Display Editor

The Graphical Display Editor is used for various tasks.

- Creating HMI display raster layouts
- Adding static text
- Adding measurands
- Adding busbars
- Adding symbols onto display page
- Drawing lines (creating a link)
- Adding buttons to control ACT application with SPCGGIO

HMI display page
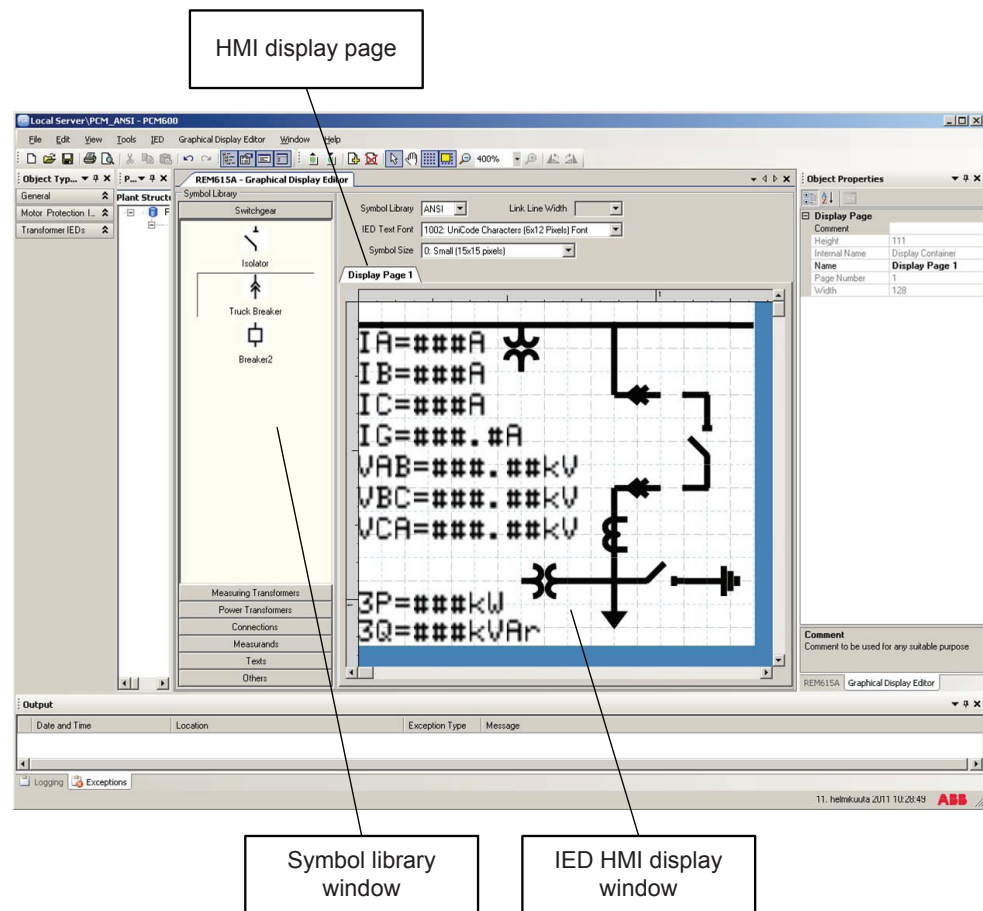
Figure 51: *Graphical Display Editor: active view*

The Graphical Display Editor has a stationary symbol library window on the left side of the view. The window is empty when no page exists for the protection relay. A default single-line diagram presentation is displayed if standard configurations are used.

6.1.1.1 Display window and sequence order

The HMI pages are handled according to rules.

- The protection relay supports one bay with up to ten single-line diagram HMI pages.
- Measurements and the single-line diagram can be displayed on the page in any possible order and placement.
- All symbol objects, for example apparatus and measurement, on the HMI page must be linked to the correct function block in the application configuration to present the correct process values.

6.1.1.2   Symbol library

The **Symbol Library** view contains panes that include drawing symbols or elements for creating a single-line diagram, measurements and texts onto a page. Panes can be opened by clicking the name bar of the selected element.

The library shows the symbols either in the ANSI standard or IEC standard. The standard is selected from the list located on top of the window.

When changing to another library standard, Graphical Display Editor changes the symbols according to the selected new standard and redraws the single-line diagram in the window.

> To change the symbol format used in the protection relay, select **Main menu/Configuration/HMI/SLD symbol format** and choose IEC or ANSI.

> To become familiar with the available symbols, select the different panes and their symbols.

6.1.1.3   Supported single-line diagram symbols

Table 7:   *Single-line diagram symbols*

Description	IEC representation	ANSI representation
Circuit breaker — Intermediate position		
Circuit breaker – Open position		
Circuit breaker – Closed position		
Circuit breaker – Bad (faulty) position		
Disconnector – Intermediate position		
Disconnector – Open position		
Table continues on next page		

Description	IEC representation	ANSI representation
Disconnector – Closed position		
Disconnector – Bad (faulty) position		
Truck – Intermediate position		
Truck – Open position		
Truck – Closed position		
Truck – Bad (faulty) position		
In-feeder		
Out-feeder		
Current transformer		
Voltage transformer		
Ground symbol		
Motor		
Generator		
Table continues on next page		

Description	IEC representation	ANSI representation
Power transformer with two windings		
Fuse		
Button		

6.1.1.4   HMI display raster layout and text font selection

The raster on the page changes from symbol presentation to text presentation when a text object is selected and vice versa.

The text can be presented in UniCode characters (6 x 12 pixels). The total size of the presented white area (page) represents the visible part of the LHMI display without the header line.

The visible display for a single-line diagram is organized in a raster of 9 x 7 (columns x rows). Each symbol (presented in 15 x 15 pixels) included in the drag-and-drop method must be dropped into a raster box.

The description text for an apparatus object can be placed in all four directions around the symbol. The description is part of the apparatus object. It is possible to place the symbols without the assistance of **Snap to Grid** and manually change the position coordinates.

6.1.1.5   Text handling

The display switches when text is selected in a display of 22 x 9 (columns x rows). One display box holds one character. A text element must be placed in the position of the display.

> The name and the unit of a measurement or text symbol can be changed by double-clicking the symbol or via the **Object Properties** view.

Selecting and toggling **Show Texts using the IED fonts** can be used to preview the single-line diagram to see how it is presented in the real HMI display.

6.1.1.6   Adding static text

1.   Place a **Static Text** object into a raster box by dragging-and-dropping.
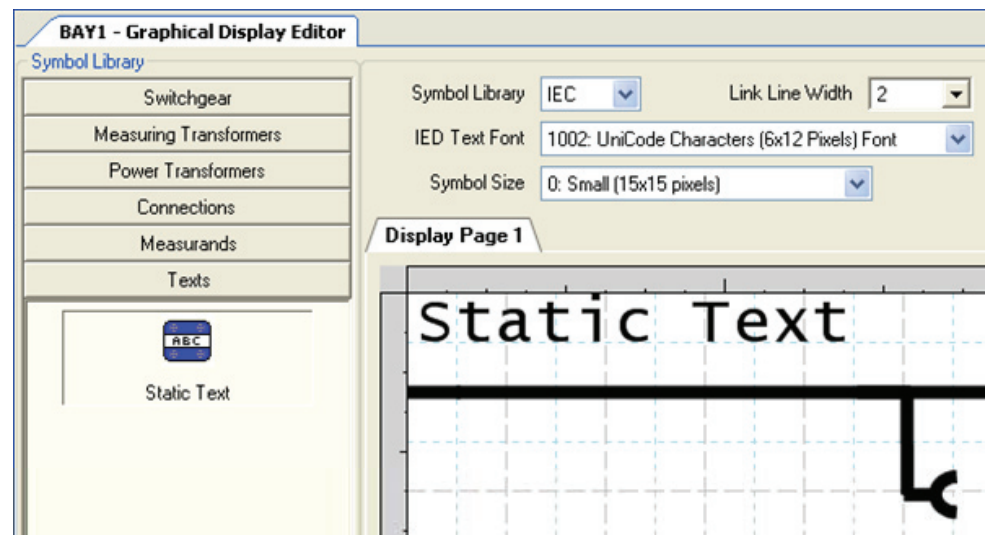
Figure 52:   Adding a static text field into a LHMI view

2.   Edit the text in the **Name** field in the **Object Properties** view, or alternatively double-click the text to edit it.

6.1.1.7   Adding select buttons

1.   Drag a **Select Button** object into a raster box.
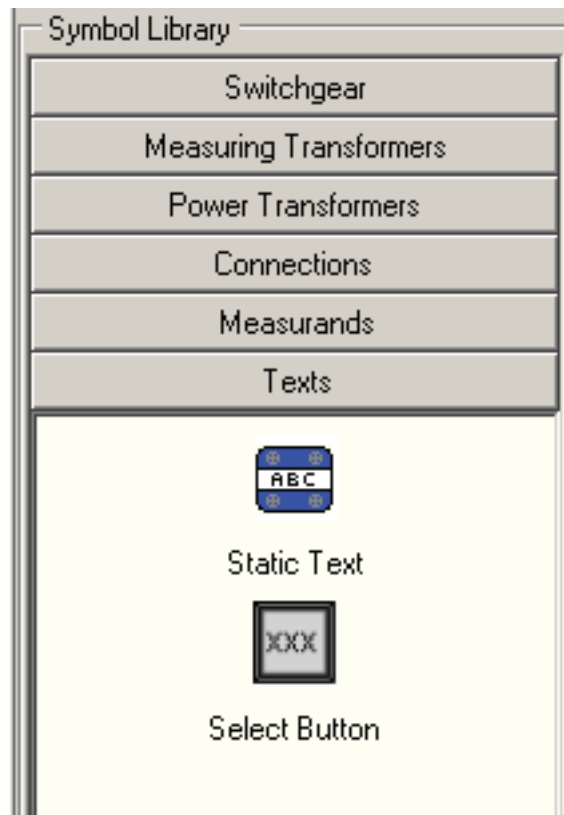
Figure 53: *Select button*

2. Right-click the select button symbol, point to **Select Input Signal** and select the input signal from the list.

6.1.1.8 Adding measurands

1. Drag a **Measurand** object into a raster box.
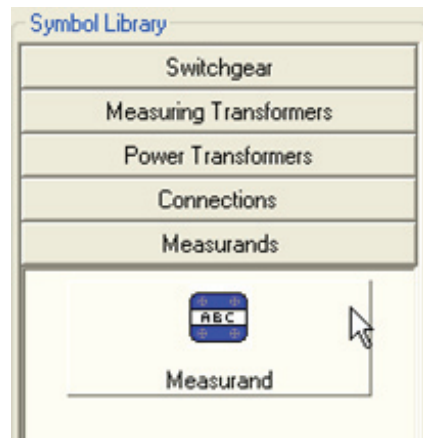
Figure 54:   Adding a measurand object to an LHMI view

2.   In the **Objects Properties** view, edit the name, unit and the number of decimals.
      Unit text specifies the default text used for the measurement's unit. If the **Unit text**
      is empty in the Graphical Display Editor, no unit is shown. If the **Unit text** is not
      empty, the unit in the protection relay is updated dynamically based on the signal it
      is connected to. The *Scale factor* parameter is not used.

6.1.1.9   Adding a busbar

1.   Add at least two **Busbar Junction** elements from the **Symbol Library** to the display
      page.
2.   Select the **Busbar Junction** and use the rotate command from the toolbar to ensure
      that the busbar ends to the margin.
3.   Add links between the busbar junctions.
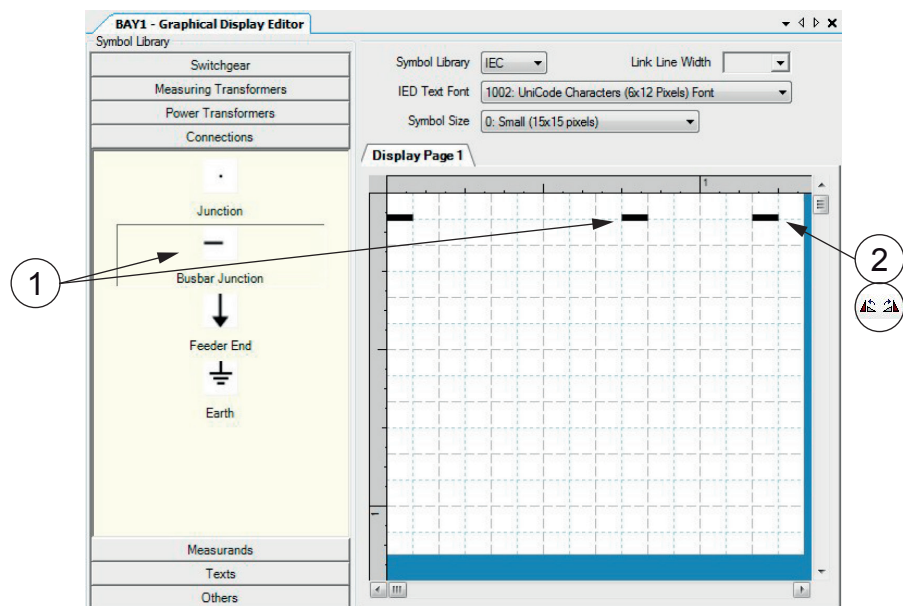
Figure 55:   *Graphical Display Editor: drawing a busbar and placing busbar junctions*

1   Busbar junction

2   Rotate command

4.   Add a link between one busbar junction point and the corresponding symbol or junction point.

6.1.1.10   Adding symbols into a display page

1.   Prepare the body of the single-line diagram by locating symbols to the wanted positions on the display.
2.   Drag the apparatus or transformer symbols into a raster box.
3.   Drag the connection symbols into a raster box.
4.   Place the junction points.
      Do not connect two symbols directly to each other. Instead, add a junction between them.
5.   Use the X and Y coordinates in the **Object Properties** window to adjust the placement of symbols in the single-line diagram.
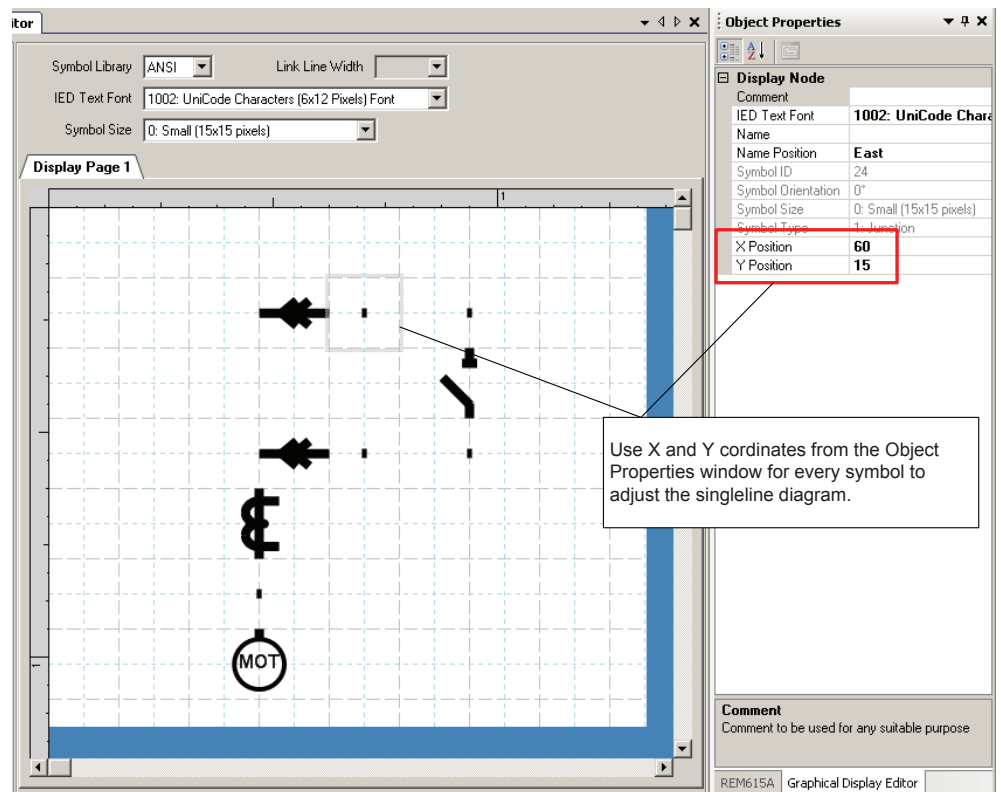
Figure 56: *Graphical Display Editor: adding single-line diagram symbols into a display page*

6.1.1.11 Drawing lines to create links

After the apparatus symbols are placed, lines can be drawn to create links.

1. To draw a line, point to the center of the connection point which is visible in two circles at the end points of a line.
2. Drag the pointer to the destination connection point. Center the pointer again and release to draw the line.
3. Draw all the necessary line elements.
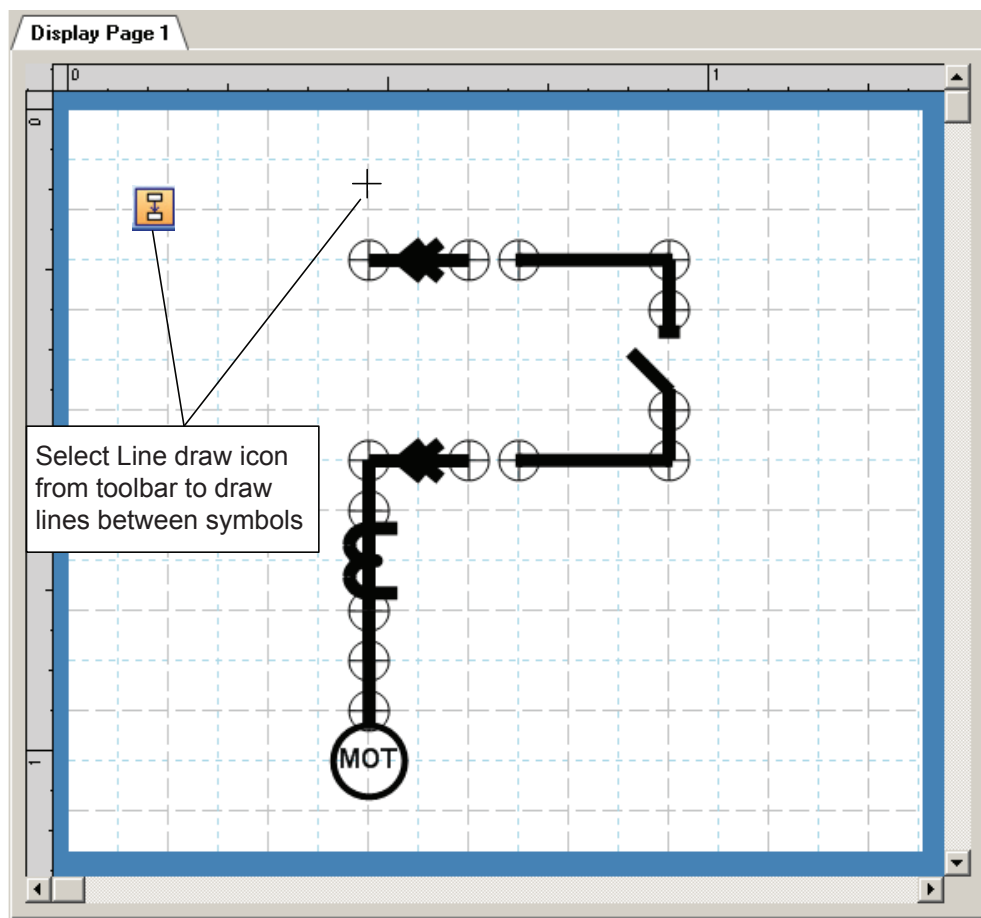
Figure 57:   *Graphical Display Editor: drawing a line between symbols*

4.   To finish the line drawing, click **Select** on the menu bar.

6.1.2   Bay configuration engineering

A view with a single-line diagram and measurements contains active living objects. The object values are updated by the protection relay periodically (measurement) or in case of an event.

Once the symbols are placed on the HMI page, they must be linked to the corresponding function block in the application configuration, which protects or controls the object that the symbol on the HMI page represents.

6.1.2.1   Creating a complete HMI display page

1. Make a sketch of how to present the single-line diagram.
2. Place the apparatus, transformer and other symbols that are needed for the single-line diagram into the raster boxes.
3. Add **Junction points** where needed.
4. Link the apparatus symbols with line elements.
5. In the **Object Properties** view, adjust the text symbols while writing to north, east, south or west.
6. Place measurements when needed.
7. Edit the name, unit and the number of the measurements' decimals.
8. Select each object that has a dynamic link and make the link to the corresponding process object.
9. Check that the correct function block is selected.
   Function blocks of the same type can have different instance numbers.
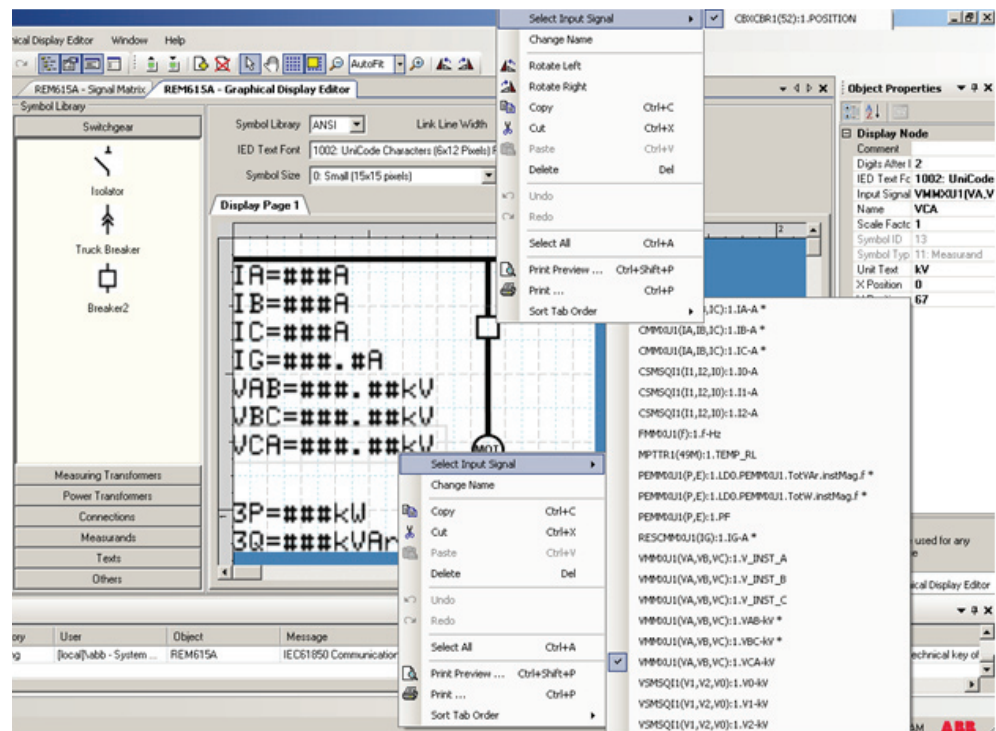
Figure 58:   *Graphical Display Editor: establishing a dynamic object link*

10. Ensure that all links are done.
11. Save the complete picture.
12. Write to the IED.
13. Validate the single-line diagram on the protection relay.

6.1.2.2 Linking process objects

To describe a process object within an IED, it needs to be established in the application configuration, configured when given the parameters by the Parameter Setting tool and linked to be displayed in the HMI.

Three tools are involved in the described steps.

- Application Configuration tool for programming the application function block for the apparatus and measurements
- Parameter Setting tool for adapting the settings and configuration parameters of the application function block
- Graphical Display Editor for establishing the link to update the selected data attribute in the HMI of the application function block

The needed information is delivered with switch controller (of type CSWI) for an apparatus and all the configured function blocks with measurements (of type MMXU) for the measurements

1. Right-click the apparatus symbol and select **Select Input Signal**.
   A list of engineered switch control application function blocks opens.
2. Select the switch control application function block that corresponds to the selected apparatus.
3. Right-click the measurement symbol and select **Select Input Signal**.
   A list of the engineered measurement application function blocks opens.
4. Select the measurement application function block that corresponds to the selected symbol.
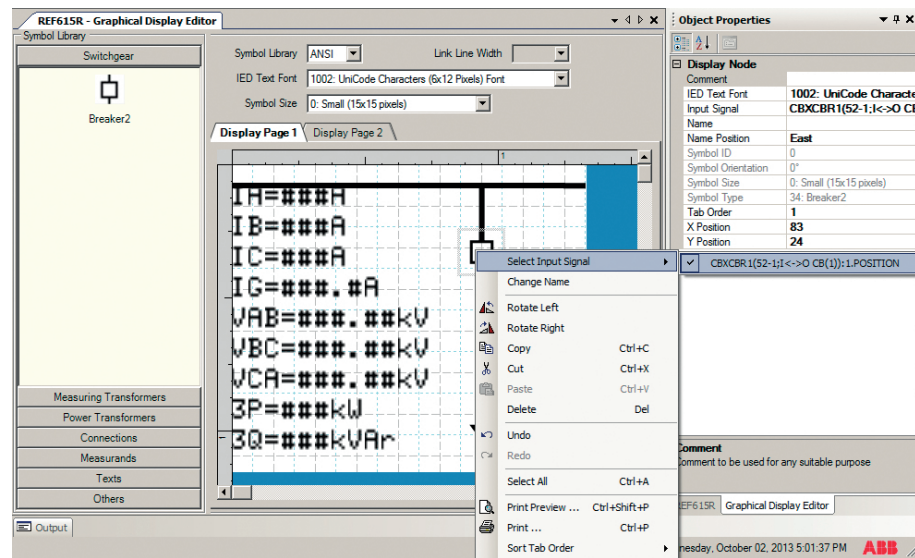
Figure 59:   *Graphical Display Editor: input signal selection*

The ordering number in the selection window of the process objects corresponds to the number given in the Parameter Setting tool tree and to the application function block in the Application Configuration tool.

Only the apparatus and measurements that are configured in the application configuration program are displayed.
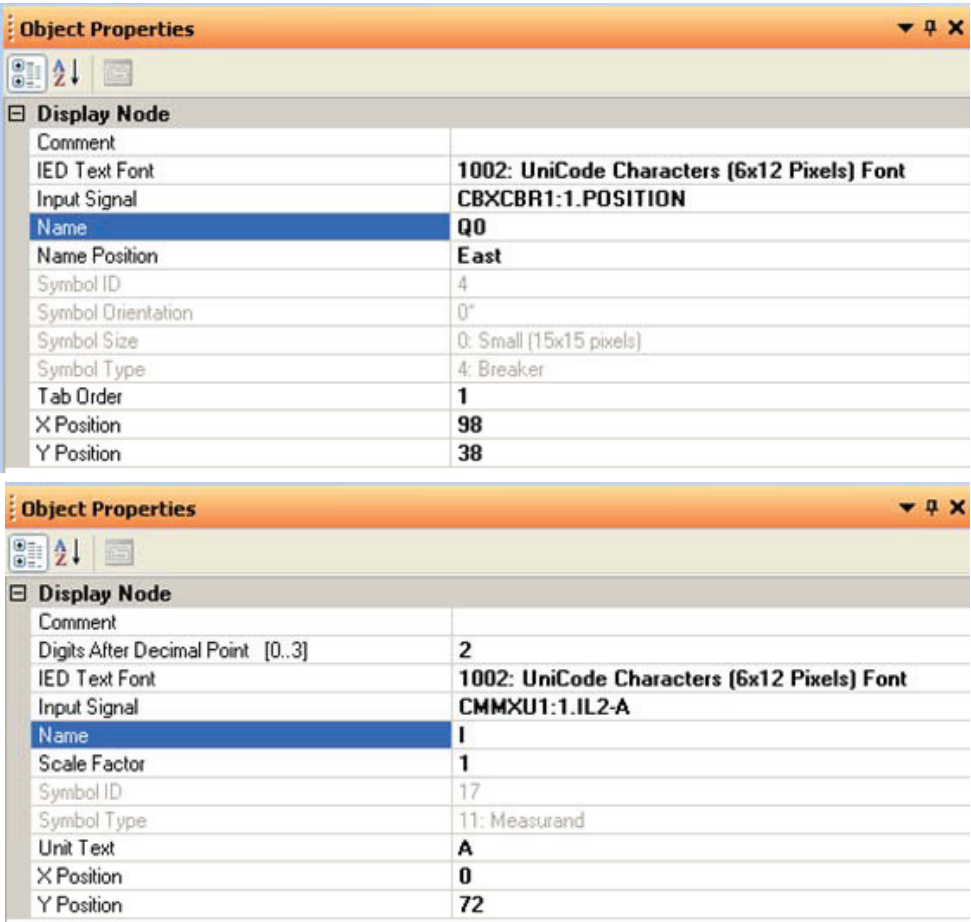
Figure 60:   Graphical Display Editor: object properties view for text insertion

Section 7   IEC 61850 communication engineering

7.1   IEC 61850 protocol references and pre-conditions

To engineer the IEC 61850 protocol interface for the protection relay, the following additional manuals or knowledge of their contents is required.

- Knowledge of the IEC 61850 engineering process as described in the IEC 61850 standard
- The technical manual describes the function blocks defined as logical nodes
- The IEC 61850 engineering guide
- The IEC 61850 parameter list

7.2   IEC 61850 interface

For more information on the implementation of IEC 61850 in protection relays, see IEC 61850 engineering guide.

7.2.1   IEC 61850 interface in the protection relay
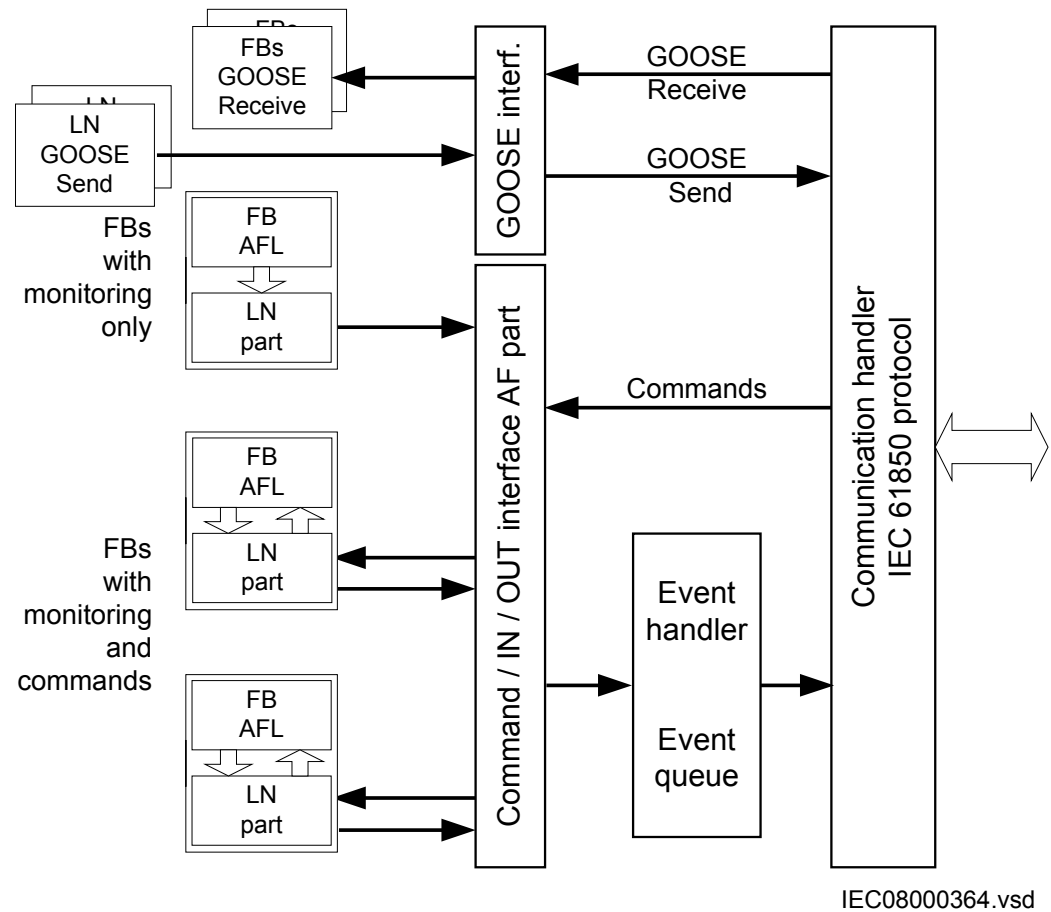
Figure 61:   IEC 61850: Communication interface principle

IEC 61850 provides a method for identifying all signals that belong to a function. These signals are identified through the logical nodes representing the functions. All signal information for commands and monitoring are available in logical nodes.

Whenever a function block is instantiated in the Application Configuration tool, PCM600 automatically generates the corresponding logical node data.

7.2.1.1   GOOSE data exchange

The IEC 61850 protocol supports a method to directly exchange data between two or more devices (IEDs). This method is described in the IEC 61850-7-2 clause 15.

The concept is based on sending a multicast over the Ethernet. Whoever needs the information, detects the telegram by its source address, reads the telegram and handles it. The telegrams are multicast sent and not acknowledged by the receiver.
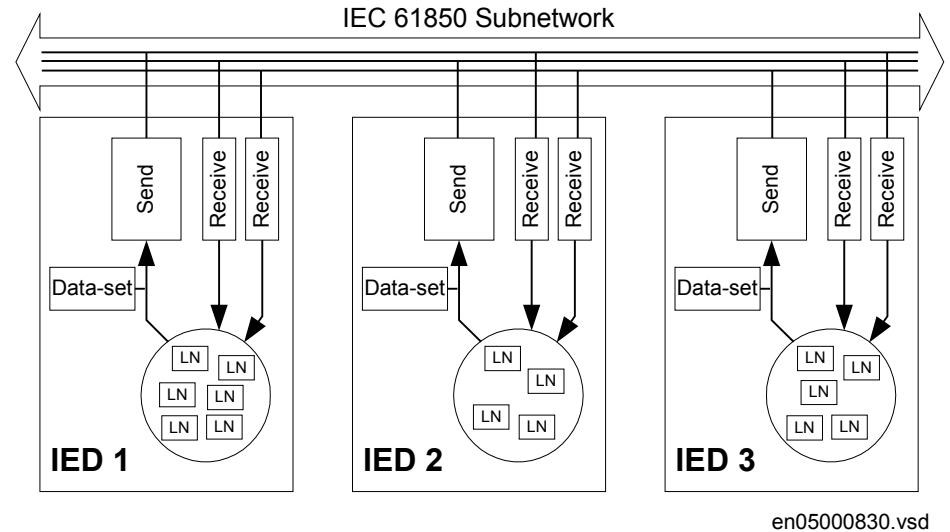
Figure 62:   *IEC 61850: Horizontal communication principle, an example of three IEDs where each IED communicates with all others*

When a GOOSE message is to be sent, it is defined by configuring the data set with the defined trigger option and GoCB. This engineering process is done in a station configuration tool, for example, IEC 61850 Configuration tool or IET600. The task involves configuring lists with the signal, value and quality (data attributes) that belong to the GOOSE message data set.

In the opposite direction, the standard only defines the IED as a receiver of a GOOSE message. How the GOOSE input signals are handled must be defined in the device's application configuration. The SCL data generated by the IEC 61850 Configuration tool or IET600 (or any other station configuration tool) contains the GOOSE data sets as input data. The input data must be connected to a GOOSE receive function blocks in the Signal Matrix tool.

7.2.2   Function view for IEC 61850 in PCM600

The IED design is directly based on IEC 61850. Thus, the function blocks in PCM600 tool use IEC 61850 logical node naming for function blocks. This relation is automatically handled by the PCM600 tools.

The concept in the IED is such that the IEC 61850 data for each function instance is available in the data model, even when the function is not used in the application. This

means that it is not necessary to handle any instance information for the functions regarding IEC 61850.

7.2.3 Station configuration description file types

The IEC 61850 standard defines SCL file types in the sequence of engineering. These files have a different definition, which is explained in IEC 61850-6. Three of the file types are used in the engineering process for an IED.

- ICD = IED capability description
    - Capability description of the IED in logical nodes and their data. No information about, for example, the communication configuration is included.
    - An IED is already extended by default data sets and report control blocks. They are predefined by ABB. Changes or additional data sets, for example, have to be done with IEC 61850 Configuration tool or IET600.
- SCD = Station configuration description
    - A complete configuration description of all IEDs in a station and the full engineering of process signals and communication structure is included. This includes all the needed data sets and control blocks.
- CID = Configured IED description
    - The CID file contains the information needed for configuring one specific IED. The CID file contains the complete configuration description of one specific IED. This includes the configured IED name, communication part, data sets and all control blocks.

7.3 IEC 61850 engineering process

The IEC 61850 standard defines how information is communicated in a substation. The information communication can be divided into different parts.

- Description of the substation part, including the used logical nodes
- Description of the IEDs with their logical nodes
- Description of the communication network
- Description of the engineering process

When exporting an SCL file from PCM600, the tool builds a default substation structure and creates default data sets and control blocks for vertical communication between the substation client and IEDs. For more information, see the IEC 61850 standards.

In the following example, it is assumed that PCM600 and IET600 are used as the system configuration tools. Another option is to use the IEC 61850 Configuration tool inside PCM600. In that case the SCL file export and import operations (steps 1 and 3) are not needed.

1.   SCL files are exported from PCM600. In this case, a SCD file. It is also possible to export other SCL file types.
2.   Horizontal and vertical communication is configured using the station configuration tool, for example, IEC 61850 Configuration tool or IET600.
3.   SCL files are imported to a PCM600 project. In this case, it is the updated SCD file.
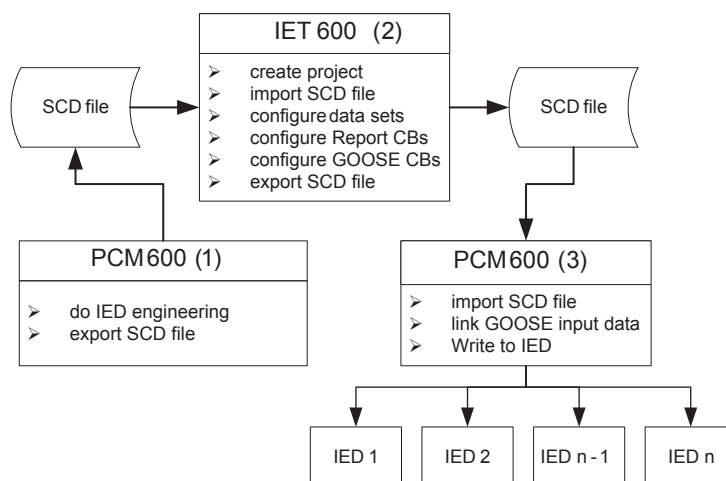
Figure 63:   *IEC 61850: signal engineering procedure flow when a complete station is exported as a SCD file*

7.3.1   Exporting SCL files from PCM600

A pre-condition for exporting SCL files from PCM600 is that all IEDs in the project must be engineered in PCM600. The IEDs require unique name and IP addresses and they must be set according to the project definitions. IED configurations must be finalized as far as possible before starting the IEC 61850 configuration part.

7.3.1.1   Exporting SCD files

1.   Select the station in the **Plant Structure** view.
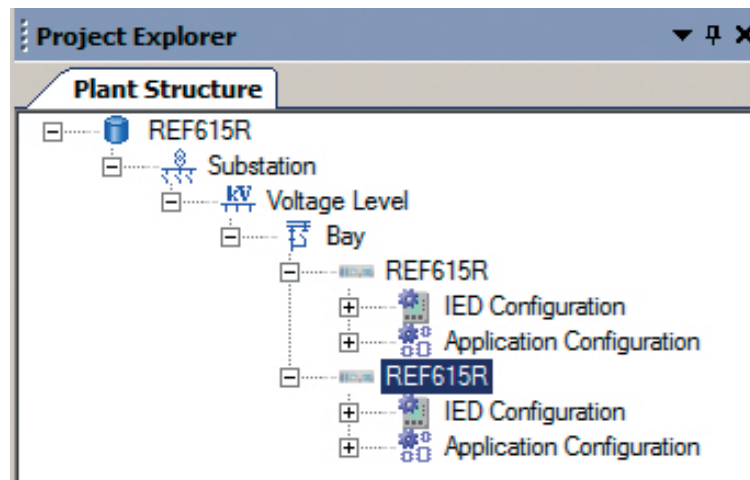
Figure 64:   IEC 61850: selecting the station

2. Right-click the station and select **Export**.
3. From the open standard Windows dialog box, select the location to store the file and name it.
4. Click **Save**.
    The **SCL Export Options** dialog box opens.
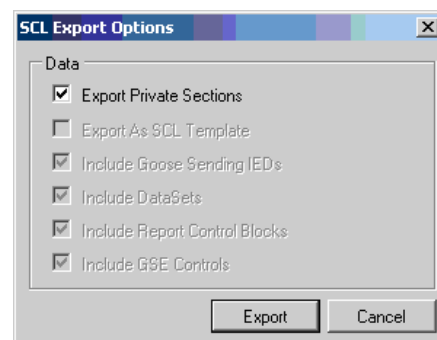
IEC09000627-1-en.vsd

Figure 65:   IEC 61850: selecting the SCL export option

5. Select the **Export Private Sections**.
6. Click **Export** to export the private sections to the SCD file.
    A progress window shows the ongoing export of the station.

7.3.1.2   Exporting ICD or CID files

1. Select the IED in the **Plant Structure** view.
2. Right-click the IED and select **Export...**

The **Export** dialog box opens.

3. From the **Save as type** list, select the type of file to export.

- Configured IED description (.cid) for the IEC 61850 structure as needed for the IED at runtime
- IED capability description (.icd) for the IEC 61850 structure

IEC08000416.vsd
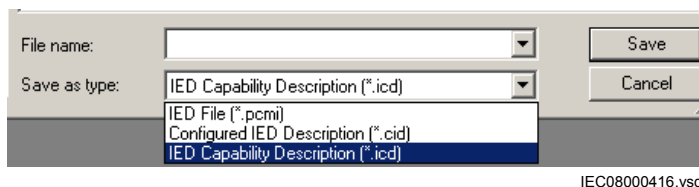
Figure 66:   IEC 61850: export IED file type selection

4. Click **Save**.
   The **SCL Export Options** dialog box opens.
5. Select the export options.

IEC08000418.vsd

Figure 67:   IEC 61850: Export IED file Options

6. Click **Export**.

7.3.2   Engineering vertical and horizontal communication

For IEC 61850 engineering a separate system configuration tool is needed to be used with PCM600. In PCM600 Ver.2.5 or later the recommended tool for smaller projects is the IEC 61850 Configuration tool. For larger projects it is recommended to use IET600, which is available as a standalone tool.

1.   Create a project in IEC 61850 configuration tool. [1]
2.   Import the SCD file created by PCM600. [1]
3.   Conduct vertical communication engineering (monitoring direction).

    3.1.   Check the default data sets.
    3.2.   Configure and/or reconfigure the default data sets.

> Data sets meant for vertical reporting can only contain data on the data object level, not on the data attribute level.

> The data set for GOOSE can contain signals only on the data attribute level.

    3.3.   Configure additional **Report Control Blocks** when needed for each data set used for vertical communication.
    3.4.   Link the IED clients to the **Report Control Blocks**.

> Up to five report clients can be configured.

4.   Conduct horizontal communication engineering.

    4.1.   Configure GOOSE control blocks for each data set configured for GOOSE messages.

> One data can be included in the GOOSE data set only once.

    4.2.   Define the client IEDs for each GOOSE control block.
    4.3.   Link the IEDs to the GOOSE control block that is to receive the GOOSE control block.

5.   Export the updated SCD file. [1]

> All data sets, **Report Control Blocks** and GOOSE control blocks must be located in LLN0.

---

[1] Applicable when using IET600

7.3.3 Importing SCL files to PCM600

The IED engineering tool must be able to receive a SCD file or an ICD file as an import to receive the engineered communication extensions, for example, for the different IEDs.

7.3.3.1 Importing SCD files

1.   Select the station in the **Plant Structure** view.
2.   Right-click the station and select **Import**.
3.   From the open standard Windows menu, select the file to be imported and start the reading.
     The **SCL Import Options** dialog box opens, querying how the file should be handled during the import.
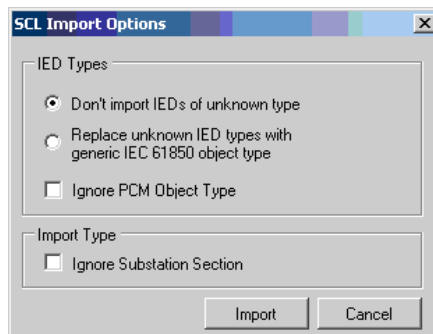
IEC09000631-1-en.vsd

Figure 68:   *IEC 61850: importing a SCD file*

4.   In the **SCL Import Options** dialog box, select how to handle the file during the import.

     •   Click **Don't import IEDs of unknown type** to protect the existing IEDs in case the SCD file does not match the original configuration in PCM600.
     •   Click **Replace unknown** if it is known that the file includes additional IEDs that are needed. The IED of type "Generic IEC 61850 IED" is used to integrate these kinds of IEDs into the plant structure, for example.
     •   Click **Ignore PCM Object Type** to update the IED object(s) in PCM600 from the IED type(s) in the SCD file, whether or not the IED type(s) in the SCD file matches the IED object(s) in PCM600.
     •   Click **Ignore Substation Section** to not import the SSD file part of the SCD file.

5.   Click **Import** when the file definition has been completed.
     A progress view displays the importing procedure.
6.   Make connections from the sending IEDs to the receiving function blocks with the Signal Matrix tool.

Make connections between the signals that the server is sending and the function blocks on the receiver's side.

7. Write the configuration to the IED.
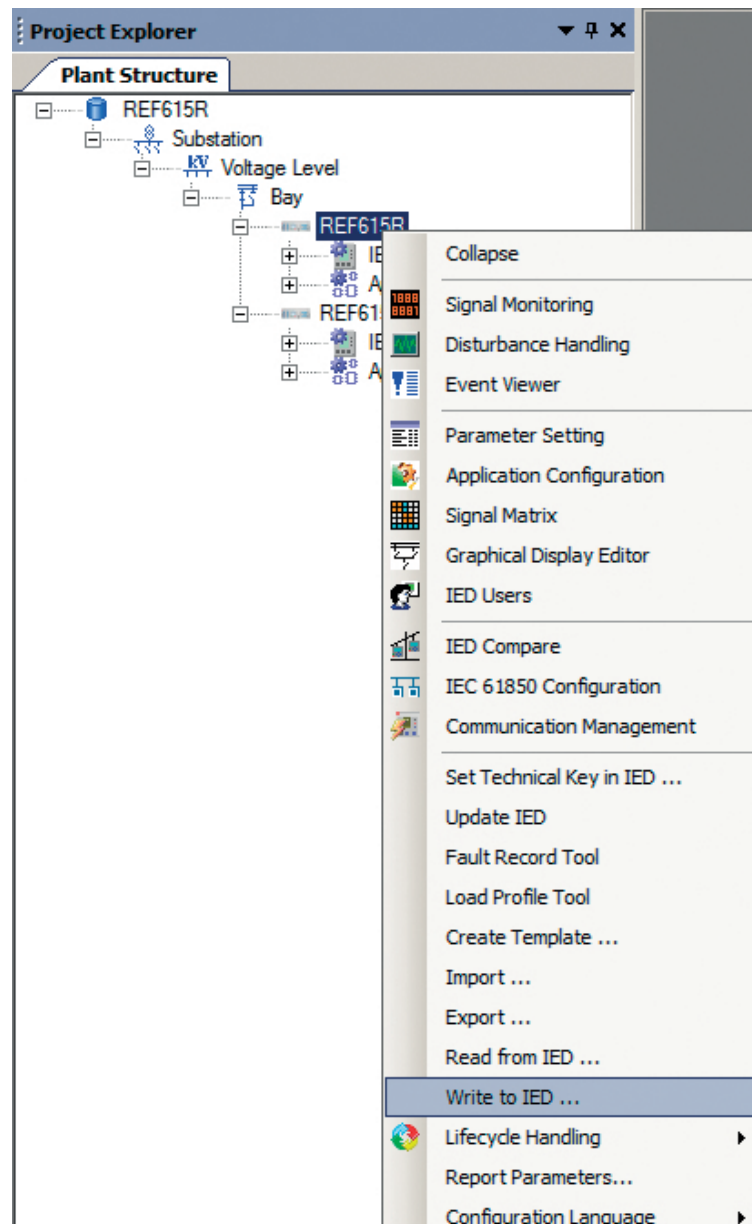In the **Plant Structure** view, select the IED, right-click and select **Write to IED**.

*Figure 69:   Common write menu*

> The engineered data is written to the IED when executing a common *Write to IED operation*.

7.3.3.2 Importing ICD or CID files

1. Select an existing IED to import IEC 61850 files.
2. From the **Files of type** list, select the file type of IEC 61850 to be imported (ICD or CID).
    The **SCL Import Option** dialog box opens.
3. In the **SCL Import Option** dialog box, select how the file is to be handled during the import.
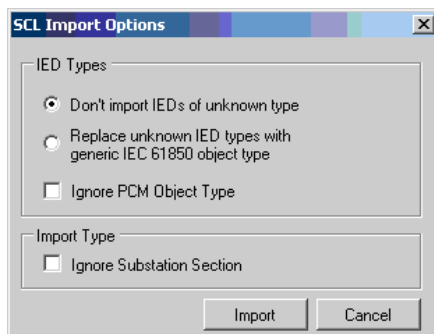
IEC09000631-1-en.vsd

Figure 70:   IEC 61850: SCL import options

*   **Don't import...** protects the existing IEDs in case the SCD file does not match the original configuration in PCM600.
*   **Replace unknown...** can be used when it is known that the file includes additional IEDs that are needed. The IED of type "Generic IEC 61850 IED" is used to integrate these kinds of IEDs into, for example, the plant structure.
*   **Ignore PCM Object Type** updates the IED object(s) in PCM600 from the IED type(s) in the SCD file, discarding whether or not the IED type(s) in the SCD file matches the IED object(s) in PM600.
*   **Ignore Substation Section** does not import the SSD file part of the SCD file.

4. Click **Import** when the definition has been completed.
    A progress view displays the importing procedure.

7.3.4 Writing communication configuration to the IED

IEC 61850 communication depends on the proper communication configuration in all IEDs that communicate via IEC 61850.

It is possible to make a configuration change in one IED, without affecting the communication engineering. For example, when the Application Configuration tool configuration is changed, but no changes are done to the instantiation or deletion of functions that represent a logical node.

When a changed configuration is written to the protection relay, the communication configuration needs to be updated.
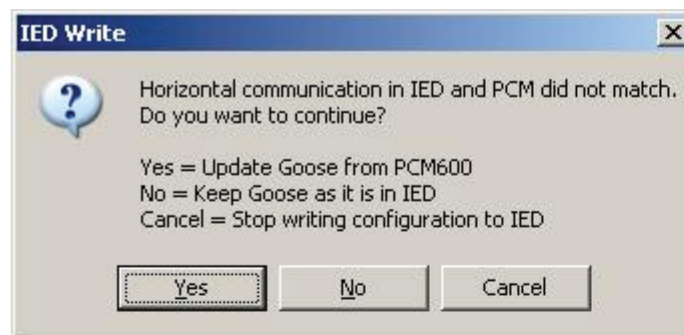
Figure 71:   Updating the communication configuration in the IED with the configuration made in PCM600

1. Select whether or not to update the configuration.

    •   Click **Yes** in the **Update Communication** window to update the communication configuration part in the IED.
    •   Click **No** in the **Update Communication** window to keep the communication configuration part in the IED. Other parts of the configuration will be updated.

> If no changes have been done in the communication configuration part, click **No** in the **Update Communication** window.

Section 8   Glossary

ACT	1. Application Configuration tool in PCM600 2. Trip status in IEC 61850
ANSI	American National Standards Institute
CID	Configured IED description
CMT	Communication Management tool in PCM600
COMTRADE	Common format for transient data exchange for power systems. Defined by the IEEE Standard.
Connectivity package	A collection of software and information related to a specific protection and control IED, providing system products and tools to connect and interact with the IED
DHT	Disturbance Handling tool in PCM600
DNP3	A distributed network protocol originally developed by Westronic. The DNP3 Users Group has the ownership of the protocol and assumes responsibility for its evolution.
EMC	Electromagnetic compatibility
Ethernet	A standard for connecting a family of frame-based computer networking technologies into a LAN
EVT	Event Viewer tool in PCM600
FTP	File transfer protocol
GDE	Graphical Display Editor in PCM600
GoCB	GOOSE control block
GOOSE	Generic Object-Oriented Substation Event
HMI	Human-machine interface
HW	Hardware
I/O	Input/output
ICD	IED capability description
IEC	International Electrotechnical Commission
IEC 61850	International standard for substation communication and modeling

IED	Intelligent electronic device
IET600	Integrated Engineering Toolbox
Instance	Identical protection function blocks available in a standard configuration. By setting the application-specific parameters of an instance, a protection function stage can be established.
IP address	A set of four numbers between 0 and 255, separated by periods. Each server connected to the Internet is assigned a unique IP address that specifies the location for the TCP/IP protocol.
LAN	Local area network
LED	Light-emitting diode
LHMI	Local human-machine interface
Modbus	A serial communication protocol developed by the Modicon company in 1979. Originally used for communication in PLCs and RTU devices.
MON	Signal Monitoring tool in PCM600
NCC	Network control center
PCM600	Protection and Control IED Manager
PST	1. Parameter Setting tool in PCM600 2. Product Selection Tool
REF615R	Wire-alike replacement option for DPU2000R with the same form factor
SAB600	Substation automation builder tool
SCD	Substation configuration description
SCL	XML-based substation description configuration language defined by IEC 61850
SMT	Signal Matrix tool in PCM600
SNTP	Simple Network Time Protocol
Subnet mask	A set of four numbers used to create IP address numbers that are used only within a particular network, subnet
TCP	Transmission Control Protocol
UDP	User datagram protocol
UL	Underwriters Laboratories

| WAN | Wide area network |
| WHMI | Web human-machine interface |

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