Remote I/O
RIO600
Communication Configuration Manual

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Section 1 Introduction

1.1 This manual

The communication configuration manual contains information on how to engineer the device using the different tools in PCM600. The manual provides information for IEC 61850 engineering with PCM600 and IET600. For more details on tool usage, see the PCM600 documentation.

1.2 Intended audience

This manual addresses system and project engineers involved in the engineering process of a project.

Understanding the communication properties of the IED is a prerequisite before making any connections to RIO600. The connection details of the IED are available in the respective manuals.

1.3 Product documentation

1.3.1 Product documentation set

The installation and commissioning manual contains information on how to install and commission the device. The manual provides an introduction to engineering tasks and a description of the basic operations.

The communication configuration manual contains information on how to engineer the device using the different tools in PCM600. The manual provides information for IEC 61850 engineering with PCM600 and IET600. For more details on tool usage, see the PCM600 documentation.

The user manual (online help) contains instructions on how to use the RIO600 Configuration Wizard. The Configuration Wizard helps configure RIO600 for different system products and tools with the help of the connectivity package. See the product documentation for more information on handling the connectivity packages in different system products and tools.

1.3.2 Document revision history

Document revision/date	Product version	History
A/2011-12-23	1.0	First release
B/2012-12-18	1.1	Content updated to correspond to the product version
C/2013-09-30	1.2	Content updated to correspond to the product version
D/2014-09-29	1.5	Content updated to correspond to the product version
E/2015-08-31	1.6	Content updated to correspond to the product version
F/2016-06-09	1.7	Content updated to correspond to the product version
G/2019-05-17	1.7	Content updated
H/2019-12-16	1.8	Content updated to correspond to the product version

1.3.3 Related documentation

Name of the document	Document ID
RIO600 Installation and Commissioning Manual	1MRS757488
Specific Communication Service Mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3	IEC 61850-8-1

Download the latest documents from the ABB Web site www.abb.com/mediumvoltage.

1.4 Symbols and conventions

1.4.1 Symbols

The electrical warning icon indicates the presence of a hazard which could result in electrical shock.

The warning icon indicates the presence of a hazard which could result in personal injury.

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.
- Menu paths are presented in bold.
  Select **Main menu/Settings**.
- WHMI menu names are presented in bold.
  Click **Information** in the WHMI menu structure.
- 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 "On" and "Off".

Section 2 RIO600 overview

2.1 Overview

RIO600 is designed to expand the digital and analog I/O of ABB's Relion® protection and control relays and to provide I/O for the COM600 substation automation unit using the IEC 61850 and Modbus TCP communication. Both galvanic RJ-45 and optical LC connectors are supported for Ethernet station bus communication. RIO600 can also be used in secondary substations for fault passage indication and power measurements reporting values directly to a peer protection relay or to an upper level system. RIO600 accepts three-phase sensor signals (voltage and current) and provides fault detection and metering functions.

RIO600 allows flexible I/O assignment and provides seamless IEC 61850 connectivity between the substation's input and output signals and the protection relay or the COM600 substation gateway ensuring improved functionality and performance. RIO600 supports both Edition 1 and Edition 2 versions of the IEC 61850 standard. RIO600 can also be used as a standalone device in grid automation applications.

Figure 1: RIO600

RIO600 helps in simplifying and decreasing the wiring inside the substation by digitizing the hardwired signals. The fully hardwired traditional medium-voltage switchgear/substation control and protection system results in extensive I/O wiring, connecting devices in switchgear signaling to the external systems, for example, to the remote terminal unit (RTU) or other higher-level automation systems.

RIO600 provides additional I/O within the switchgear using Ethernet communication. The I/O signals can be efficiently transmitted between the protection relay or COM600 with fast, high performance IEC 61850 GOOSE communication. Alternatively, RIO600 can communicate with an upper level automation system using the widely accepted Modbus TCP automation protocol.

The binary input module can be used for sending binary input values from primary equipment or secondary systems to peer protection relays or an upper-level system. The binary output modules can be used to control equipment based on the control signal received from communication.

The smart control module (SCM) can be used for different switchgear applications to drive primary switches. The module enables the control of a combined three-position switch (disconnector and earthing switch) used in gas insulated switchgears or standard two-position switches such as disconnector or earthing switches. Alternatively, the heavy-duty output contacts of the SCM can be used as power outputs for circuit breaker trip circuits to make, carry and break the belonging trip coil current. The trip circuit supervision function is designed to supervise the control circuit of the circuit breaker. Furthermore, the SCM can be used as a generic module with four binary inputs and four fast power outputs.

With the RTD/mA module, RIO600 can be used in different monitoring applications. RIO600 can receive temperatures (°C) via RTDs or analog input signals (mA) from various transducers or devices. The input current (mA) can be linearly scaled for various applications, for example, transformer tap changer position indication. The input value is forwarded to a peer protection relay or to an upper-level system. With the analog output module (AOM), RIO600 can control an external device having an mA input.

RIO600 also includes a measurement module with fault passage indication (FPI) functionality. This module is intended for grid automation applications where RIO600 enables accurate current and voltage measurements or only current measurement from a MV network using ABB's accurate and lightweight sensor technology. With this measurement module, RIO600 can be used as a stand-alone fault passage indicator unit. Based on the measured MV values, it can give voltage presence and directional FPI and report them to an upper-level system. This also enables power flow and power quality monitoring. The typical accuracy of line voltages, currents and active power is better than 0.5% and for other power measurements better than 1%.

The FPI functionality can be based on phase current measurements only. It provides a selective fault passage indicator for single phase earth faults in high-impedance earth networks, that is, in compensated, unearthed and high-resistance earthed systems. It can be applied as single-phase earth-fault FPI in case of overhead lines and

underground cables, regardless of the earth-fault type (continuous, transient or intermittent) or the fault resistance value (low or high ohmic).

The FPI module incorporates the latest fault-detection algorithms used in the Relion family. With an easy-to-use multifrequency admittance-based (MFA) earth-fault detection algorithm, it accurately detects solid, resistive and intermittent earth faults. Practical sensitivity of up to 10 kΩ of the fault resistance can be achieved in symmetrical networks. This new functionality is suitable for high-impedance earthed networks, and especially for compensated and unearthed networks where accurate and selective earth-fault detection is more challenging due to low fault currents. With the use of the negative-sequence overcurrent protection function, it is easier to detect single-phase and phase-to-phase faults or unbalanced loads which are due to broken conductors or unsymmetrical feeder voltages, for example. The selective FPI functionality for single-phase earth faults in high-impedance earthed networks (that is, in compensated, unearthed and high-resistance earthed systems) is available. FPI functionality can be applied as single-phase earth-fault FPI in case of overhead lines and underground cables and is based on phase current measurements only which can be done with conventional current transformers (CTs) or with sensors (Rogowski coils). With the fault passage information, the faulted line section can be quickly identified, and manual or automatic fault isolation and supply restoration can be initiated. The three-phase inrush detector function INRPHAR can be used to coordinate transformer inrush situations in distribution networks. The fuse failure supervision function SEQSPVC can be used to block the voltage measuring functions when failure occurs in the secondary circuits between the voltage transformer (or combi sensor or voltage sensor) and the protection relay to avoid misoperations of the voltage protection functions.

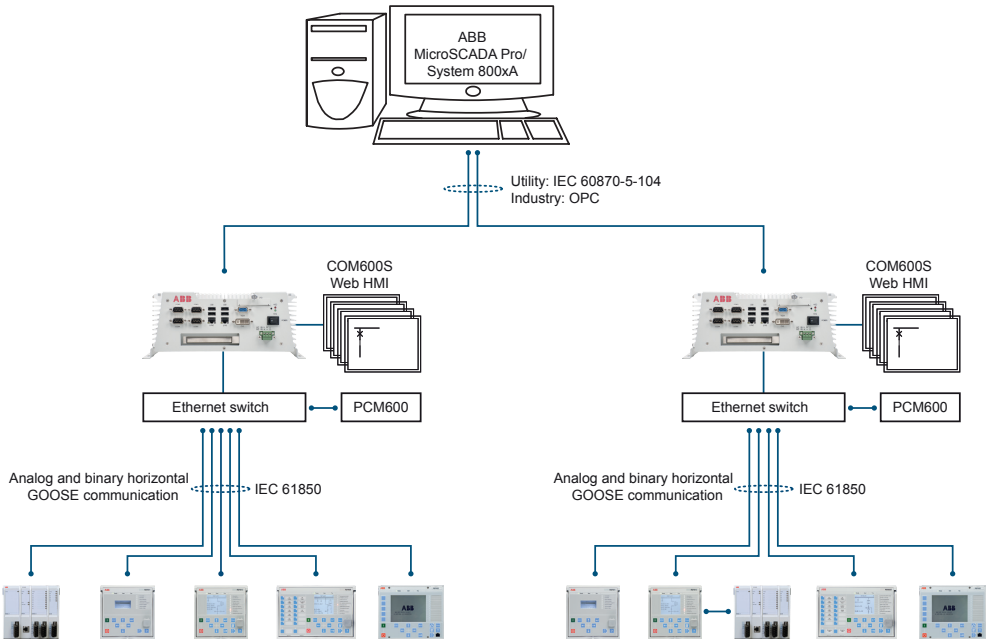

Figure 2: Conceptual picture of a typical system setup

- IEC 61850 connectivity with support of standard versions Edition 1 and Edition 2
- IEC 61850 GOOSE for real-time information exchange on the Ethernet station bus
- Modbus TCP/IP support for one client
- Standard RJ-45 interface with 10/100 Mbits/s or 100 Mbit/s multimode fiber-optic LC Ethernet interface
- Auxiliary power supply
- Easy-to-use configuration tool for the IEC 61850 data mapping
- Reduced conventional cabling
- Up to 40 configurable binary and analog I/O channels
- DIN rail mountable modules
- Support of two SNTP servers
- WHMI-based monitoring
- Subscribes and publishes GOOSE messages from/to multiple IEDs as configured
- "Stand-alone" operation, with support of intermodule logic

2.1.1 Module configuration

RIO600 uses a modular architecture where the I/O control functionality is built on modules. The modules can be stacked on a standard DIN rail to achieve the required configuration. The minimum configuration required for RIO600 contains a power supply module, a communication module and an I/O module.

Table 1: RIO600 module types

Module type		Description
Power supply modules	PSMH	High-voltage range power supply module
	PSML	Low-voltage range power supply module
Communication modules	LECM	Communication module with Ethernet port
	LECM	Communication module with optical Ethernet port

Table continues on next page

Module type			Description
I/O modules	Digital input module	DIM8H	High-voltage range, eight optically isolated binary inputs with common return for two inputs
		DIM8L	Low-voltage range, eight optically isolated binary inputs with common return for two inputs
	Digital output module	DOM4	Four output contacts in each digital output module with two pairs of potential free contacts with common return
	RTD module	RTD4	Four optically isolated channels supporting RTD sensors (Pt100, Pt250, Ni100, Ni120 and Ni250) and an mA input (0...20 mA configurable). Individual channels are non-isolated from each other.
	Analog output module	AOM4	Four individually isolated channels of configurable mA outputs driving 0...20 mA signals
	Sensor input module	SIM8F	Sensor input module with combined three-phase current and voltage signals
	Sensor input module	SIM4F	Sensor input module with three-phase current signals
	Smart control module	SCM8H	High-voltage range, SCM with five application types • 4I4O – four input and four output channels • Three-position switch • Disconnector • Circuit breaker • Earthing switch
		SCM8L	Low-voltage range, SCM with five application types • 4I4O – four input and four output channels • Three-position switch • Disconnector • Circuit breaker • Earthing switch

The availability and combination of RIO600 modules and channels depend on the number of power supplies connected.

Table 2: Maximum number of modules and channels available when one power supply module is connected

	LECM with copper interface		LECM with fiber interface	
Description	Modules	Channels	Modules	Channels
Digital input modules (DIM8H/ DIM8L)	5	40	5	40
Digital output modules	5	20	4	16
RTD4 modules	5	20	4	16

Table continues on next page

	LECM with copper interface		LECM with fiber interface	
Description	Modules	Channels	Modules	Channels
Analog output modules	2	8	1	4
SIM8F/SIM4F modules	5	-	4	-
Smart control module (SCM8H/ SCM8L)	3	24	2	16

Table 3: Maximum number of modules and channels available when two power supply modules are connected

	LECM with copper interface		LECM with fiber interface	
Description	Modules	Channels	Modules	Channels
Digital input modules (DIM8H/ DIM8L)	5	40	5	40
Digital output modules	10	40	9	36
RTD4 modules	10	40	9	36
Analog output modules	4	16	3	12
SIM8F/SIM4F modules	5	-	5	-
Smart control module (SCM8H/ SCM8L)	5	40	5	40

A combination of all the modules can be used in a single RIO600 stack. The number of modules supported by a number of power supply modules is automatically checked by PCM600. If the selected combination of modules exceeds the number of supported modules related to power consumption, the configuration tool gives an indication and does not configure the stack.

2.2 PCM600 tool

PCM600 with the RIO600 connectivity package is used for configuring RIO600.

- Configuring RIO600 in the online and offline modes
- Setting the operating parameters for the modules using Parameter Setting
- Performing the I/O mapping across the modules using Signal Matrix
- Reading and writing the configuration and the parameter file to RIO600
- Setting the password using IED Users
- Establishing the GOOSE communication between the devices configured in PCM600 using IEC 61850 configuration
- Configuring the Modbus communication settings for connection with Modbus TCP client
- Updating composition of existing RIO600 in online and offline modes
- Migrating from older version of RIO600 to the higher version using IED Configuration Migration
- Generating Modbus address point list for the configured modules
- Creating graphical logic configuration with Application Configuration

- Support for IEC 61850 Edition 1 and Edition 2 enabling the creation of IED objects in PCM600 with the selected protocol standard version
- Exporting configuration files to a local machine
- Establishing GOOSE communication between the devices configured in PCM600 using IEC 61850 Configuration or Goose Engineering through Application Configuration or both

2.2.1 PCM600 and RIO600 connectivity package version

- Protection and Control IED Manager PCM600 Ver.2.9 Hotfix 2 or later
- RIO600 Connectivity Package Ver.1.8 or later

Section 3 RIO600 engineering flow

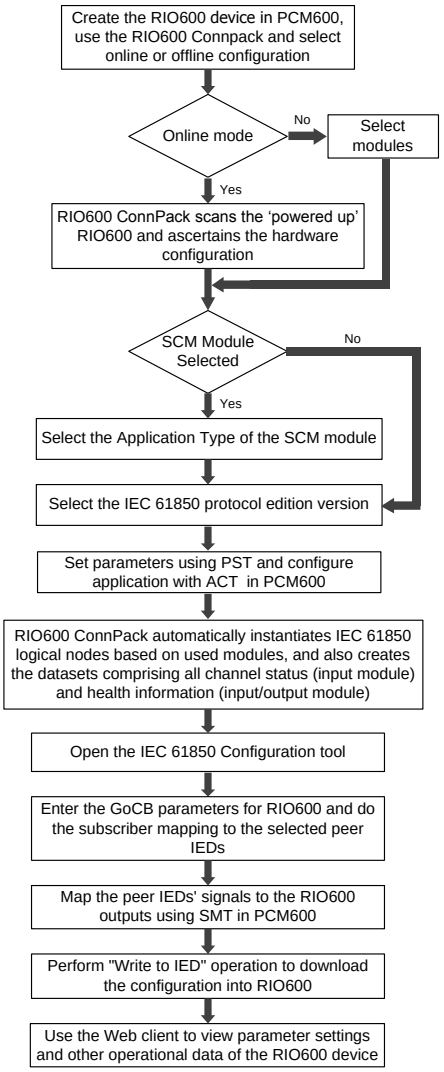

Figure 3: Basic steps in RIO600 GOOSE engineering

Section 4 IEC 61850 overview

The international IEC 61850 standard defines a framework for substation communications networks and systems. The standard consists of several parts ranging from the requirements on substation automation systems to the details of a communication protocol. Its main goal is interoperability; the ability for IEDs from one or different manufacturers to exchange information and use the information for their own functions.

IEC 61850 standard for communication networks and systems in substations has been out since 2005 and used successfully in ABB products. IEC 61850 standard is updated with a new version, Edition 2. Edition 2 extends to new application areas in transmission and distribution power systems and also defines a new functionality to Edition 1 functionality.

Edition 2 is a new version of IEC 61850 standard and it adds new functionality which is not supported by the Edition 1 devices. Therefore it is recommended to always use the same standard version in all devices and not to mix different versions in the same project.

A major difference between the other communication protocols applied in substation automation and IEC 61850 is that the latter is not only a communication protocol, but a whole framework for specifying, engineering and operating substation automation systems. The communication part covers the connection between the IEDs and the substation clients, for example, SCADA and gateways.

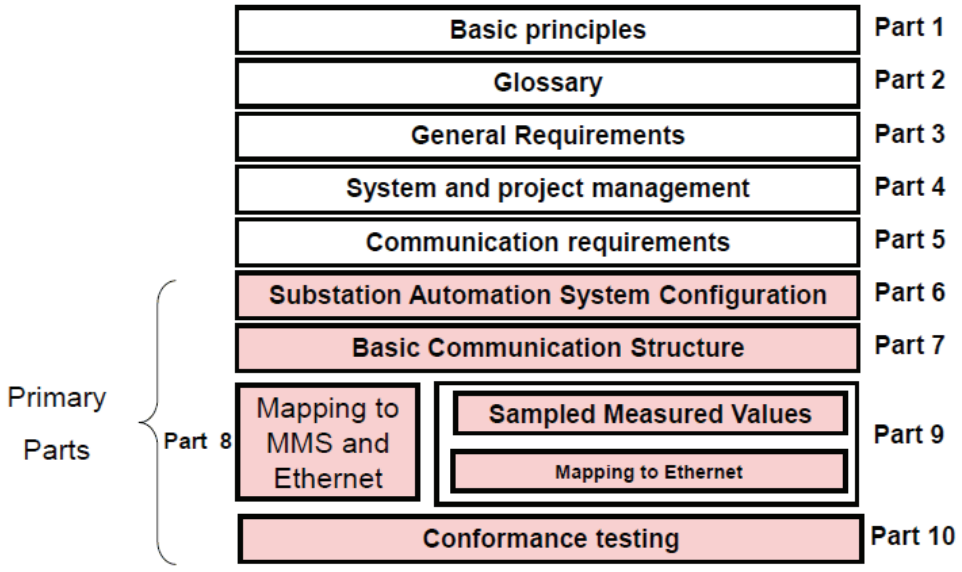

Figure 4: Structure and parts of the IEC 61850 standard

The IEC 61850 standard specifies an expandable object-oriented data model and wide set of protocol services for substation automation (standard parts 7-x). The standard does not specify any protection or control functions, but specifies how the functions expose their information to a communication network.

The standard supports free allocation of functions to devices. With efficient communication facilities, the functions can be located anywhere in the system, that is, an interlocking function can reside in the IED or on the station level. Additionally, the standard is open for different system implementations, that is, different integration levels and allocation of functions to different devices is supported.

The standard also defines an XML description language for substation automation systems. The language facilitates efficient integration of devices into systems in an automated fashion. Additionally the standard supports a comprehensive and consistent system definition and engineering, which makes not only the devices, but also their tools and systems interoperable (standard part 6).

The standard uses Ethernet and TCP/IP for communication. Since Ethernet and TCP/IP are widely accepted and used, the application of these technologies provide a broad range of features from mainstream communication (standard parts 8-1, 9-2).Communication profiles in IEC 61850 can be divided to vertical and horizontal. The vertical profile uses MMS over TCP/IP and vertical communication Layer 2 Ethernet multicast messages. The standard separates the functionality represented by the data model and the related communication services from the communication implementation thus being open for possible new communication concepts in the future.

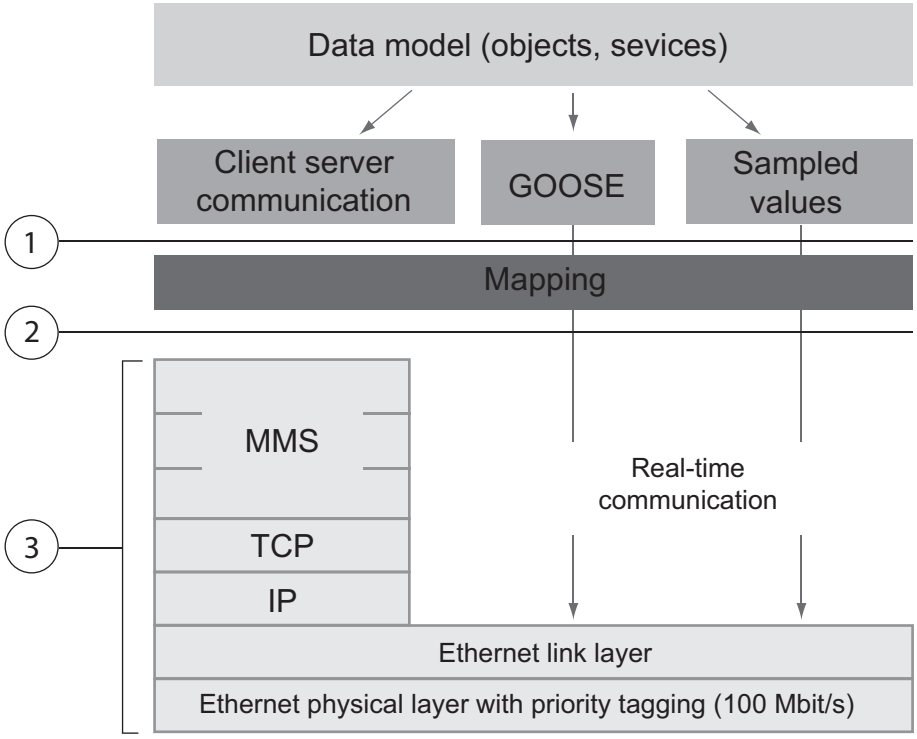

Figure 5: Communication stacks and mapping used in IEC 61850

1 Abstract communication services interface (ACSI)
2 Stack interface
3 ISO/OSI stack

Section 5 Setting up a project

5.1 Handling connectivity packages

Uninstall the old RIO600 connectivity package before installing a new version. The product code has changed in the latest release.

5.1.1 Uninstalling connectivity packages

1. To uninstall a connectivity package version, click **Start**, click **Control Panel**.
2. In the **Control Panel**, double-click **Add or Remove Programs**.
3. Select the connectivity package and click **Remove**.

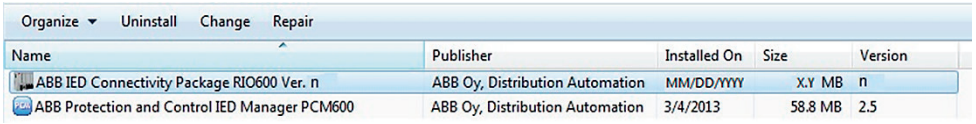

Figure 6: Selecting the RIO600 connectivity package

4. In the **Add or Remove Programs** dialog box, click **Yes** to confirm the uninstallation.

5.1.2 Installing connectivity packages

1. Close PCM600.
2. Run the **ABB RIO600 Connectivity Package Ver. n.msi** installer (n = version number).
   To install the connectivity package, follow the below steps.

Figure 7: Running RIO600 installation wizard

2.1. Click **Cancel** to exit the installation.
2.2. Click **Resume** to revert back to the installation or **Exit Setup** to confirm the cancellation.

3. Select **I accept the license agreement** and click **Next**.

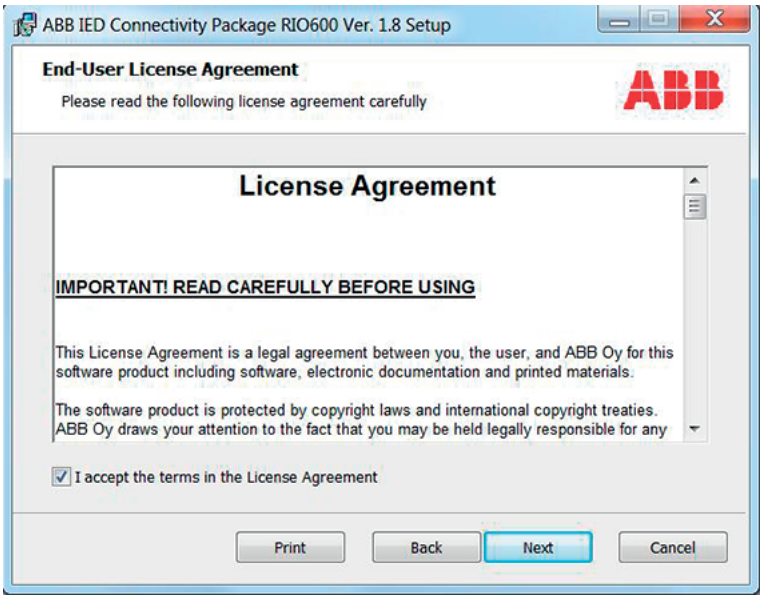

Figure 8: Accepting the License Agreement before installation

4. Click **Browse** to select the file destination and click **Next**.

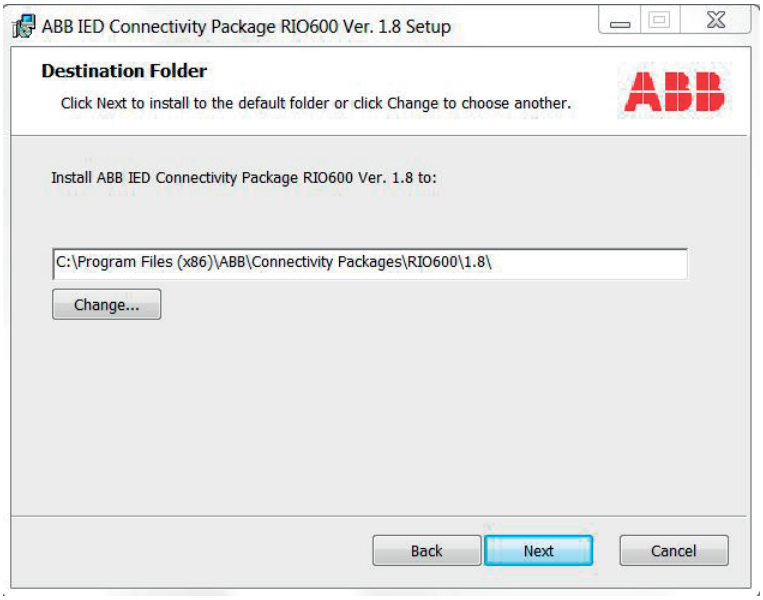

Figure 9: Selecting the folder for installation

5. Click **Install** to start the installation.

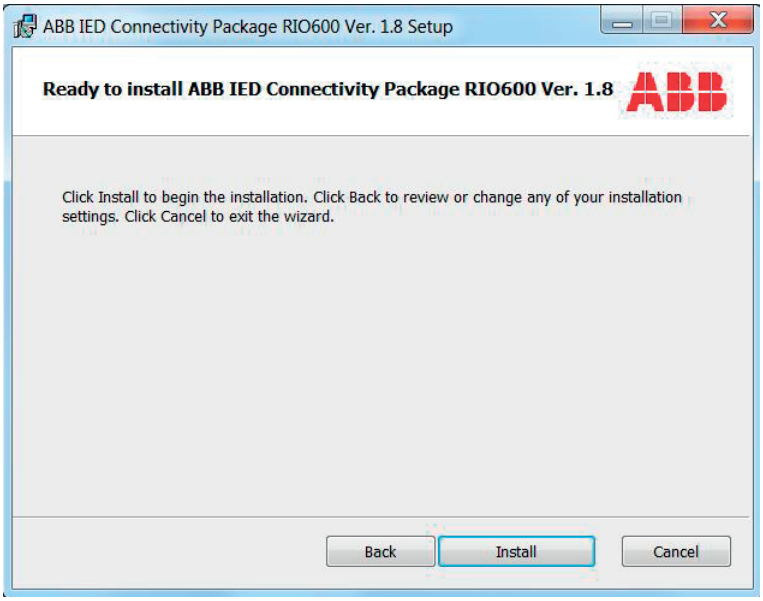

Figure 10: Starting the installation

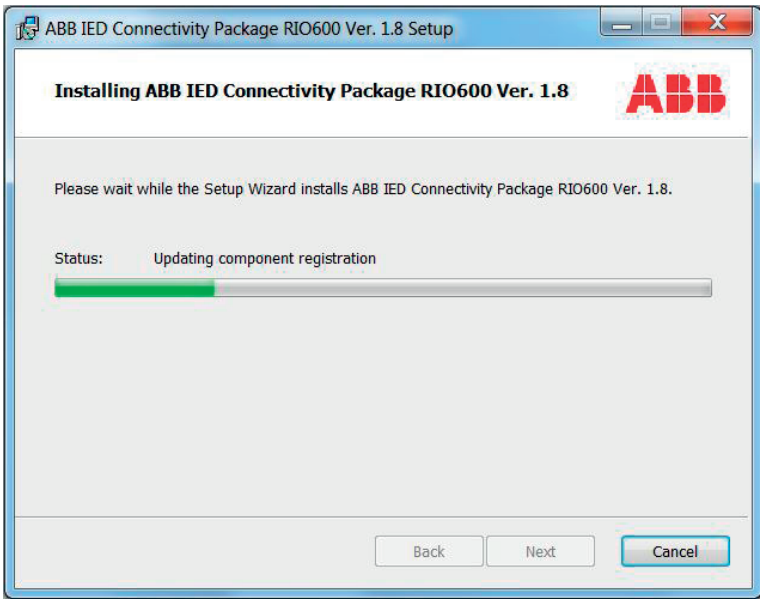

Figure 11: Installation progress

6. After the installation is complete, click **Finish** to exit the setup program.

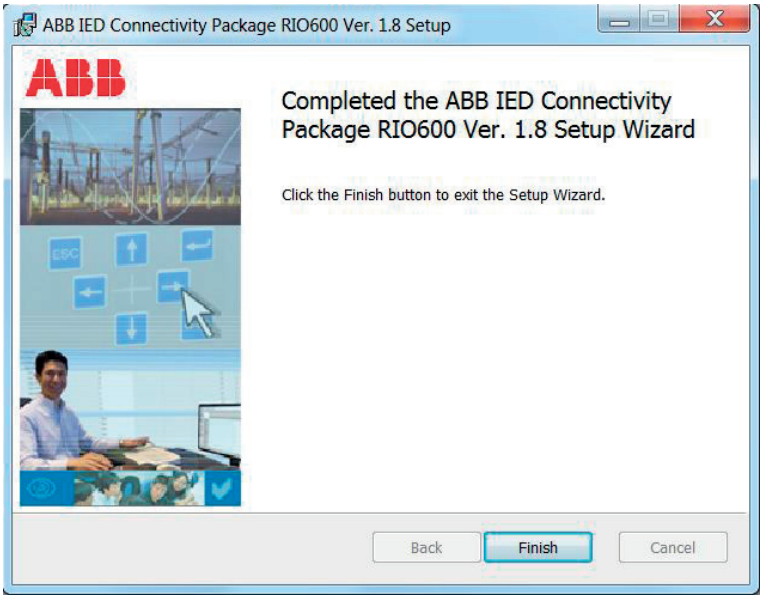

Figure 12: Completing the installation

5.1.3 Activating connectivity packages

The connectivity package has to be installed before it can be activated.

1. In the **Update Manager**, activate the appropriate connectivity package.

The **Update Manager** shows the connectivity packages that are compatible with the installed PCM600 version.

2. Select the **ABB RIO600 Connectivity Package Ver. n** (n = version number). Always use the latest version of the connectivity package.

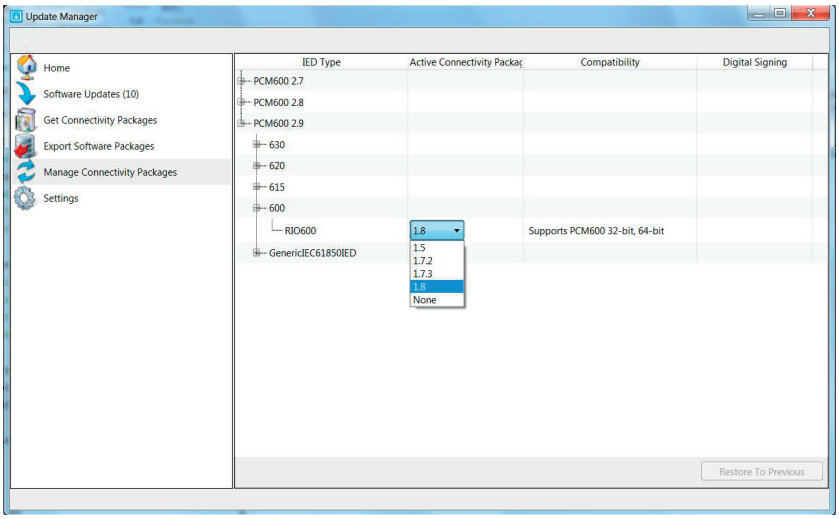

Figure 13: Selecting the connectivity package

5.2 Creating a new project

1. Start PCM600.
2. To see the projects that are currently available in the PCM600 database, click **File** and select **Open/Manage Project**.
   The **Open/Manage Project** dialog box opens.

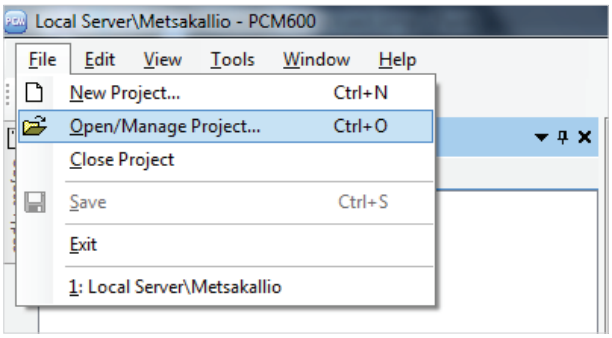

Figure 14: Managing projects

3. Select **Projects on my computer**.

- If there are currently any projects or object tools open, close them.

4. Click **New Project**.
   The **Create New Project** dialog box opens.

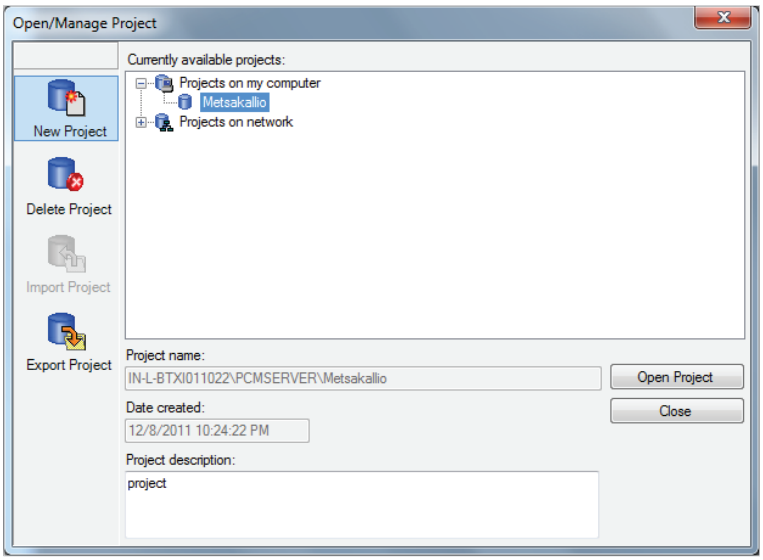

Figure 15: Creating new projects

5. In the **Project Name** box, give a name for the project.
   - Optionally, write a description of the project in the **Description** box.

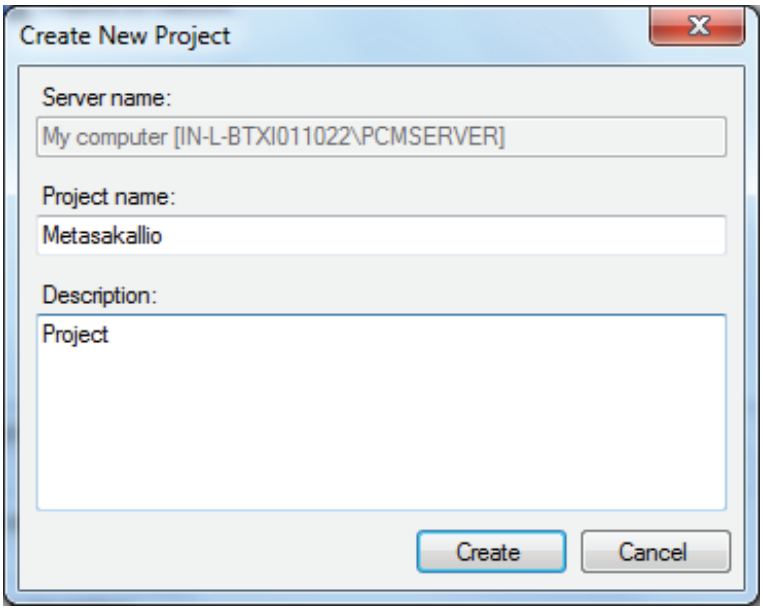

Figure 16: Naming the project

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

5.3 Building the plant structure

1. Create a new plant structure in PCM600.
   1.1. In the **Plant Structure**, right-click and select **New/General**.
   1.2. Select the element like **Substation**, **Voltage level** and **Bay**.

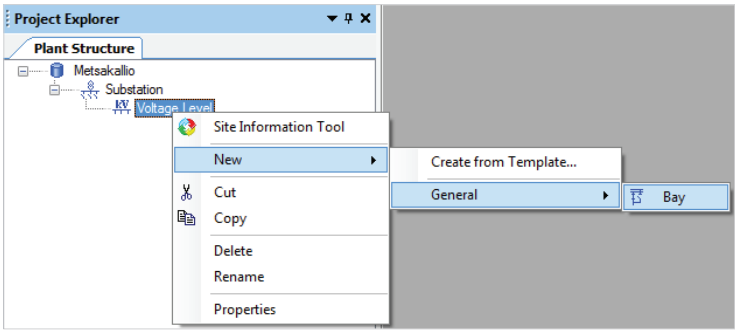

Figure 17: Creating a bay

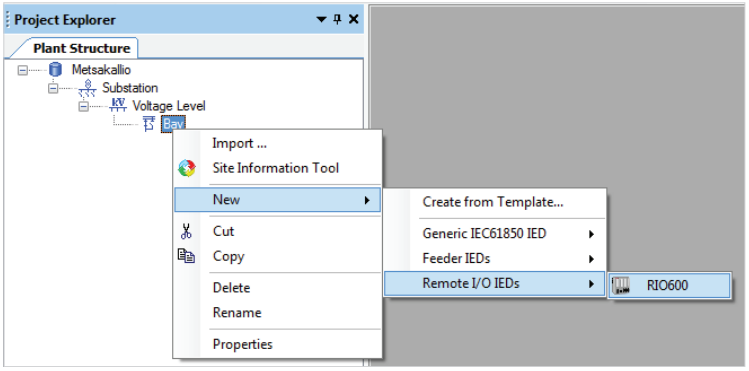

Figure 18: Creating a RIO600 IED

RIO600 is available only if the connectivity package is installed and activated successfully.

2. Rename each level in the structure by the names or identifications used in the grid.
   2.1. Right-click the level and select **Rename**.
   2.2. Rename the levels in the **Object Properties** view.

5.4 Inserting IEDs

IEDs can be inserted to the project either in offline or online mode.

When the physical device is not available or not connected to PCM600, the engineering is done without any synchronization with the device. The offline configuration in PCM600 can be synchronized with the physical device later by connecting the device to PCM600. Working in the offline mode has an advantage compared to online mode that the preparation for the configuration can be started even though the device is not available.

When the device is already connected to PCM600 and the communication is established, PCM600 can read the configuration directly from the physical device. This is useful when an order-specific device is used.

If the device is not configured or it contains an invalid configuration, select **Write to IED** before any other operations in the online mode. If the device has a valid configuration, select **Read from IED** directly after the device instance has been created to retain the communication parameter's value. In Parameter Setting tool, the communication parameters are then updated according to the device configuration. Otherwise, the Parameter Setting tool contains the default data, for example, the default IP Address *192.168.2.10*.

Check that the selected order and amount of modules corresponds to the actual one when configuring IED in offline mode. If module configuration does not match, the IEC 61850 data model is not valid and the RIO600 horizontal communication part must be re-configured.

5.4.1 Inserting an IED in offline mode

1. In the **Plant Structure**, right-click the bay and point to **New**, point to **Remote I/O IEDs** and then click **RIO600**.
   The **Configuration mode selection page** dialog box opens.
2. Under **Configuration mode**, select **Offline Configuration** and click **Next**.

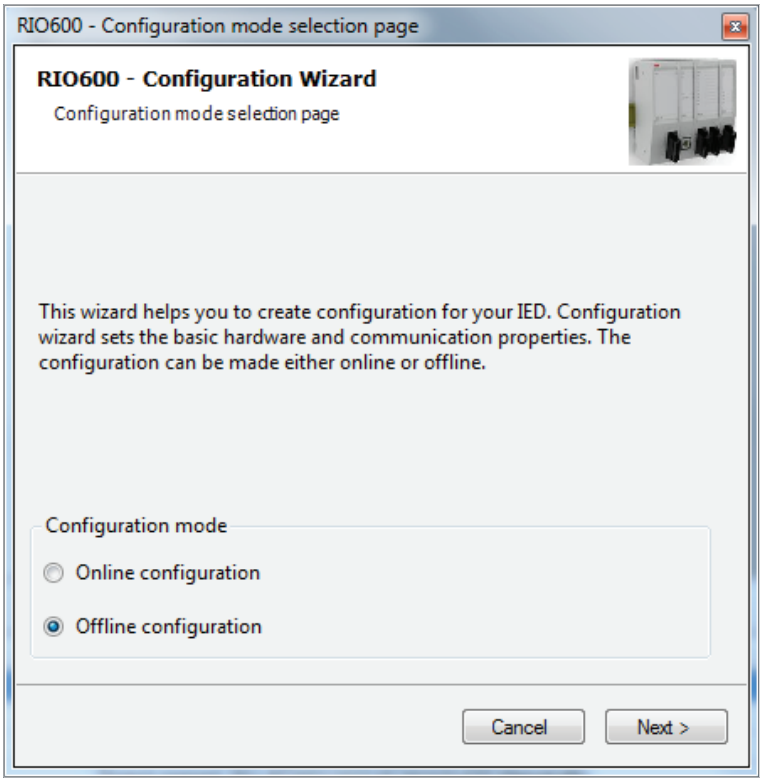

Figure 19: Selecting offline configuration mode

3. In the **IED protocol** list, select the protocol, for example, **IEC 61850** and click **Next**.

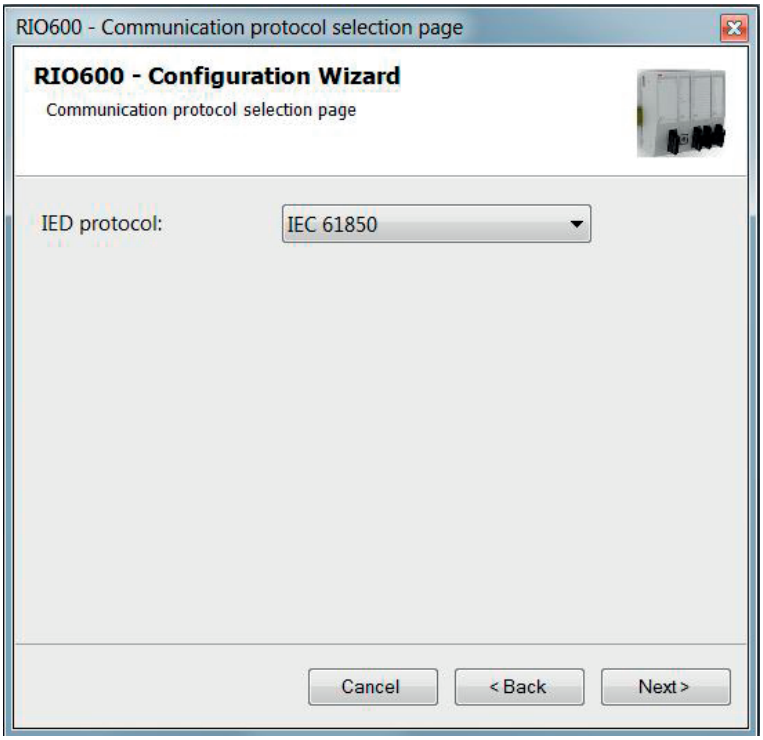

Figure 20: Selecting the IED protocol in offline mode

4. Under **PCM600 communication**, define the communication parameters and click **Next**.

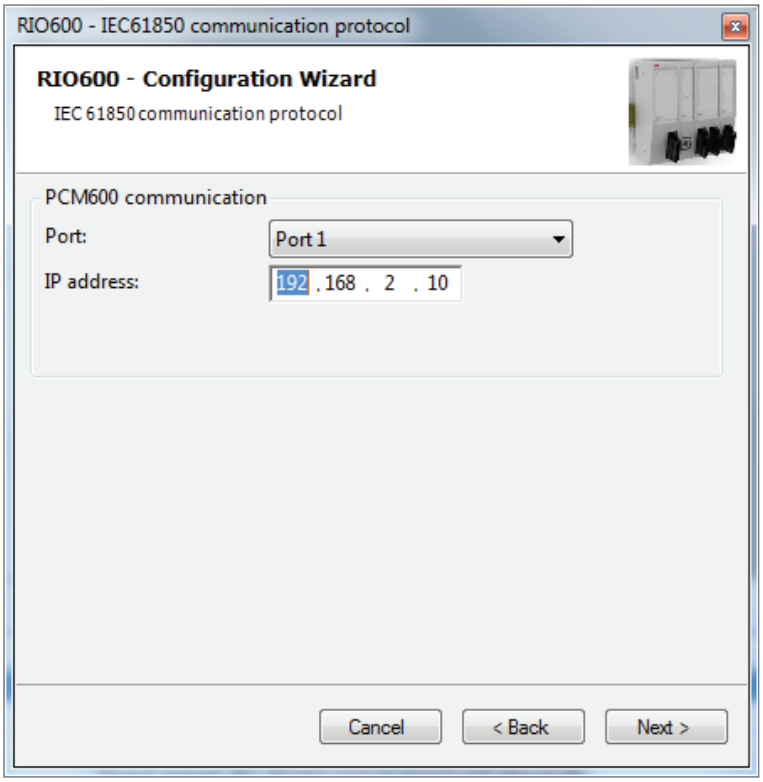

Figure 21: Defining the communication parameters in offline mode

4.1. In the **Port** list, only **Port 1** can be selected as the communication port.
4.2. In the **IP Address** box, enter the correct IP address.

5. In the **Communication configuration complete** dialog box, click **Next**.

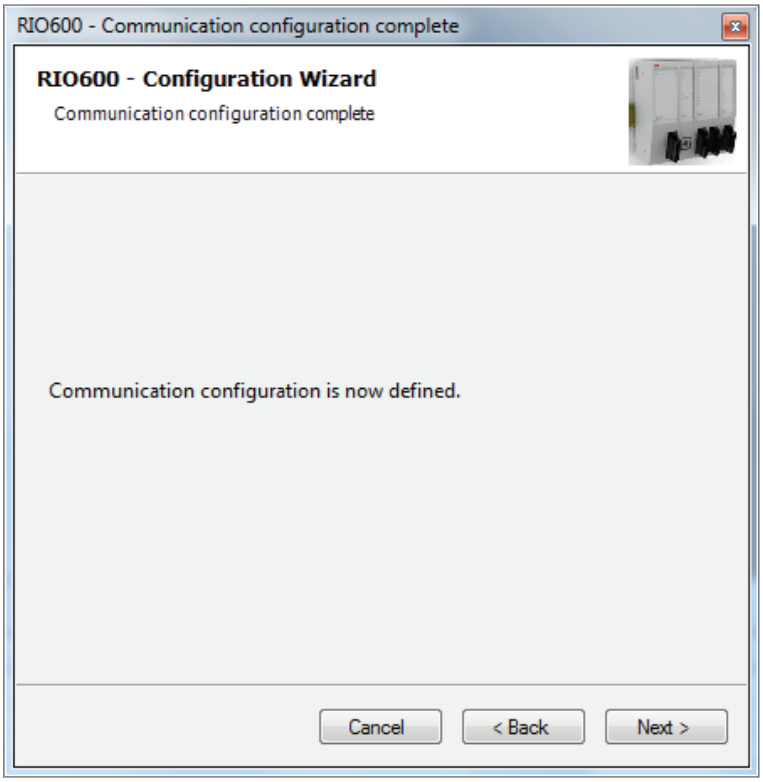

Figure 22: Completing the communication parameter configuration in offline mode

6. In the **Composition selection page** dialog box, configure the channels and generate the order code.
   By default, the channels are not configured.

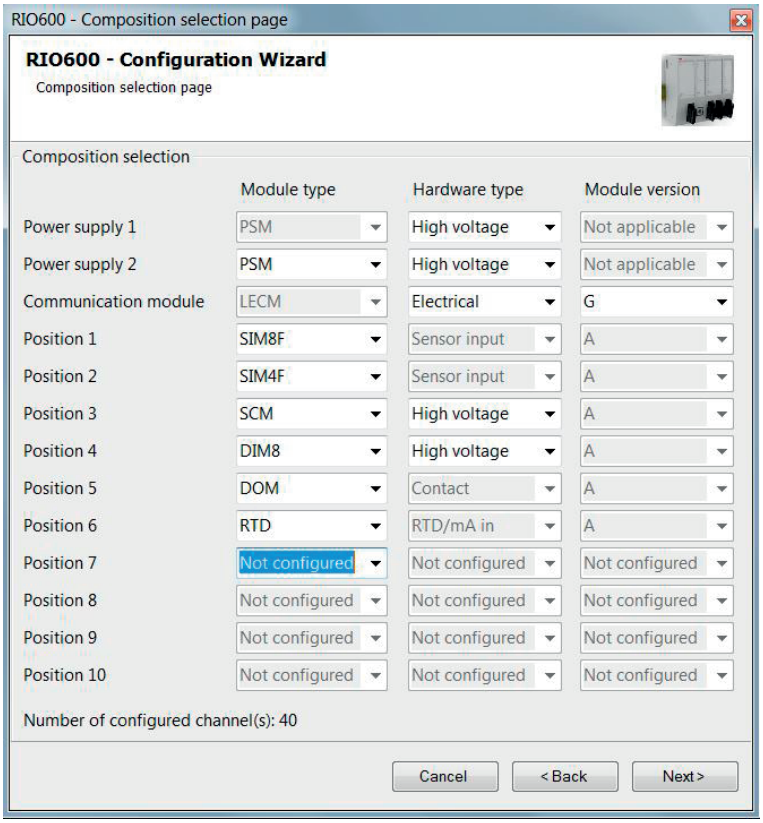

Figure 23: Selecting the composition in offline mode

6.1. In the **Hardware Type** list, select the correct hardware type for the communication module (**Electrical**/**Optical**).
6.2. In the **Module Type** lists, select the correct module types for each used channel (position). The corresponding hardware type choices are enabled.
6.3. Click **Next** to go to the **Application Type selection page**.

The **Application Type selection page** dialog box opens only, if at least one SCM module has been selected in the **Composition selection page**.

7. In **Application Type selection page** dialog box, configure the application types of all the SCM modules in the stack.

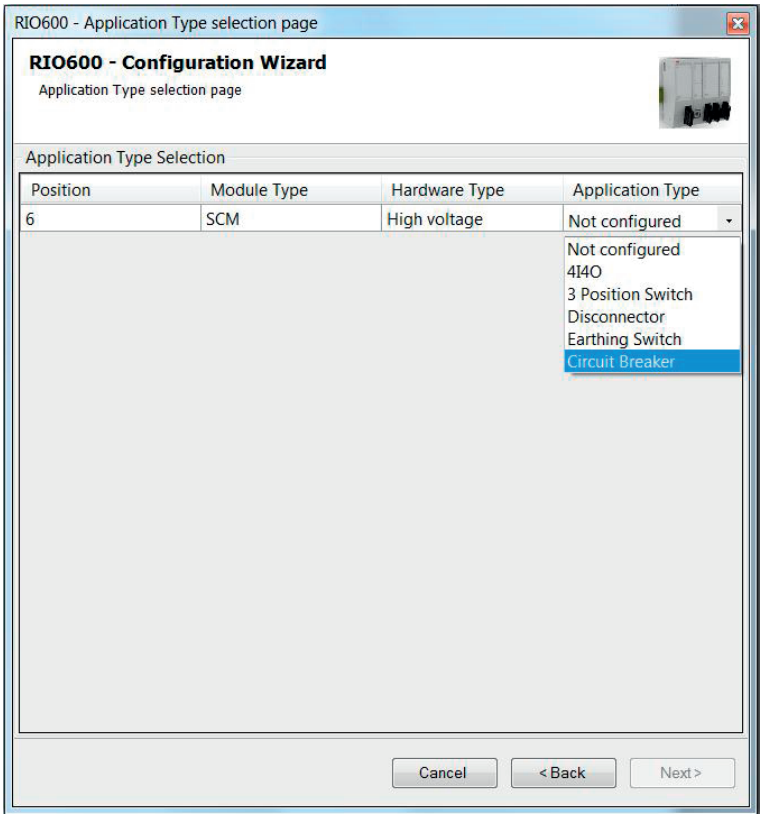

Figure 24: Selecting the application types of SCM modules

7.1. In the **Application Type** list, select the correct option for each SCM module.
7.2. Click **Next** to go to the **Version Selection** page.

8. In the **Version Selection** dialog box, select the IED's IEC 61850 protocol edition and click **Next**.

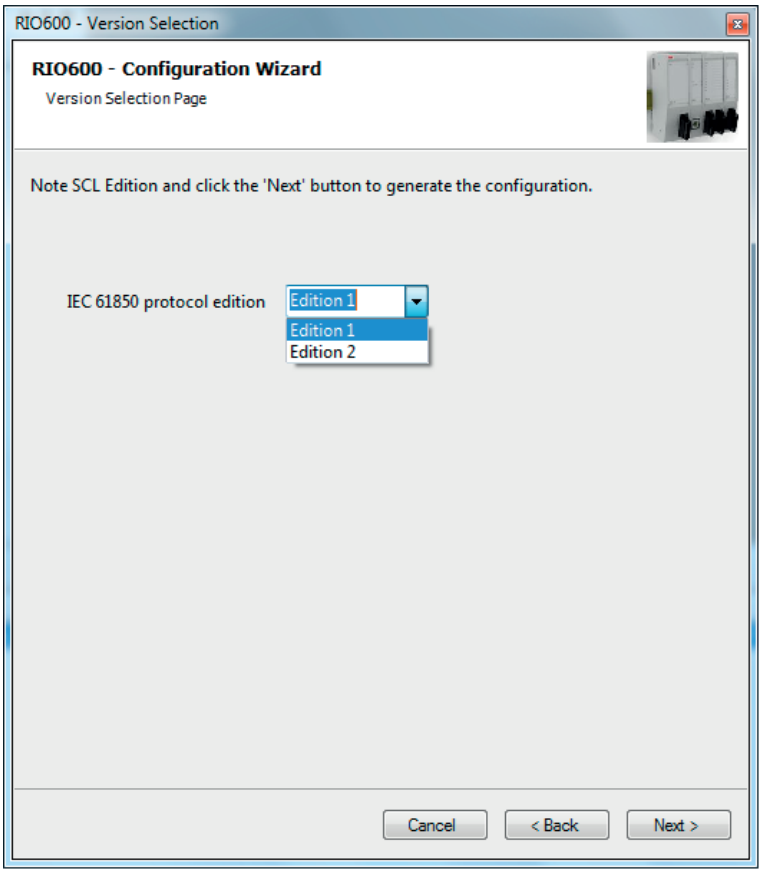

Figure 25: Selecting the IEC61850 protocol edition

The version selection is available only if the configured RIO600 is the first one in the PCM600 project.

A progress bar is provided to show the status of the function generation. Wait until the function generation is complete.
The **Setup complete** dialog box opens when the function generation is complete.

9. In the **Setup complete** dialog box, click **Finish**.

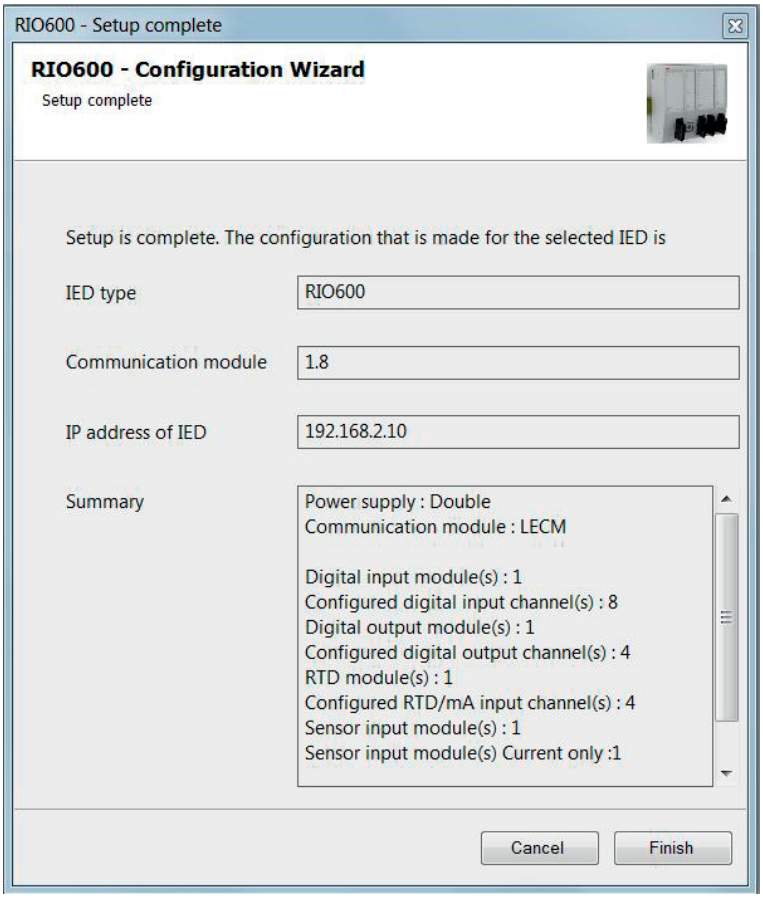

Figure 26: Viewing the summary page in offline mode

10. In the **Set technical key** dialog box, click **OK** to close the configuration setup wizard.
The **Plant Structure** is updated according to the hardware configuration. The module types and the related positions are visible under the **HW Configuration**.
The available power supply modules in the RIO600 stack are represented as **PSMH/L** in **Plant Structure** under the **HW Configuration** node. Only the modules available under the **HW Configuration** represent the physical stack.

The module instances are created based on the module type. For example, the instance created for the stack in summary page is PSMH-PSMH-LECM-DIM8H-DOM4-RTD4-AOM4-SIM8F-SCM8H-SIM4F.

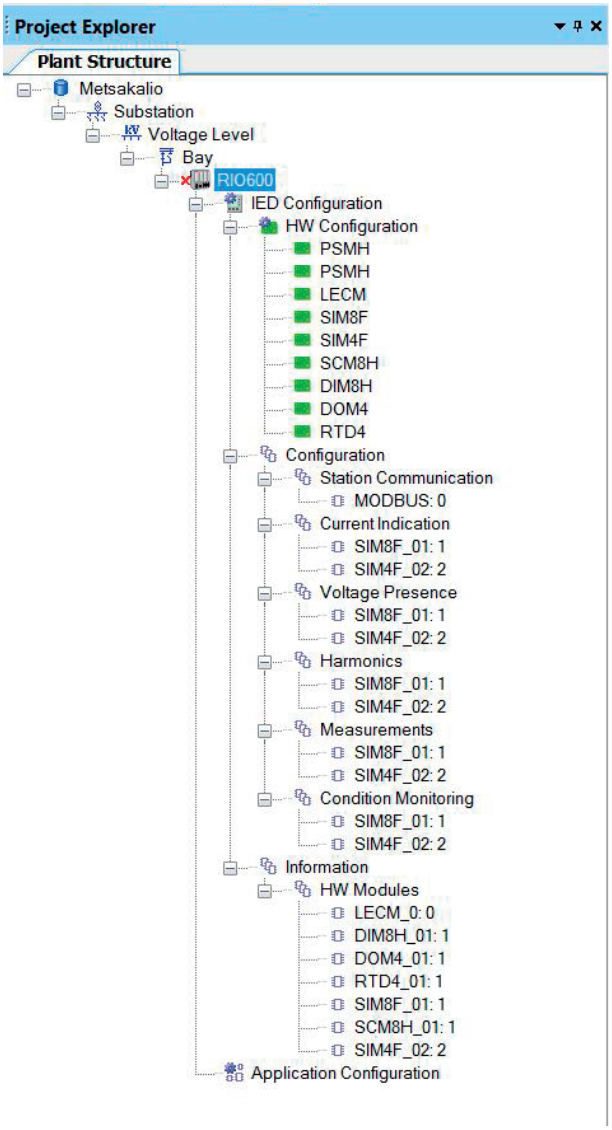

Figure 27: Updating the plant structure in offline mode

In the **Plant Structure**, the **Application configuration** does not contain any data.

Click **Cancel** anytime during the configuration setup to remove the created RIO600 device from the plant structure. Use **Back** and **Next** to navigate between the pages in the setup wizard.

During the offline configuration, some modules, such as DOM4, AOM4 or SIM8F, are created with the latest module versions.

However, during commissioning, the versions can be updated using the online composition update tool. In online configuration, the configuration is generated based on the available versions of the modules in the physical stack.

When configuring the SIM8F and SIM4F modules in the stack, the instance number can be SIM8F1 and SIM4F2 or vice versa. This is because a few common logical nodes such as EFPTOC and PHPTOC are confusing if both are instantiated as 1. To avoid this, the instance numbers are consecutive. If the stack has a SIM4F module before the SIM8F module, they are considered as SIM4F1 and SIM8F2. All corresponding logical nodes take the same instance number, for example, EFPTOC1, PHPTOC1 and FPIPTOC1 for the SIM4F1 module, and EFPTOC2, PHPTOC2, MFAPSDE2 for the SIM8F2 module.

5.4.2 Inserting an IED in online mode

To set up a device in online mode, the device must be connected to PCM600.

1. In the **Plant Structure**, right-click the bay and point to **New**, point to **Remote I/O IEDs** and then click **RIO600**.
   The **Configuration mode selection page** dialog box opens.
2. Under **Configuration mode**, select **Online Configuration** and click **Next**.

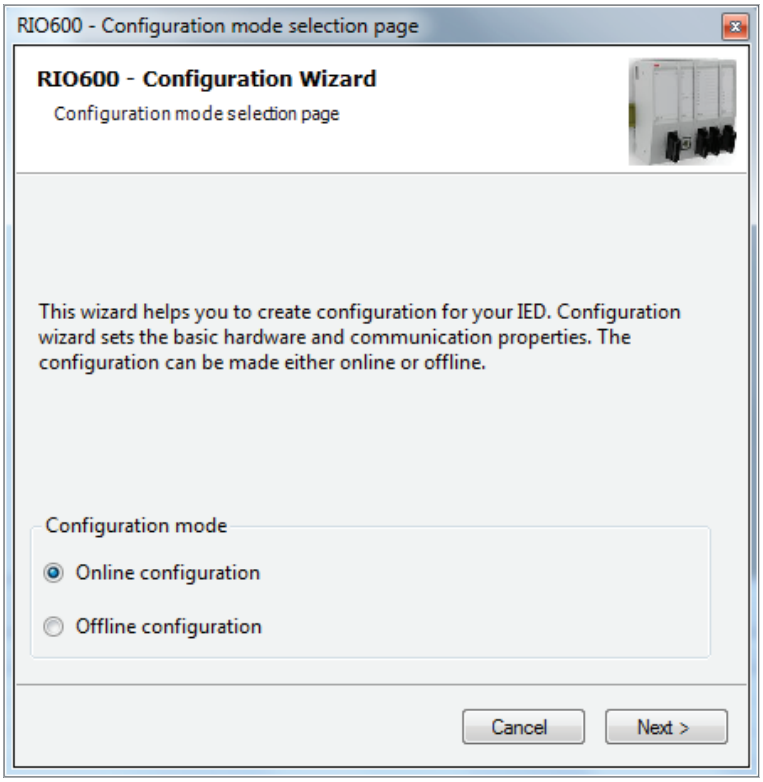

Figure 28: Selecting online configuration mode

3. In the **IED protocol** list, select the protocol, for example, **IEC 61850** and click **Next**.

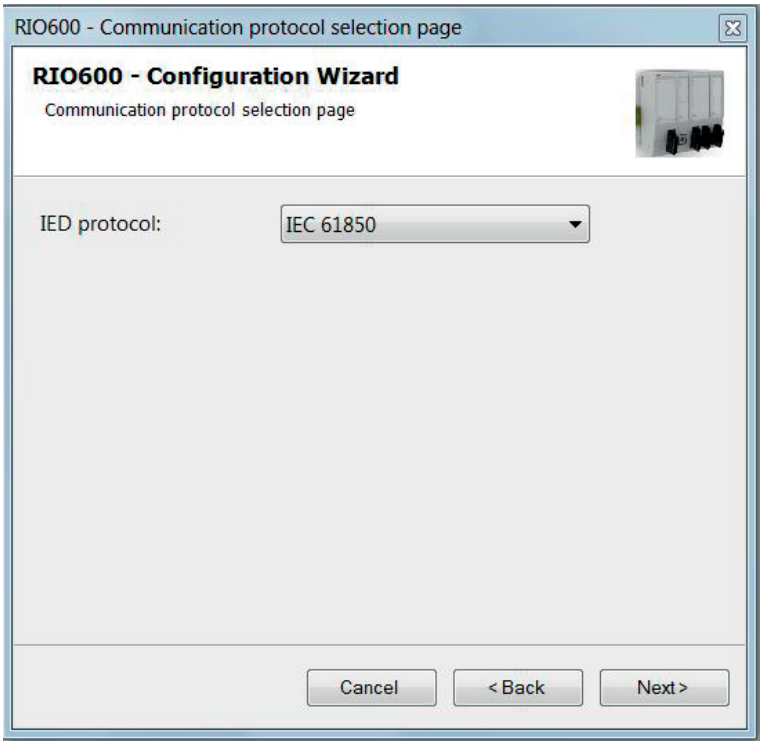

Figure 29: Selecting the IED protocol in online mode

4. Under **PCM600 communication**, define the communication parameters and click **Next**.
   4.1. In the **Port** list, only **Port 1** can be selected as the communication port.
   4.2. In the **IP Address** box, enter the correct IP address.

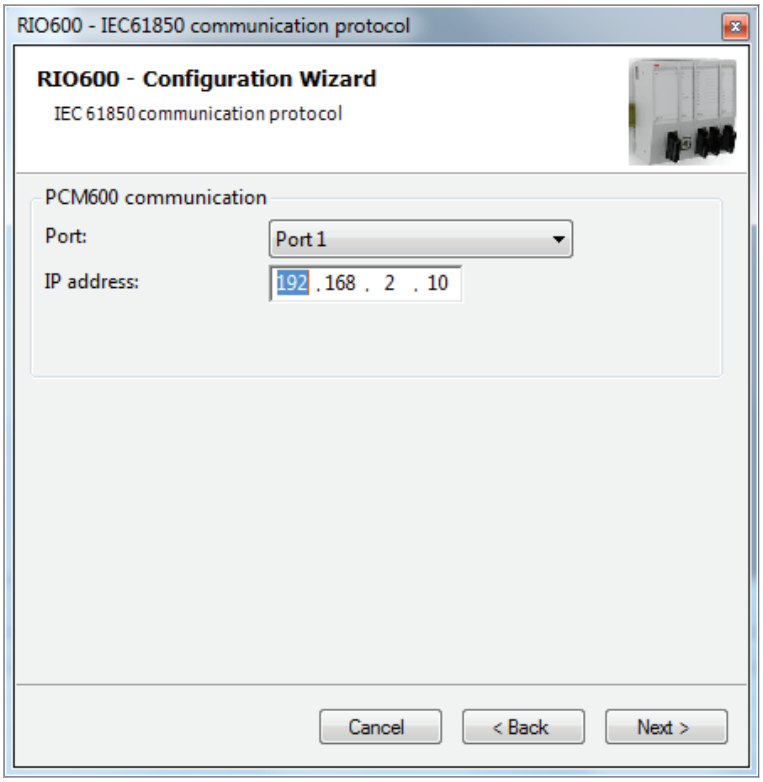

Figure 30: Defining the communication parameters in online mode

5. In the **Communication configuration complete** dialog box, click **Next**.

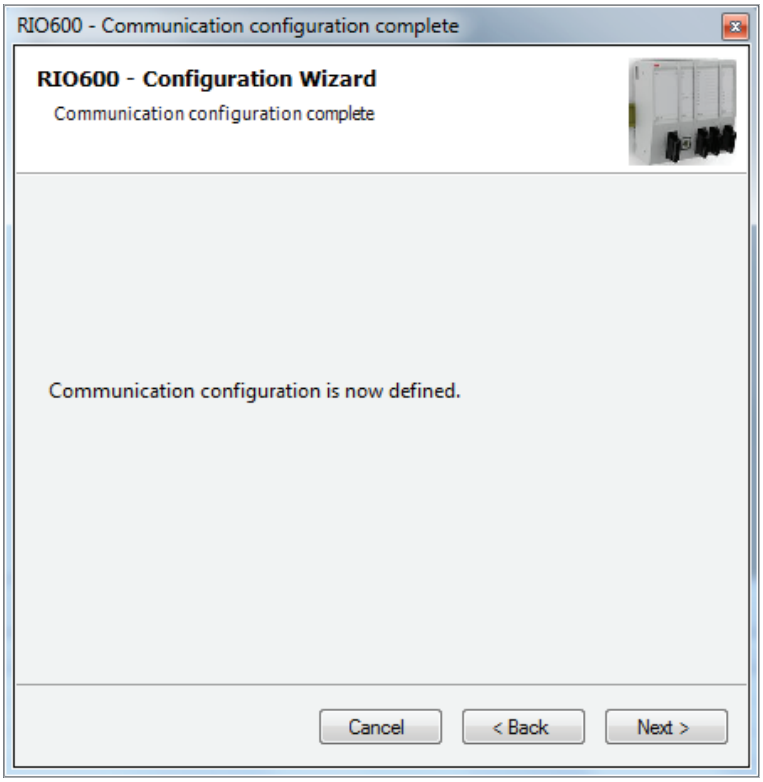

Figure 31: Completing the communication parameter configuration in online mode

6. If the IEC 61850 editions between the IED and PCM600 differ, a dialog box opens.

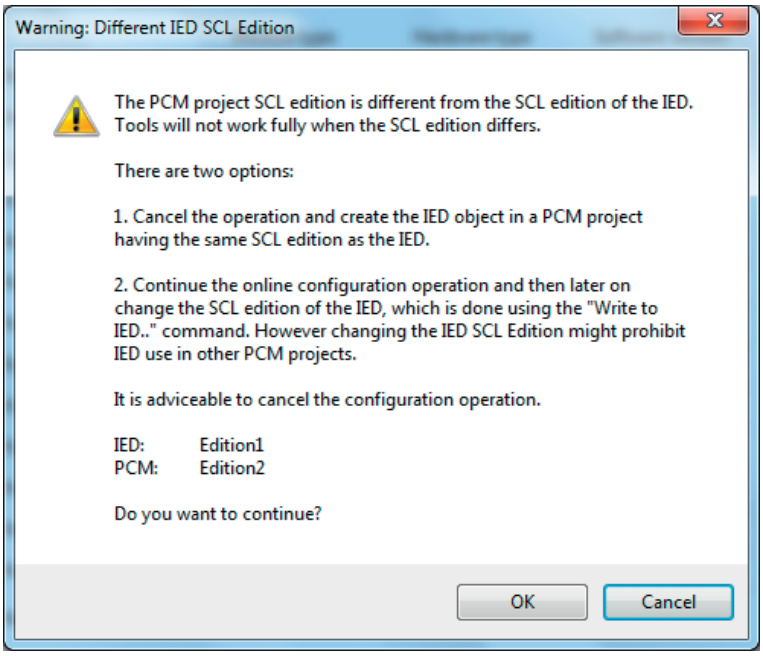

Figure 32: Detecting difference in SCL version during online configuration

6.1. Click **Cancel** to close the **Composition detection page** dialog box and to cancel the online configuration.
6.2. Click **Ok** to ignore the warning and to read the hardware configuration from the IED.

7. In the **Composition detection page** dialog box, wait until the hardware configuration is read from the device.
In online mode, the contents of the **Composition detection page** dialog box are read-only and cannot be edited.

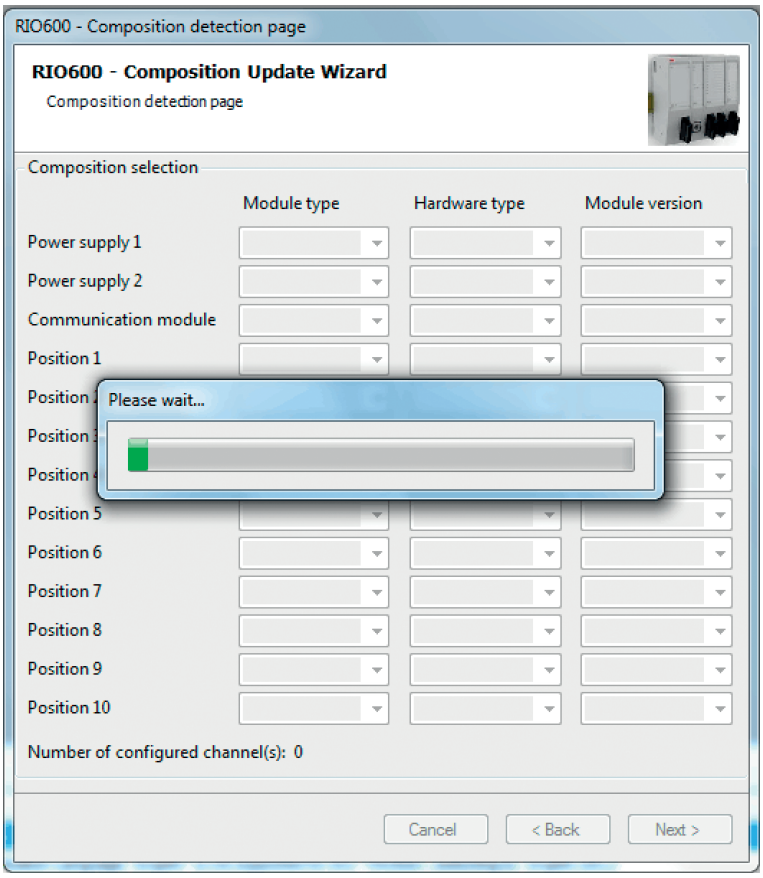

Figure 33: Reading the device composition in online mode

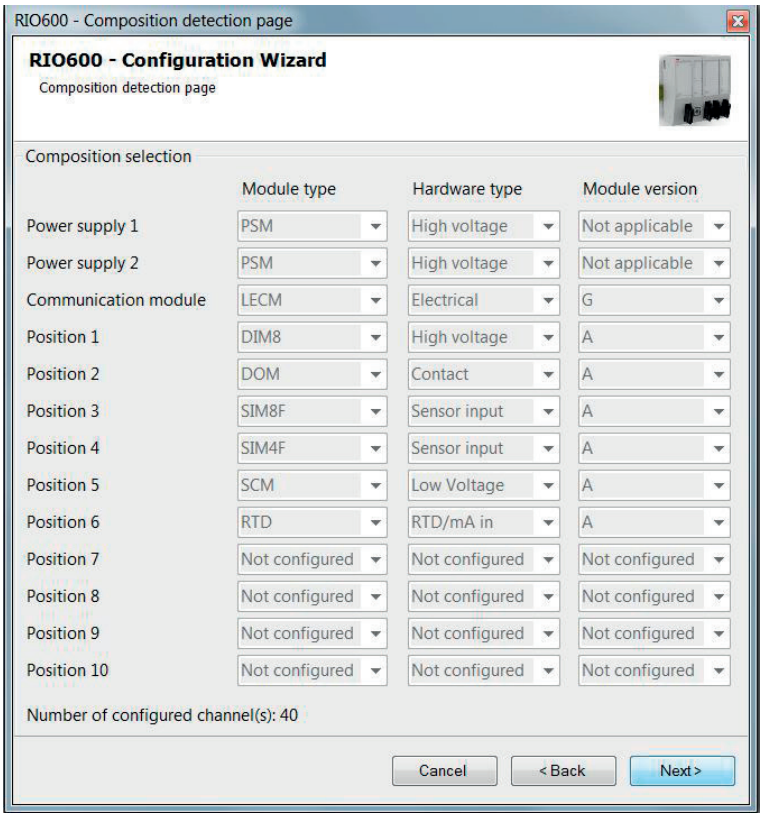

Figure 34: Viewing the device composition in online mode

8. In the **Composition detection page** dialog box, click **Next**.
9. In **Application Type selection page** dialog box, configure the application types of all the SCM modules in the stack.

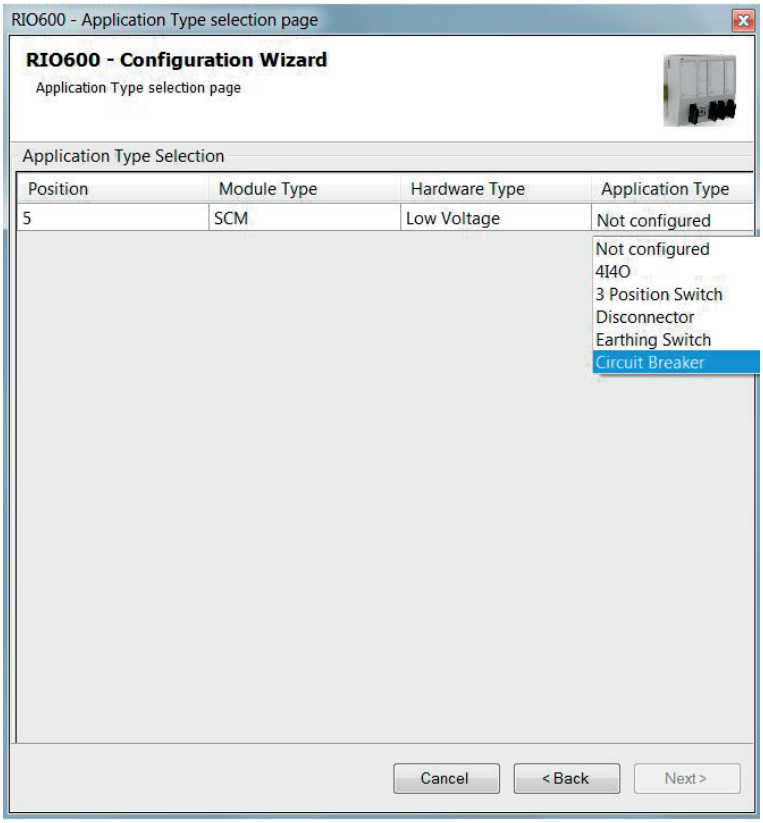

Figure 35: Selecting the application types of SCM modules

The **Application Type selection page** dialog box opens only if at least one SCM module has been detected in the **Composition detection page** dialog box.

9.1. The application types of the SCM modules are already selected, if configured. In the **Application Type** list, change the selection, if required.
9.2. Click **Next** to go to the **Version selection page**.

10. In the **Version selection page**, select the IEC 61850 protocol edition of the IED and click **Next** for function generation.

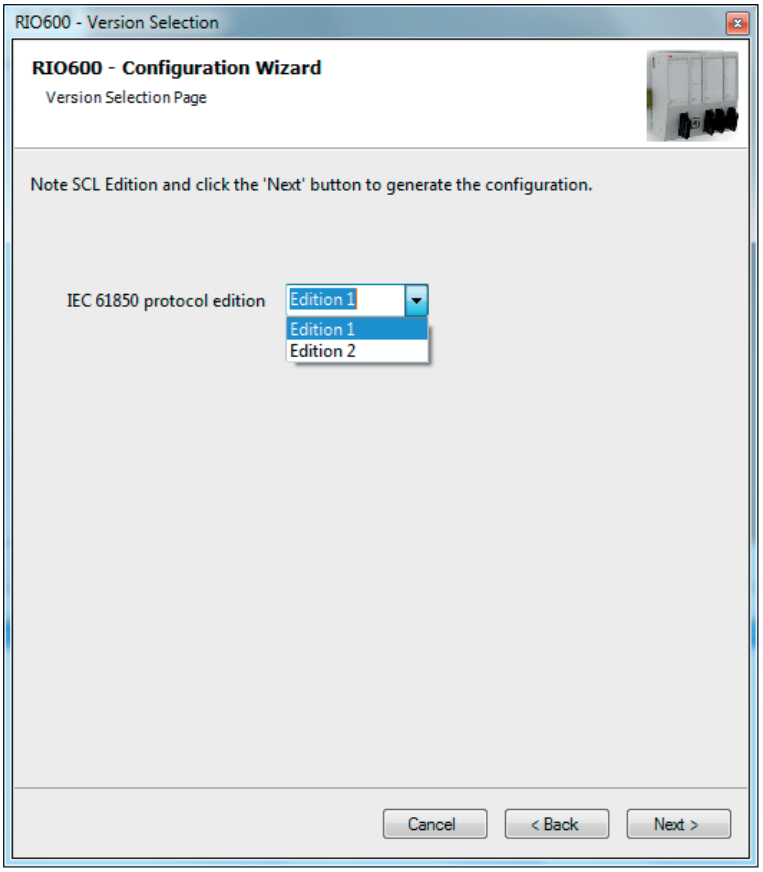

Figure 36: Selecting the IEC61850 protocol edition

A progress bar is provided to show the status of the function generation. Wait until the function generation is complete.

11. When the function generation is complete, the **Setup complete page** dialog box opens.
    The available power supply modules in RIO600 stack are represented as **PSMH/L** in the **Plant Structure** under the **HW Configuration** node. Only the modules available under the **HW Configuration** represent the physical stack.

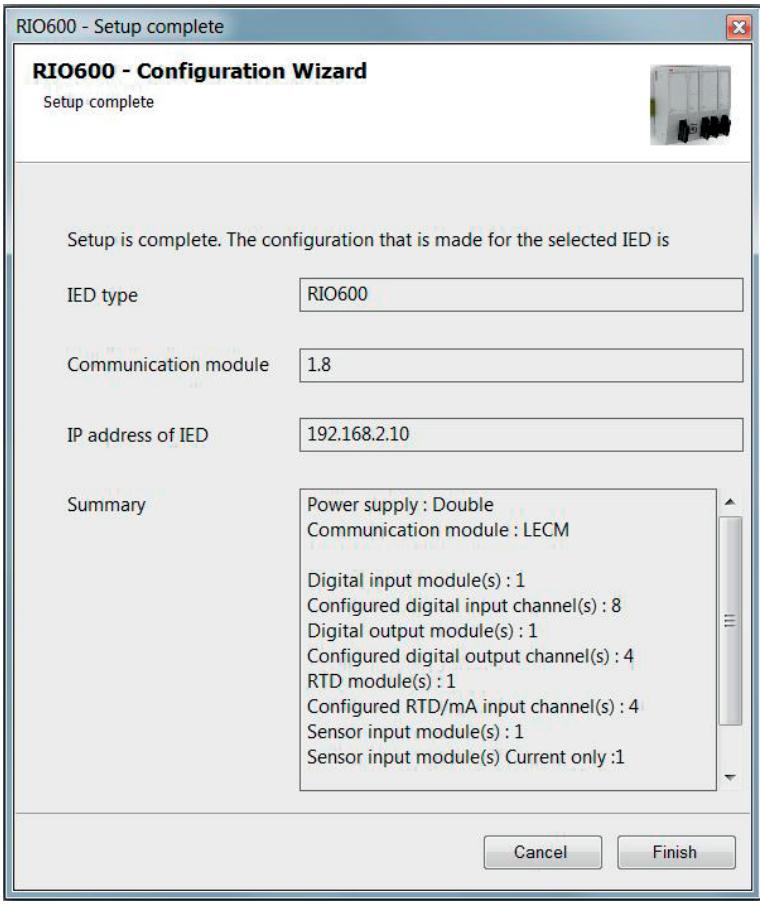

Figure 37: Viewing the summary page in online mode

In the **Plant Structure**, the **Application configuration** does not contain any data.

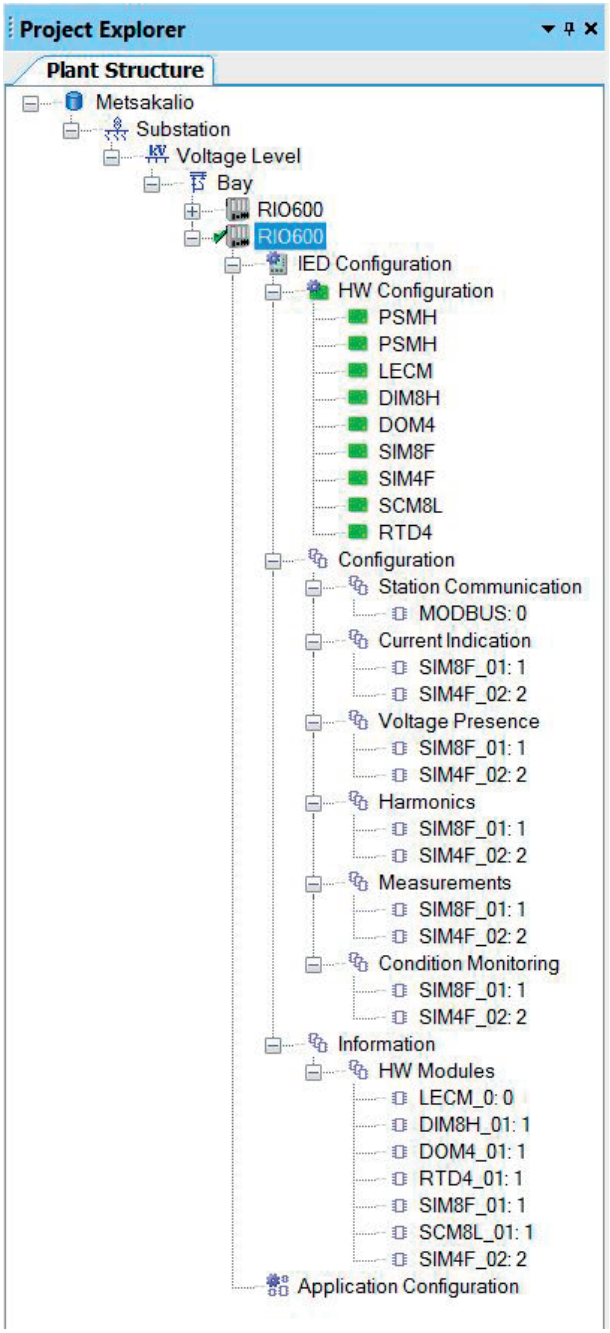

Figure 38: Updating the plant structure in online mode

Click **Cancel** any time during the configuration setup to remove the created RIO600 device from the plant structure. Use **Back** and **Next** to navigate between the pages in the setup wizard.

The module instances are created based on the module type.

The version selection is available only if the configured RIO600 is the first one in the PCM600 project.

The default data sets created for a stack with more than two SIM8F/SIM4F modules contain only the data entries of first two SIM8F/SIM4F module instances.

5.5 Setting the technical key

The technical key is used for the unique identification of each device and must be modified for every new device.

1. In the **Plant Structure**, right-click **RIO600** and select **Set Technical Key in IED**.

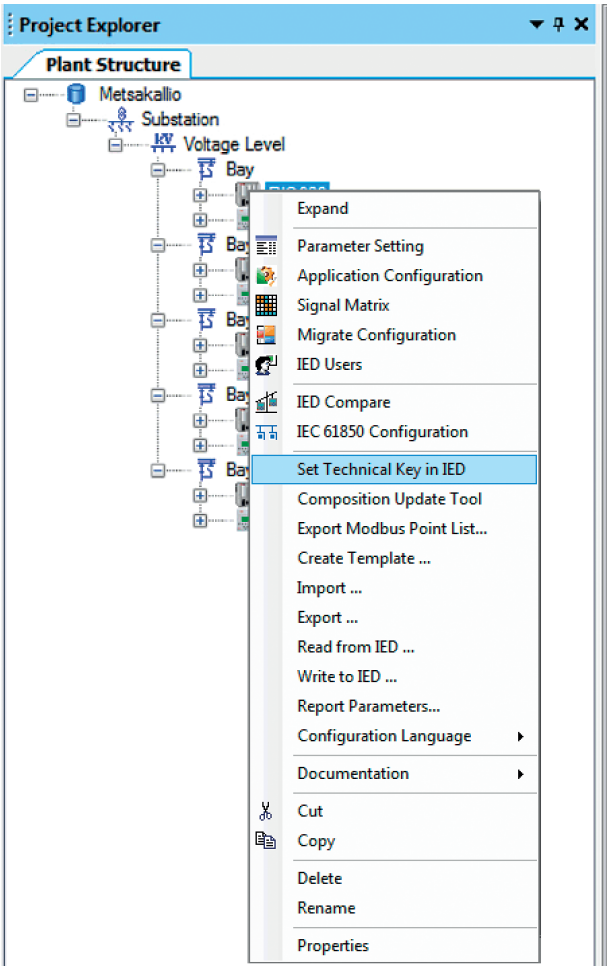

Figure 39: Setting the technical key

2. In the **Technical Key Information** dialog box, click **OK**.
   - Click **Cancel** or close the dialog box to cancel the setup.

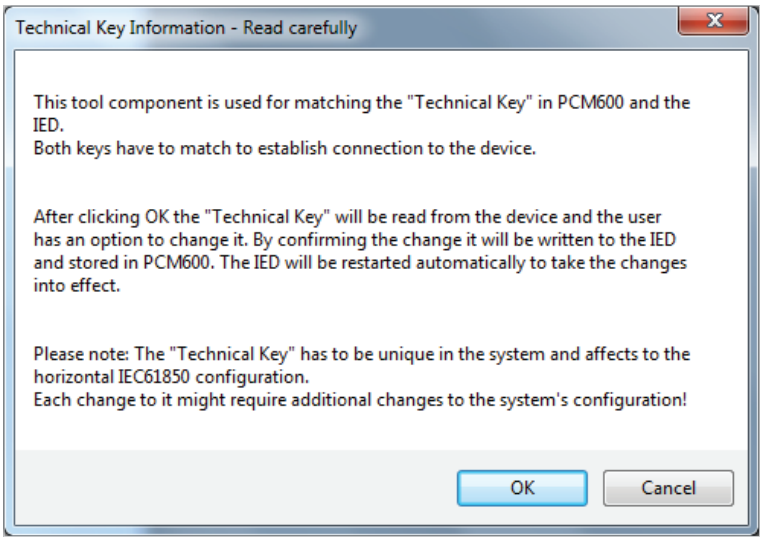

Figure 40: Viewing the technical key information

3. In the **Set Technical Key** dialog box, define the technical key when the IED is in online mode and click **OK**.
   - Select **Technical Key in IED** to set IED technical key to PCM600.
   - Select **Technical Key in PCM600** to set PCM600 technical key to IED.
   - Select **User-defined Technical Key** to provide technical key to IED as well as to PCM600.

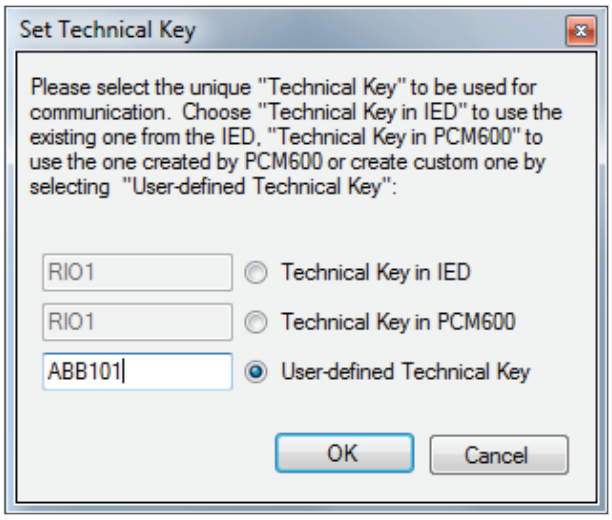

Figure 41: Selecting a user-defined technical key when the IED is in operational mode

4. Wait until the configuration is complete and click **OK**.
   If there is a module mismatch between RIO600 stack information in PCM600 and the physical stack, select the appropriate option.

- Click **Yes** to update the technical key in PCM600.
- Click **No** to keep the existing technical key unchanged.

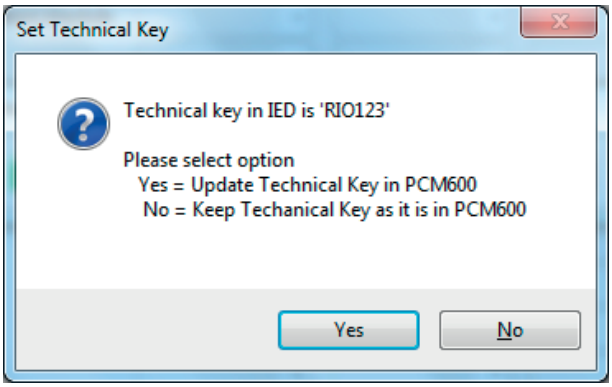

Figure 42: Selecting a user-defined technical key

The technical key can be modified using the **Object Properties** pane.

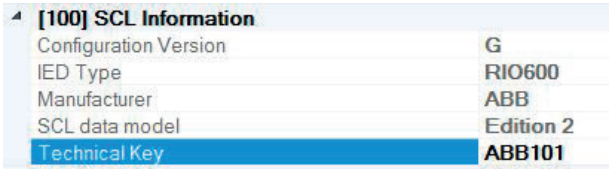

Figure 43: Viewing the technical key properties

Do not set the same technical key for more than one device through the **Object Properties** pane or an error message is displayed in the **Output** pane.

A valid technical key can have a maximum of 32 characters for Edition 1 IED and a maximum of 60 characters for Edition 2 IED.

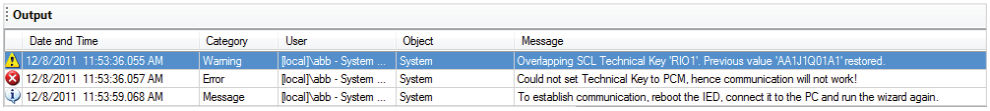

Figure 44: Failing to set the technical key

5.6 Editing the object properties

The Object Properties pane is used to view the parameters set during the configuration setup. For example, the *IP Address* and *Technical Key* can be changed directly via the Object Properties of the selected device.

1. In the **Plant Structure** view, select a device.
2. On the **View** menu, click **Object Properties**.
   The **Object Properties** pane opens.
3. Type in the value like a new IP address to the **IP Address** row.
   Some object properties like **Configuration Version** and **IED Type** are not editable.

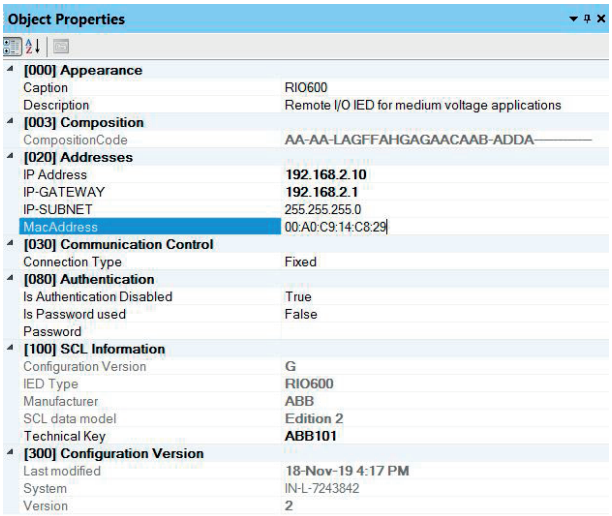

Figure 45: Viewing Object Properties

The changes in the *IP Address* and *Technical Key* in the Object Properties pane do not reflect in the device but are used to establish a connection between PCM600 and the device.

Section 6 Using the Parameter Setting tool

6.1 Viewing parameters

The device should contain a valid configuration. If the device is not configured or contains an invalid configuration, the Write to IED operation should be selected.

- In the **Plant Structure**, right-click a device and select **Parameter Setting** to view the configured parameters for the selected device.

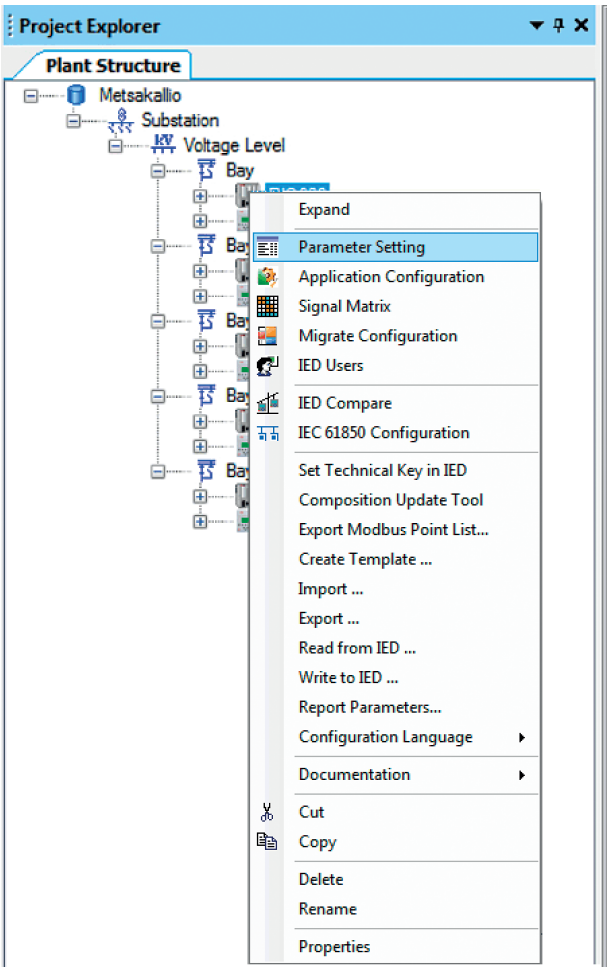

Figure 46: Selecting Parameter Setting

- View the parameters of all modules in the **Parameter Setting** pane.

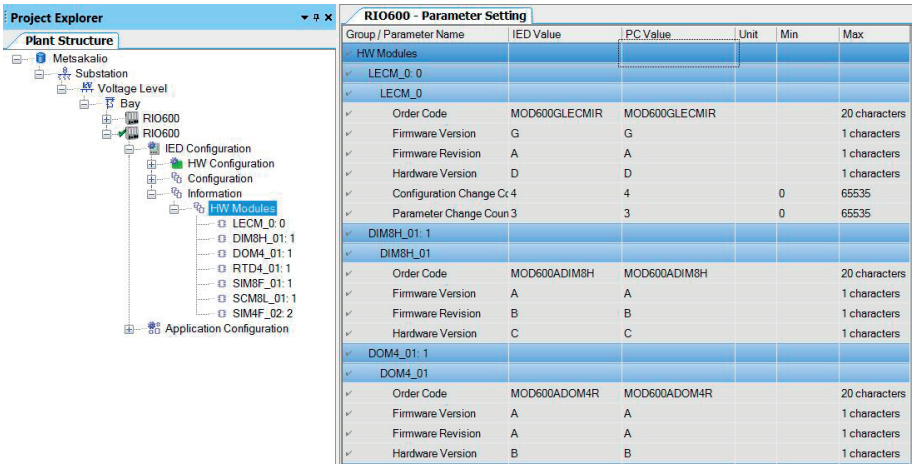

Figure 47: Viewing the parameters in the Parameter Setting tool

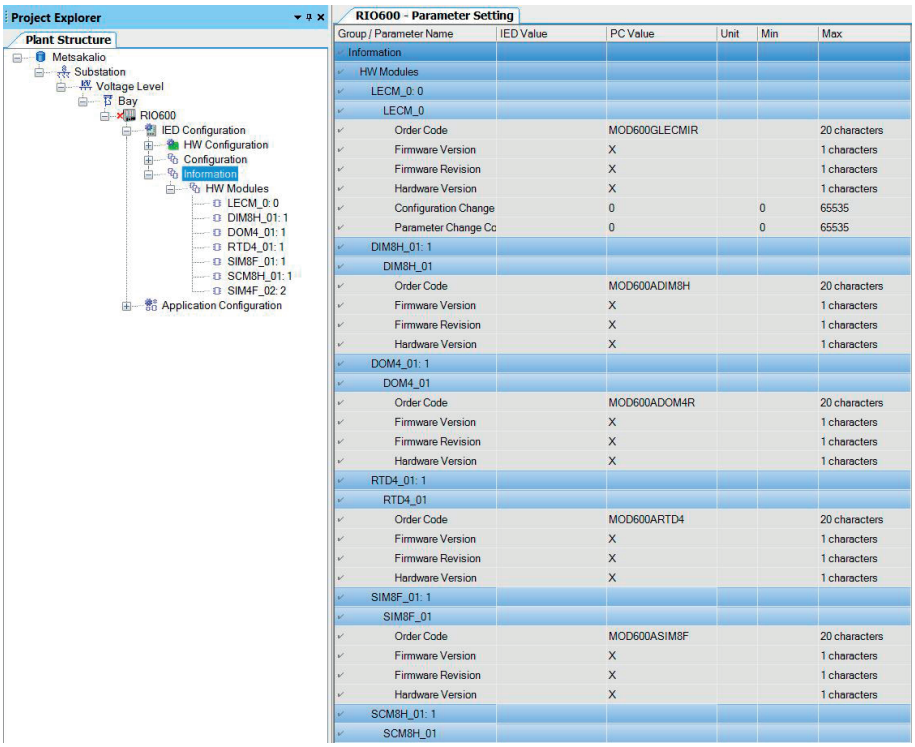

Figure 48: Viewing the module specific read-only parameters in the Parameter Setting tool

- View the available supervision data under LECM in the **Parameter Setting** pane.

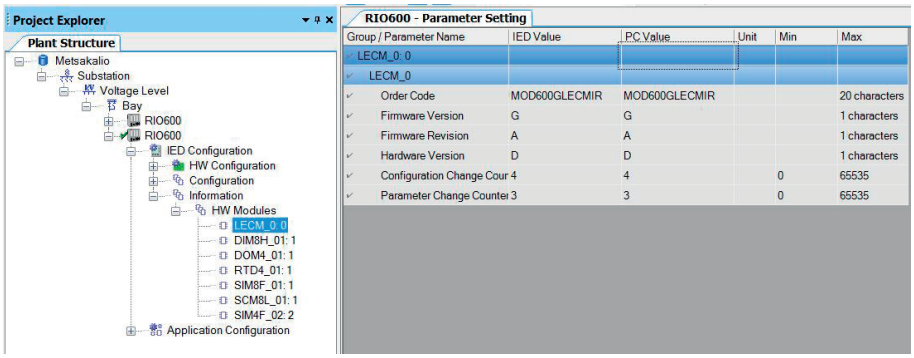

Figure 49: Viewing the supervision data in the Parameter Setting tool

The addition, removal or interchange of modules increments the *Configuration Change Counter* parameter value. Certain actions are not considered as application configuration changes and they do not increment *Configuration Change Counter*.

- Adding, removing or updating data sets in the IEC 61850 tool
- Subscribing to or unsubscribing from the data sets in the IEC 61850 tool
- Changing the application configuration layout
- Connecting a GOOSE input to a GOOSE receiver block and not to any output module in the Binary or Analog outputs tab

Any change in the parameter values increments the *Parameter Change Counter* value. The parameter read operation is required to get the updated counter values from the protection relay to the Parameter Setting tool. The common read operation does not provide the actual counter values to the Parameter Setting tool.

Parameter Setting and Logic Nodes for the Move function MVGAPC are available only after the function block has been added in Application Configuration. Parameter Setting for the Move function block can be found in the plant structure.

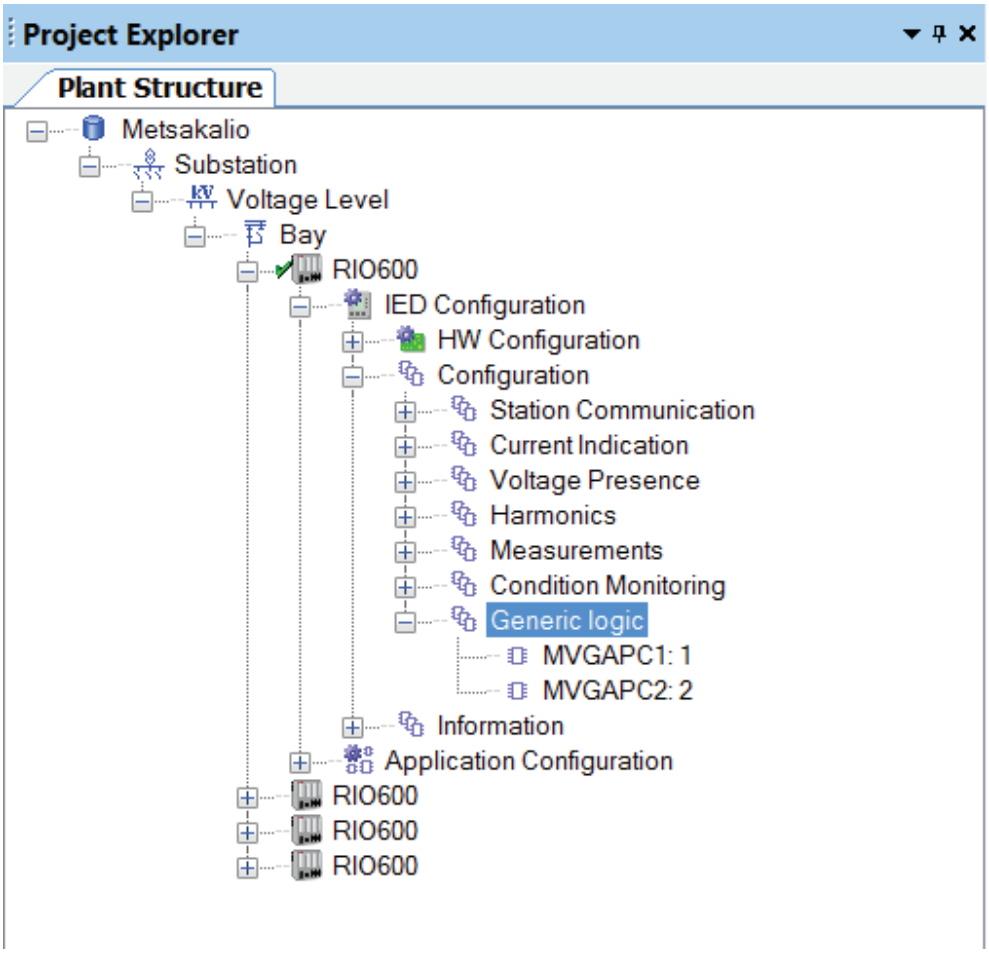

Figure 50: MVGAPC parameter setting

6.2 Reading parameters from the device

1. Click the **Read User Management Settings from IED** button to read parameters from the device.
   The **Read parameters from RIO600** dialog box opens.

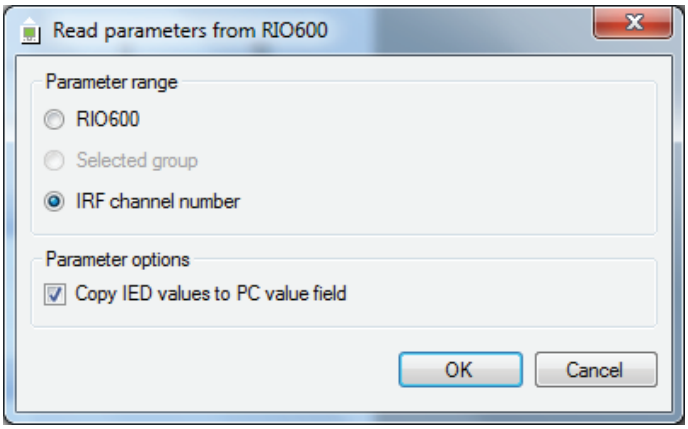

Figure 51: Reading parameters

2. Under **Parameter range**, select which parameters are read from the device.
   2.1. All parameters of a device like RIO600
   2.2. A selected group of parameters like General Parameters
   2.3. A selected parameter like IRF channel number
3. Under **Parameter option**, check the box **Copy IED values to PC value field** to update the IED value column after the configured values are read from the device.
4. Click **OK** to read the parameters from the device.

6.3 Setting communication and time synchronization parameters

1. In the **Plant Structure**, select **RIO600/IED Configuration/HW Configuration/LECM** to set the communication parameters.

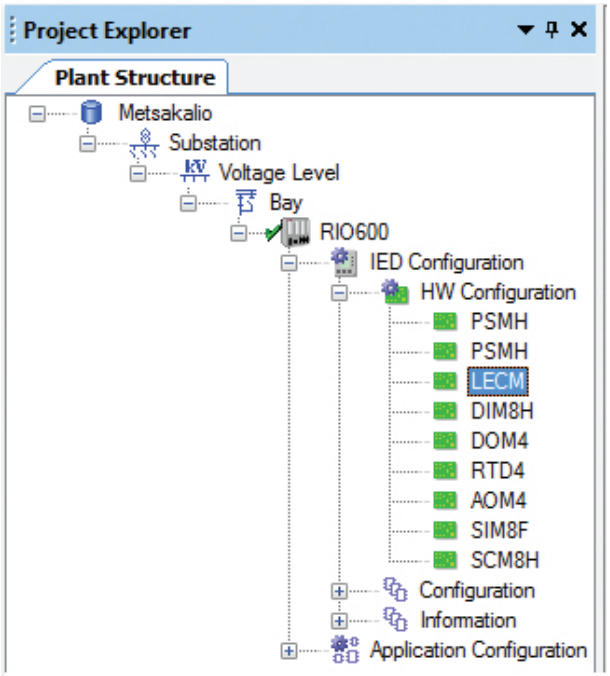

Figure 52: Selecting LECM to set the communication parameters

2. Right-click **LECM** and select **Parameter Setting** to display the general, communication and synchronization parameters in the Parameter Setting tool.

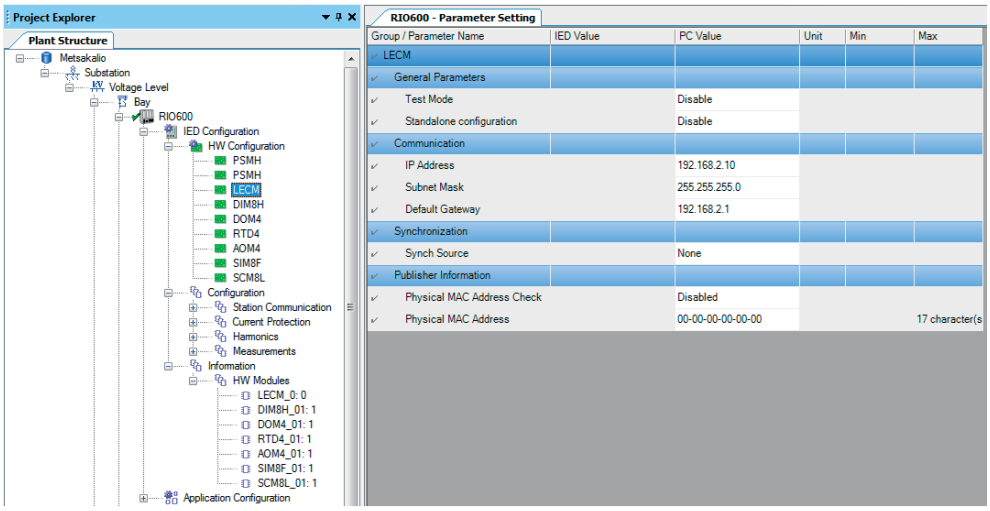

Figure 53: Viewing the parameters in the Parameter Setting tool after selecting LECM

3. Change the values of the **IP Address**, **Subnet mask**, **Default gateway**, **Synch Source**, **IP SNTP primary** and **IP SNTP secondary** parameters based on the required configuration.

6.4 Setting Modbus configuration parameters

1. In the **Plant Structure**, select **RIO600/IED Configuration/Configuration/ Station Communication/MODBUS: 0** to set the Modbus configuration parameters.

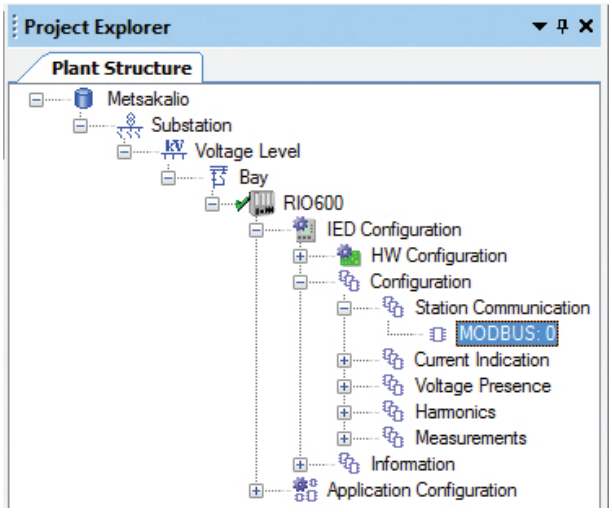

Figure 54: Selecting Modbus: 0 to set the Modbus parameters

2. Right-click **MODBUS: 0** and select **Parameter Setting** to display the Modbus configuration parameters in the Parameter Setting tool.

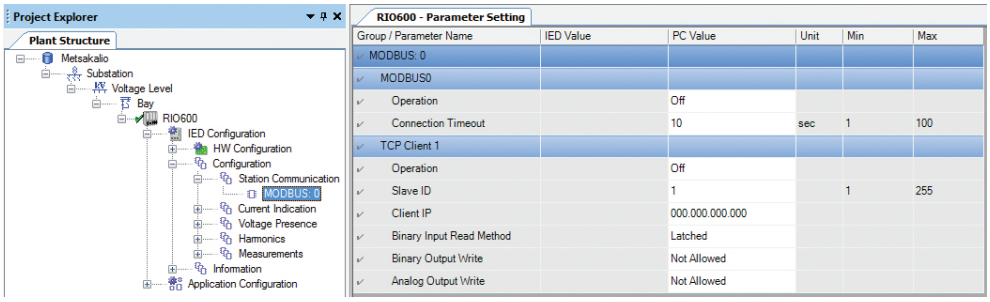

Figure 55: Viewing the parameters in the Parameter Setting tool after selecting MODBUS: 0

3. Change the values of **Operation**, **Connection Timeout**, **Slave ID**, **Client IP**, **Binary Input Read Method**, **Binary Output Write**, **Analog Output Write** parameters based on the required configuration.

6.5 Writing parameters to the device

1. Click the **Write User Management Settings to IED** button to write parameters to the device.
   The **Write parameters to RIO600** dialog box opens.
2. Under **Parameter range**, select which parameters are written to the device.
   - All parameters of a device like RIO600
   - A selected group of parameters like General Parameters
   - A selected parameter like IP Address

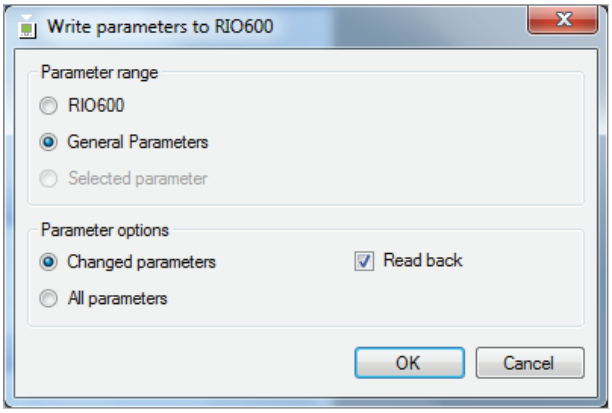

Figure 56: Writing parameter(s)

3. Under **Parameter options**, define if only the changed parameters are written to the device and if they are read back to the tool.
   - Select **Changed parameters** or **All parameters**.
   - Click the **Read back** check box to read back the parameters after writing them to the device.
4. Click **OK** to write the parameters to the device.
   If there are no modified or changed parameters and the selected parameter range is **All parameters**, the **Parameter Setting** dialog box opens.

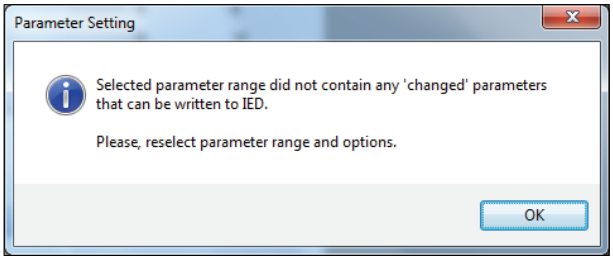

Figure 57: Detecting modified parameters

If the value of the new *Installation* parameter is changed to “Yes”, the **Special Operation** dialog box opens.

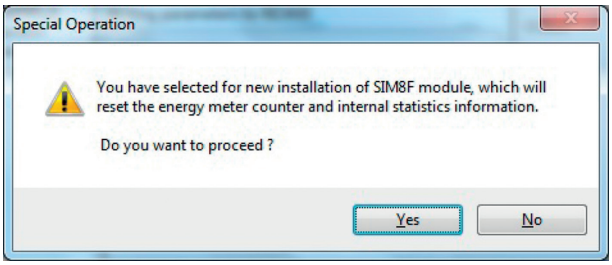

Figure 58: Writing new Installation parameter

New installation is a one-time operation and the value is set back to “No” after writing the parameters.

IED does not reboot if only the new *Installation* parameter is written through the Parameter Setting tool.

The *Description* parameter for channels should not contain the special character “&”. Such configurations are rejected by RIO600 IED.

5. Wait until the parameters are written to the device and the device reboots. The Output pane message indicates if the parameters are successfully written to the device. If the parameters are written successfully but the configuration is rejected by the device, a dialog box opens indicating an error.

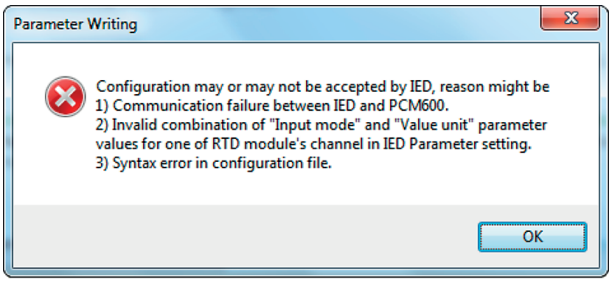

Figure 59: Failing to update parameter values

Section 7 Exporting and importing SCD files

7.1 Exporting SCD files

After the RIO600 parameters are set, export the System Configuration Description from PCM600 for the system configurations tool.

1. In the **Plant Structure** view, right-click the substation and select **Export**.

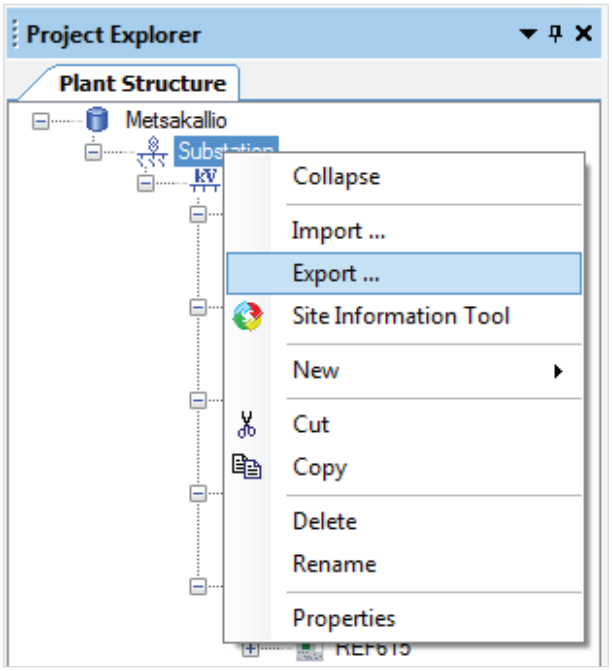

Figure 60: Selecting Export

2. In the **Information** dialog box, click **OK**.
3. In the **Export** dialog box, select the file destination and click **Save**.

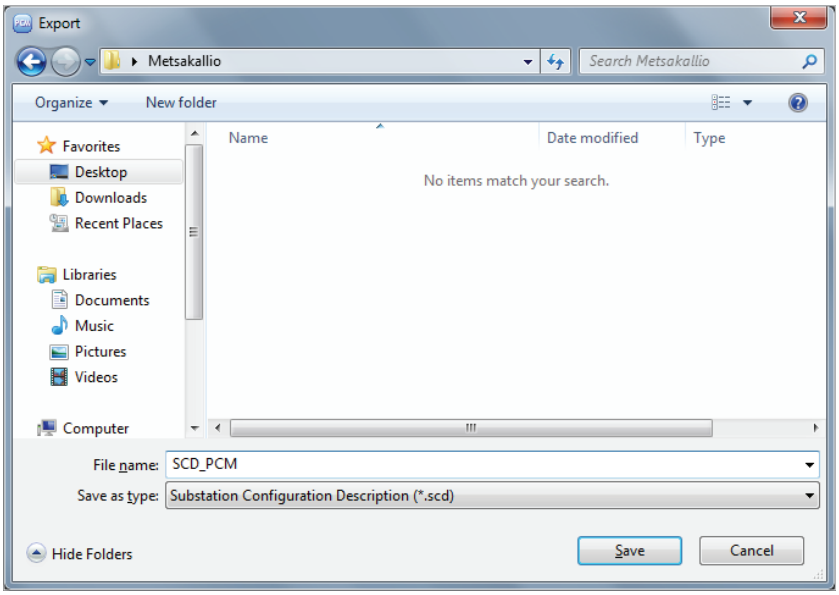

Figure 61: Selecting file destination

4. In the **SCL Export Options** dialog box, click **Export** to export the private sections to the SCD file.

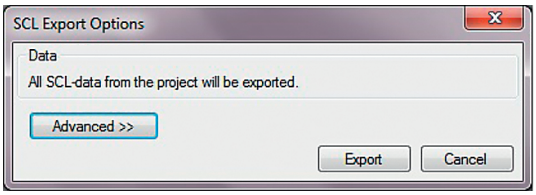

Figure 62: Exporting SCD file

7.2 Importing SCD files

After GOOSE engineering in the system configuration tool, the SCD file can be imported at the substation level.

1. Open PCM600 and ensure that the original project is open.
2. Switch off the engineering mode.

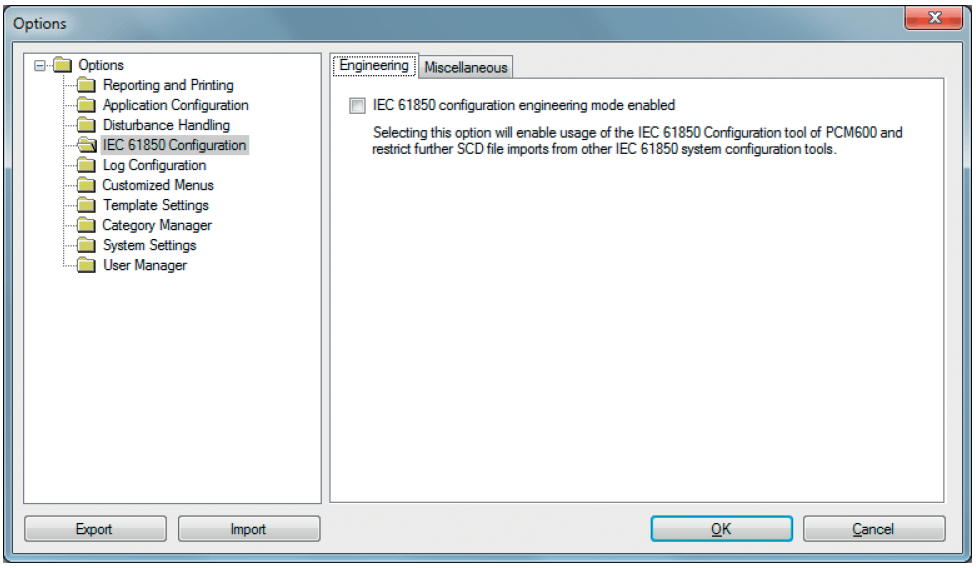

Figure 63: Switching off the engineering mode

3. In the **Plant Structure** view, right-click the substation and select **Import**.

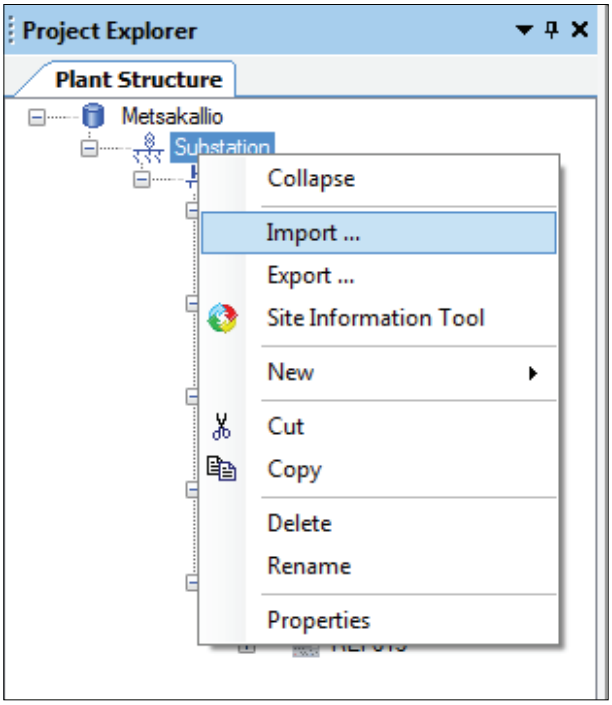

Figure 64: Selecting import

4. In the **Import** dialog box, locate an SCD file and click **Open**.
5. In the **SCL Import Options** dialog box, select how to handle the file during the import and click **Import**.

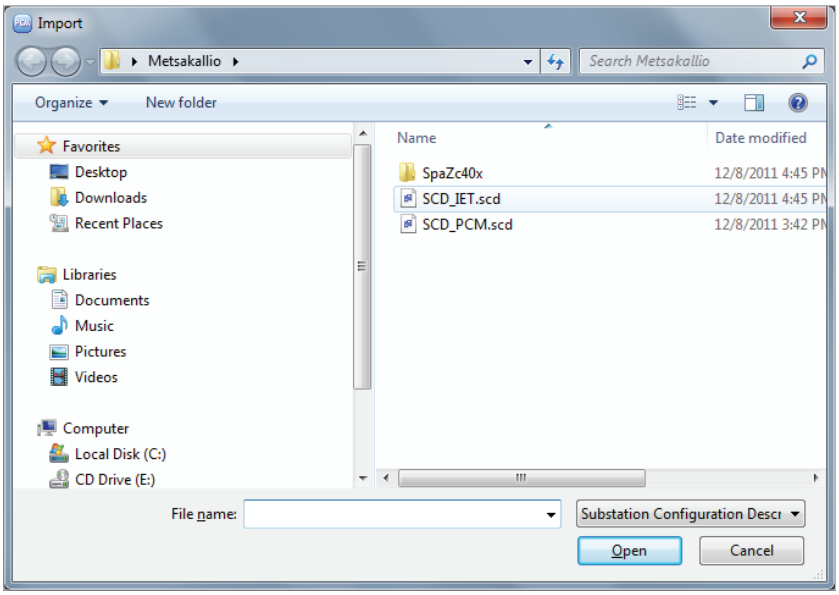

Figure 65: Selecting SCD file

5.1. Select **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.
5.2. Select **Replace unknown IED types with generic IEC 61850 object type**, if it is known that the file includes additional IEDs that are needed. The Generic IEC 61850 IED type is used to integrate these IEDs into the plant structure.
5.3. Select **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.
5.4. Select **Ignore Substation Section** to not import the SSD file part of the SCD file
5.5. Click the **Preview Changes** button in the **SCL Import Options** dialog box which opens after selecting the file to preview the changes before importing SCL files (SCD, ICD, CID). The preview window shows the changes which will be made to the SCL configuration if the file is imported.

The **Import Short Addresses** selection does not affect the RIO600 configuration.

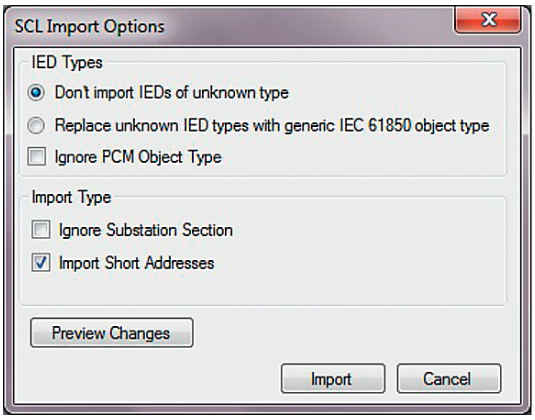

Figure 66: Importing SCD file

Section 8 Using the Signal Matrix tool

8.1 Starting the Signal Matrix tool

The Signal Matrix tool is used to map signals from other IEDs to the binary and analog outputs of RIO600 and thus connect the two devices over the IEC 61850 communication link.

1. In the **Plant Structure**, right-click a device and select **Signal Matrix**.

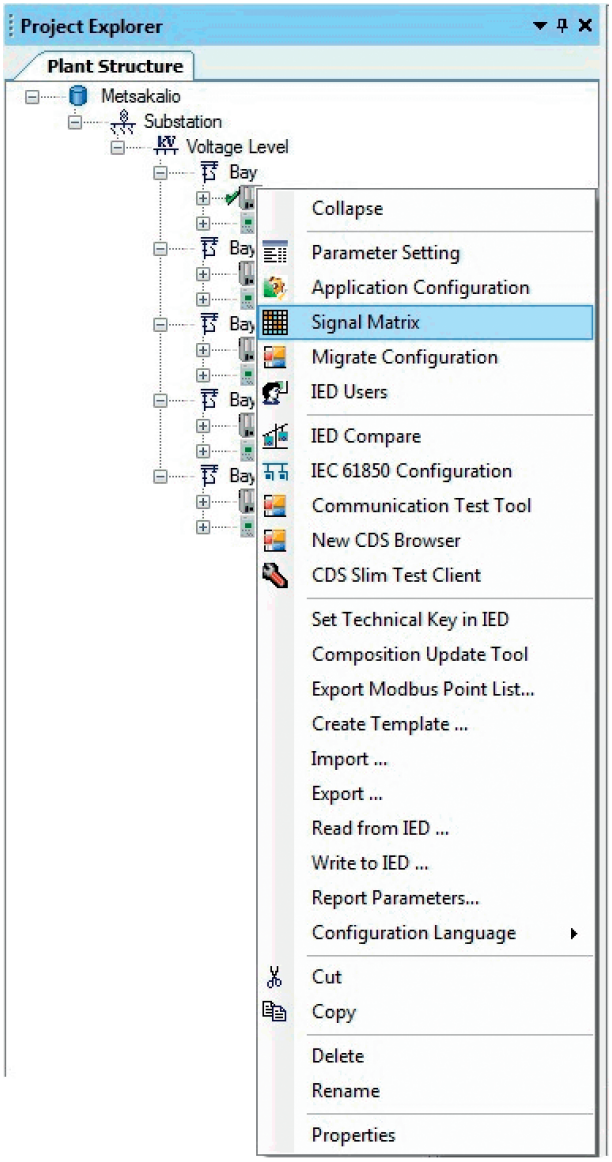

Figure 67: Selecting Signal Matrix

In a PCM600 project, the other IEDs see the RIO600 binary or analog inputs in the GOOSE tab in Signal Matrix after the system configuration.

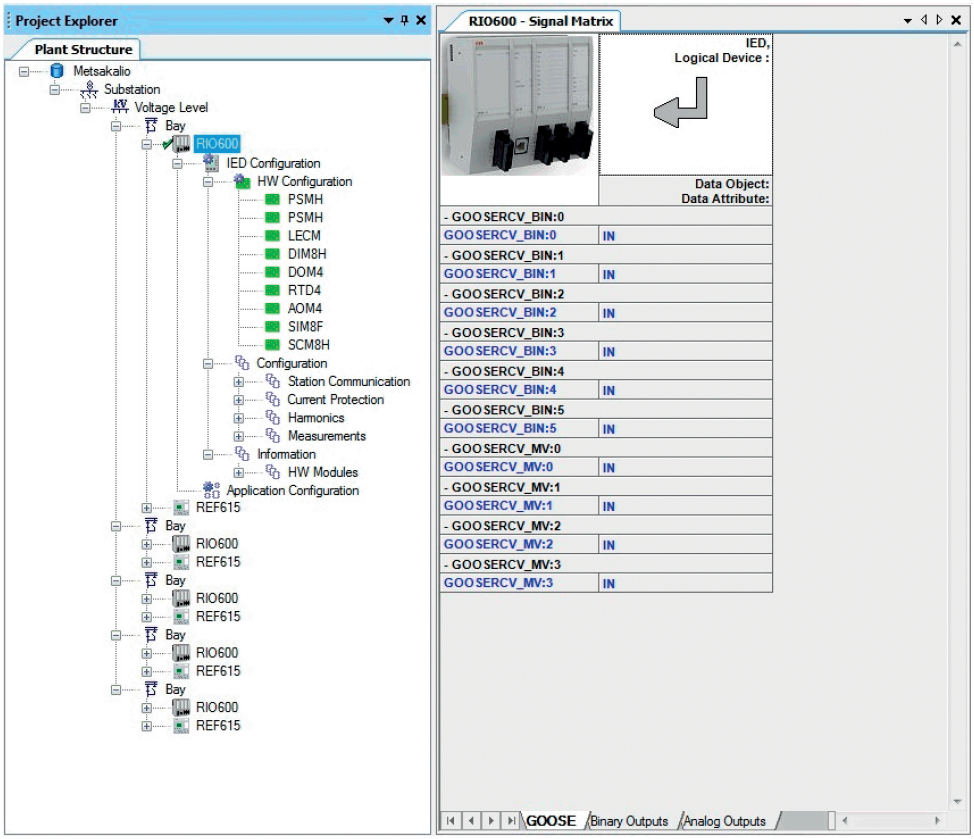

Figure 68: Signal Matrix tool before GOOSE engineering

- The GOOSE tab is used to connect the GOOSE inputs from other relay's to the available GOOSE receive blocks during GOOSE engineering.

RIO600 supports a maximum of 40 GOOSERCV_BIN functions and a maximum of 20 GOOSERCV_MV functions.

GOOSE receive blocks are automatically created during configuration based on the number of outputs which are configurable through GOOSE. However, it is always possible to add GOOSE receive blocks in Application Configuration.

The automatic creation or removal of GOOSE receive blocks is not available during the composition update operation. The unused GOOSE receive blocks can be removed manually with Application Configuration.

The GOOSERCV_BIN or GOOSERCV_MV blocks do not support output signal "Valid".

- The Binary outputs tab is used to map the binary signals between the modules in the stack to support the intermodule communication.

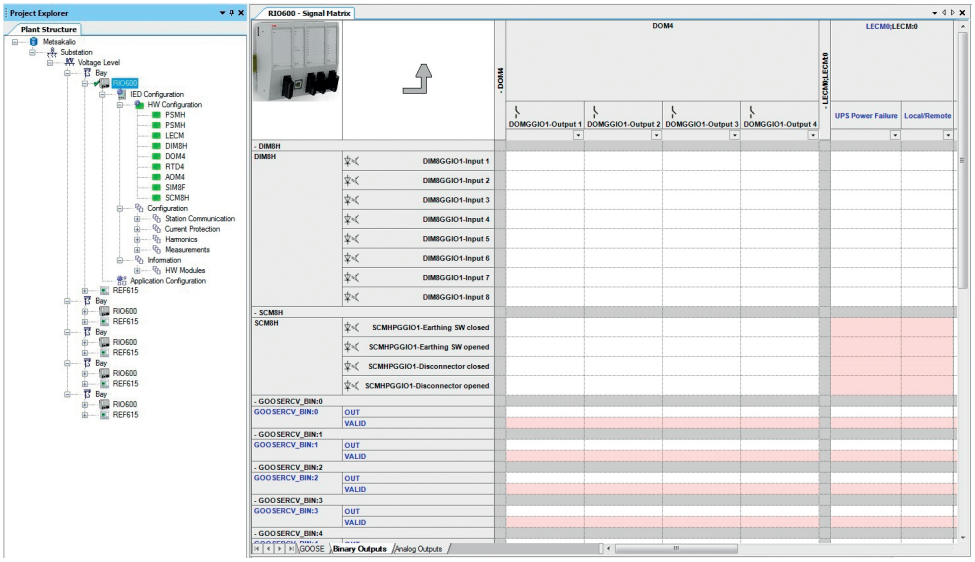

Figure 69: Signal Matrix tool before Binary Outputs Mapping

- The Analog outputs tab is used to map the signals between the analog GOOSE receive blocks and the available analog hardware channels.

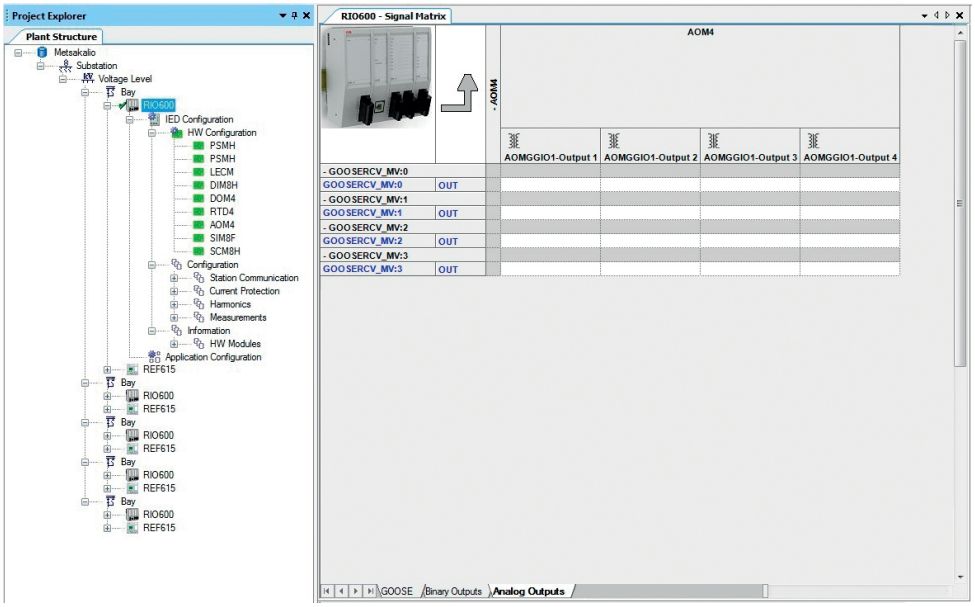

Figure 70: Signal Matrix tool before Analog Outputs Mapping

2. Make connections from the sending devices (publisher) to the receiving function blocks (subscriber).

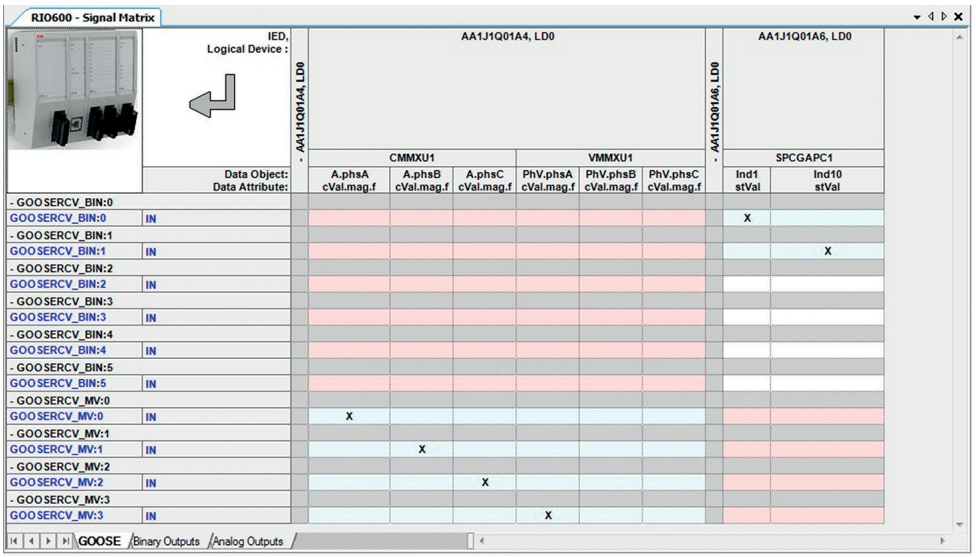

Figure 71: Making the connections with Signal Matrix

GOOSE input can be only connected to a GOOSE receive block. A direct connection between the GOOSE input and the output channel is not supported.

Multiple GOOSE received signals cannot be connected to a single GOOSE receive block. The PCM600 level validation is done for a duplicate connection.

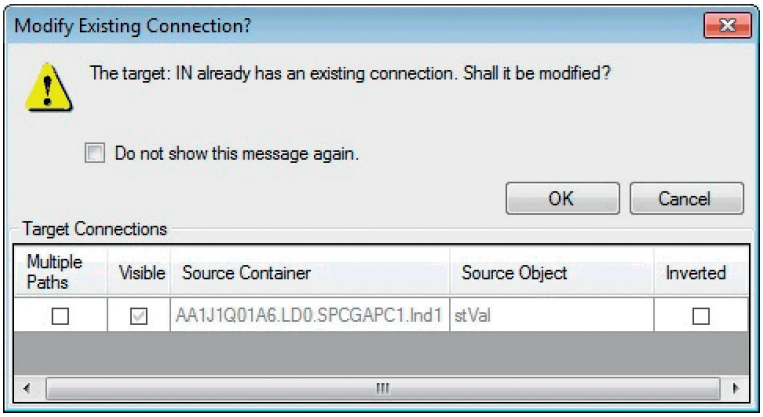

Figure 72: Detecting duplicate connection

3. Make the internal connections by mapping the signals internally between the modules in the RIO600 stack.
   The Binary output tab supports the following mappings.
   - GOOSE receive blocks to output signals (a single GOOSE receive block can be connected to multiple outputs)
   - Mappings between the hardware modules within the configured RIO600 stack (the input of one hardware module can be mapped to the output of another module)
   - Multiple input mappings to a single output (enabled with the support of OR logic)

RIO600 does not support a configuration which contains the mapping of a single input from one hardware module to multiple outputs. However, this is allowed in Signal Matrix but such configuration is restricted during the common write operation.

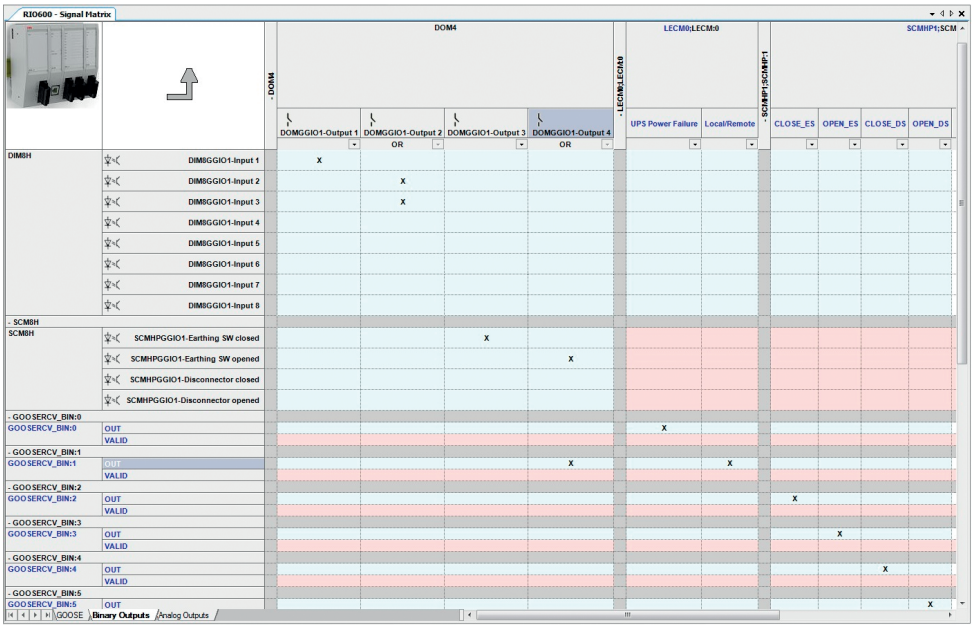

Figure 73: Making the internal connections using Signal Matrix

4. Make the connections between the analog GOOSE receive block and the configured analog output modules.

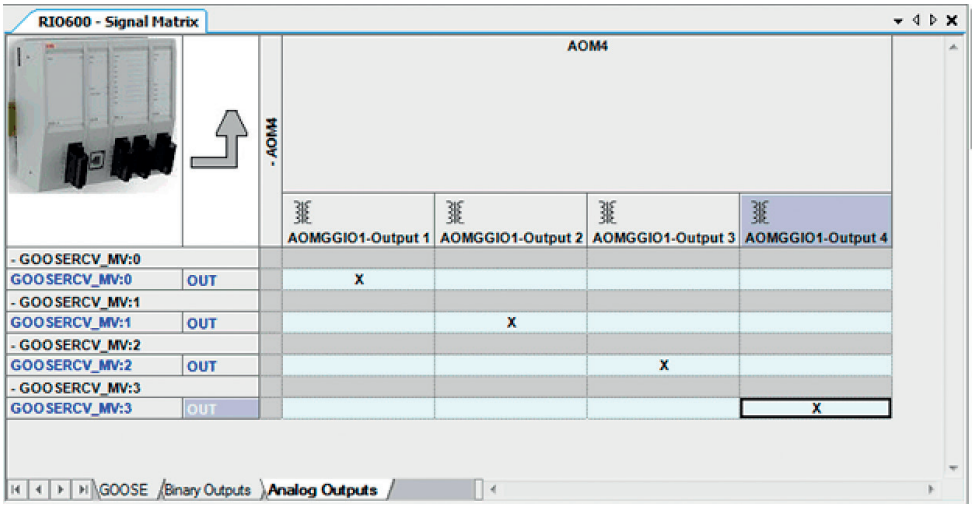

Figure 74: Making the connections in Analog Outputs tab

5. In the **Plant Structure**, select the device, right-click and select **Write to IED**.

Data set entries appended into the existing data sets during the CUT operation are not reflected to the subscribed IEDs before the data set is resubscribed (unsubscribe and subscribe) in the IEC 61850 Engineering tool. The Signal Matrix signal mapping in the subscribed

IED is not retained for the modified data sets and re-engineering is required.

Section 9 Using the Application Configuration tool

9.1 Application Configuration tool

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

The function blocks are dedicated to different functions.

- Control related functions
- IED configuration related functions
- Logical functions
- Communication

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

- Organizing an application configuration
  - Organizing an application configuration into a number of logical parts (MainApplication)
  - Organizing a MainApplication over a number of pages
- Features for programming an application configuration
  - Inserting function blocks, making connections and creating variables
  - Including the hardware I/O channels directly to the application configuration
  - Documenting the application configuration: such as, making printouts
  - Saving application configurations as templates in an application library to reuse them in other IEDs (Function blocks and related logic can be fully or partially reused depending on the functionality available in other IEDs)
  - Validating the application configuration during the configuration process on demand and while writing the application configuration to the IED

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

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

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

Cycle time is represented as zero for all the function blocks.

RIO600 does not support feedback loop configurations.

9.1.1 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.
- IEC 61850 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.

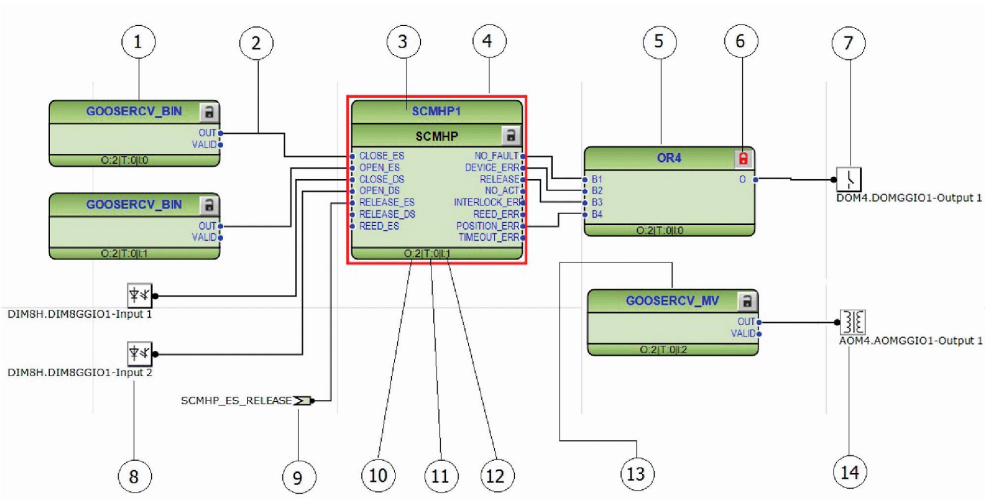

Figure 75: Function block overview

1 GOOSE Receive Block for binary signals
2 Connections
3 User-defined function block name
4 Function block, selected (red)
5 OR logic function block name
6 Function block, locked
7 Hardware, binary output channel
8 Hardware, binary input channel
9 User-defined input variable
10 Execution order
11 Cycle time
12 Instance number
13 GOOSE Receive Block for analog signals
14 Hardware, analog input channel

RIO600 supports the OR/AND logic function block with a maximum of four inputs and a maximum of twenty instances. The NOT logic function block is also supported with a maximum of twenty instances.

RIO600 supports the Move function block MVGAPC with a maximum of 8 inputs and 8 outputs with a maximum of two instances and it has one-to-one mapping. Inputs can be given from the logic gates only.

9.1.2 Signals and signal management

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.

9.1.3 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.

For more details on tool usage, see the PCM600 documentation.

Connection validation

A connection is only useful or even possible between two signals of the same base attribute type.

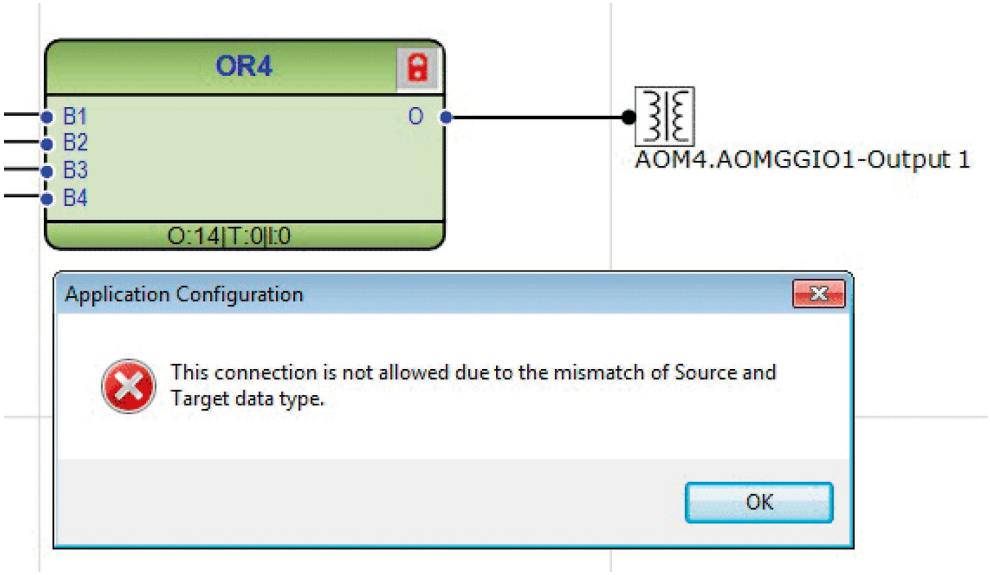

Figure 76: Invalid connection

Except for GOOSE receive blocks, mapping single input to multiple outputs is not supported. Such configuration is restricted during Common write operation.

9.1.4 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.

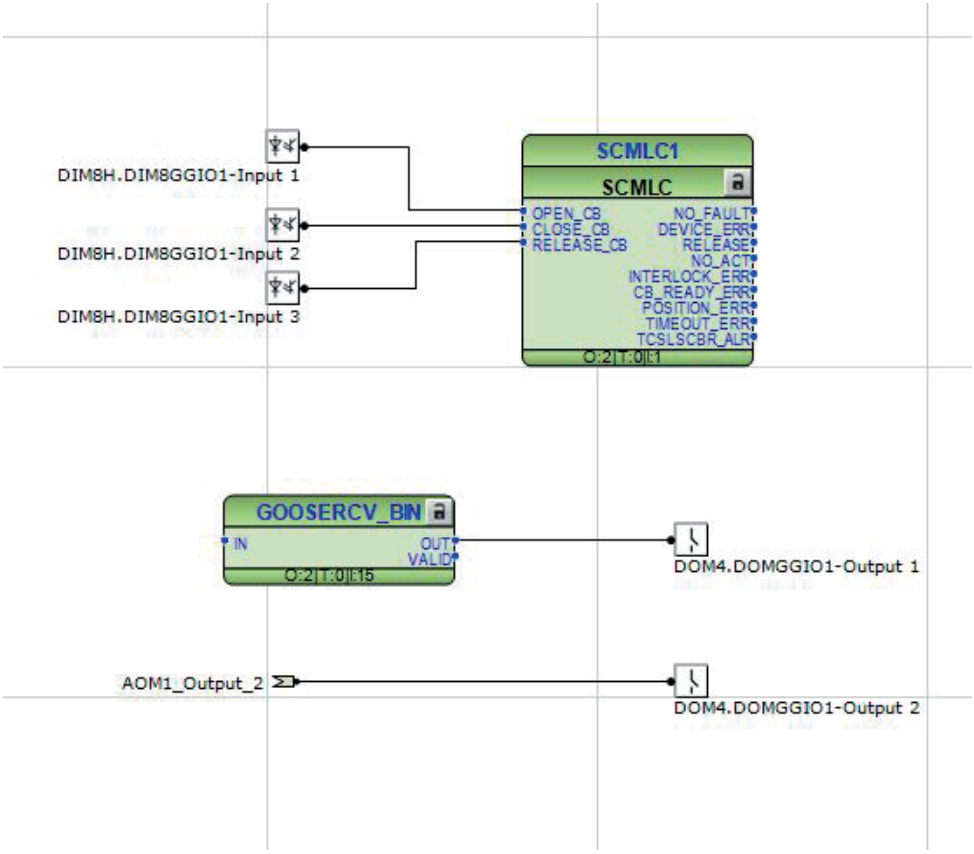

Figure 77: HW channels

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.

9.1.5 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 IED

9.1.5.1 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.

9.1.5.2 Validation on demand

The validity of an application configuration can be checked by clicking **Validate Configuration** on 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 user connects 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 IED. However, errors must be corrected before writing the application configuration to the IED. 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 IED.

These problems are listed in the **Output** pane under the **Application Configuration** tab. Double-clicking the error or warning row navigates to the **MainApplication/ Page/Area**, where the problem was identified.

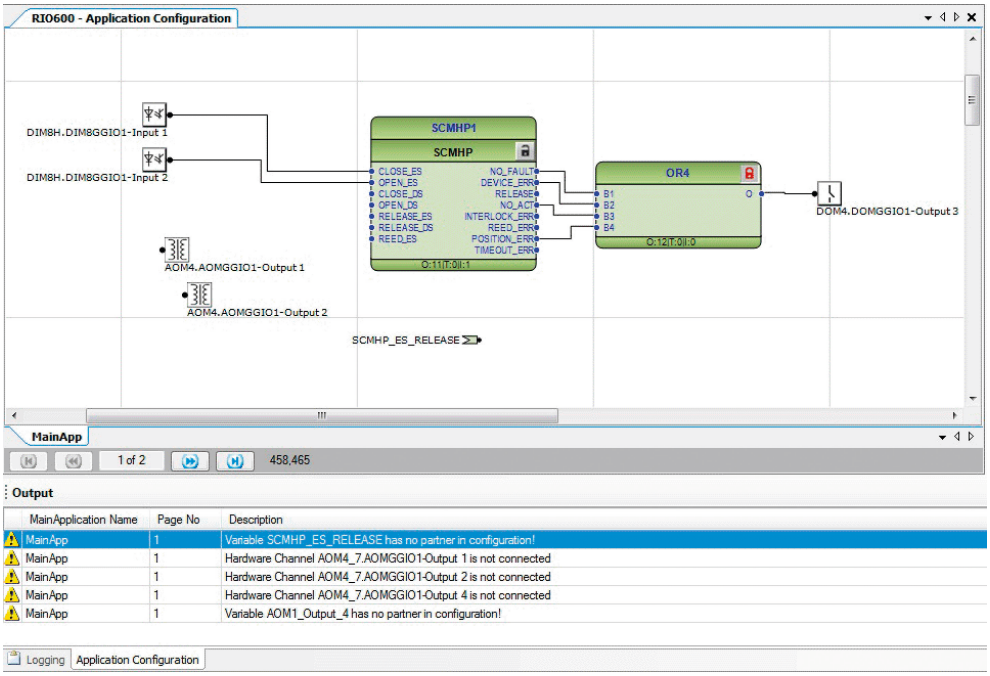

Figure 78: Validation on demand

9.1.5.3 Validation when writing to the IED

When writing the application configuration to the IED, an automatic validation is performed. The validation is the same as the one demanded manually.

9.2 Starting the Application Configuration tool

1. In the **Plant Structure**, right-click a device and select **Application Configuration**.

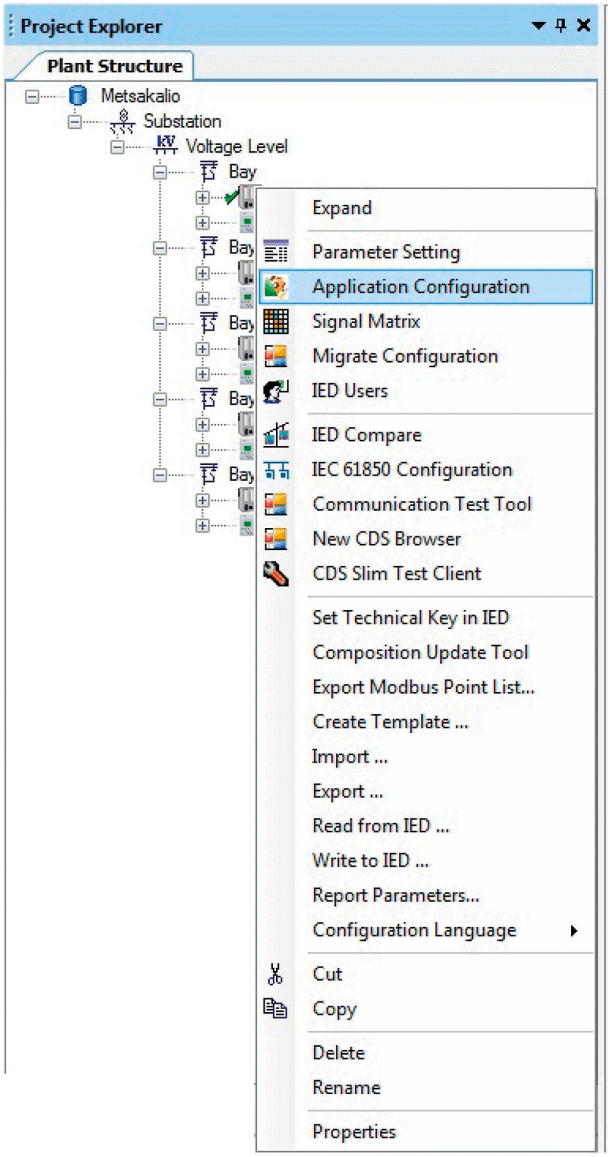

Figure 79: Selecting Application Configuration

2. Instantiate function blocks in Application Configuration after the IED configuration has been completed in PCM600.
   Binary and analog GOOSE receive blocks are automatically instantiated in Application Configuration based on the configurable outputs through GOOSE.

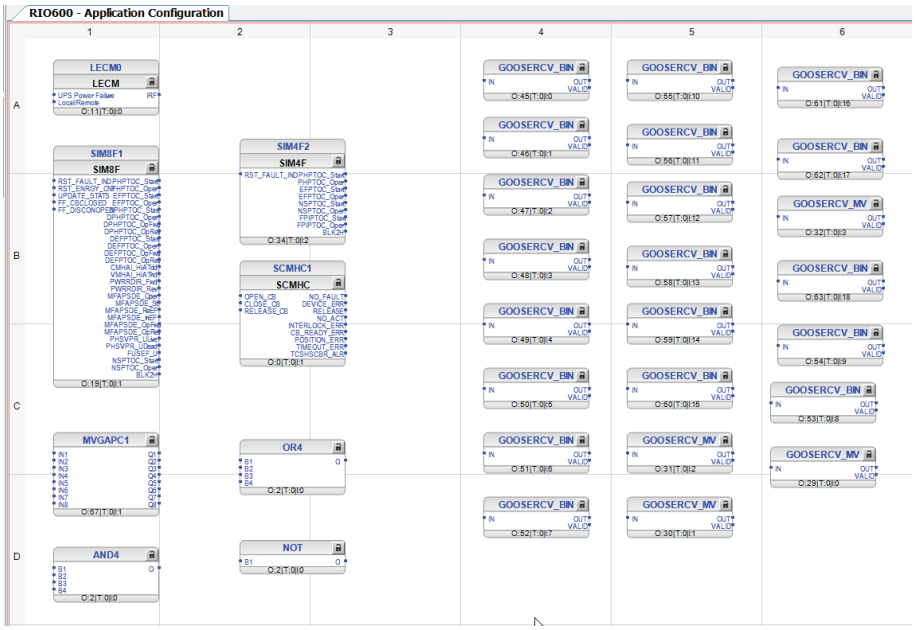

Figure 80: A basic configuration opened in Application Configuration

The creation or deleting of GOOSE receive blocks during the composition update, based on the available stack, is not supported.

The SIM8F blocks in Application Configuration have the input and output signals of the latest version even if the stack contains older SIM8F versions. When configuring, consider the signals which are not supported in an older version as nonfunctional.

Section 10 Using the IED Users Management tool

10.1 Managing IED users

The IED Users Management tool is used to configure new password in IED so that only authenticated users can perform read or write operation on the IED.

1. In the **Plant Structure**, right-click a device and select **IED Users**.

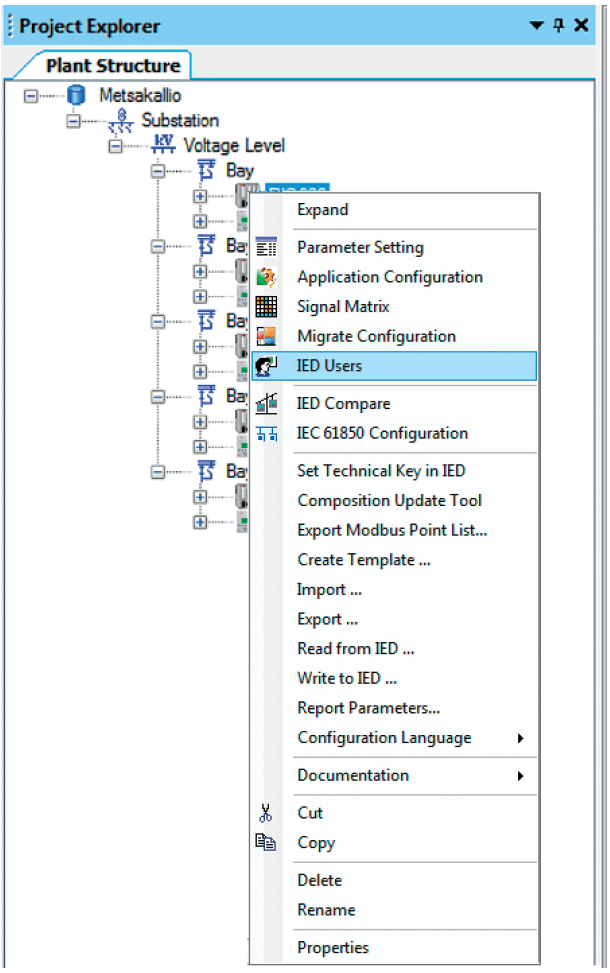

Figure 81: Selecting IED Users

2. Click **Change Password** to change the password.

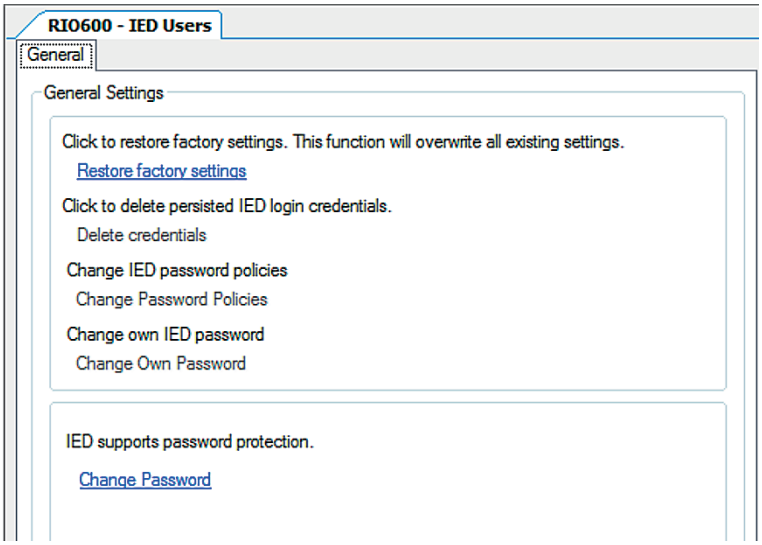

Figure 82: IED Users options

3. Enter the password.
4. Click **OK** to save or **Cancel** to discard the changes.

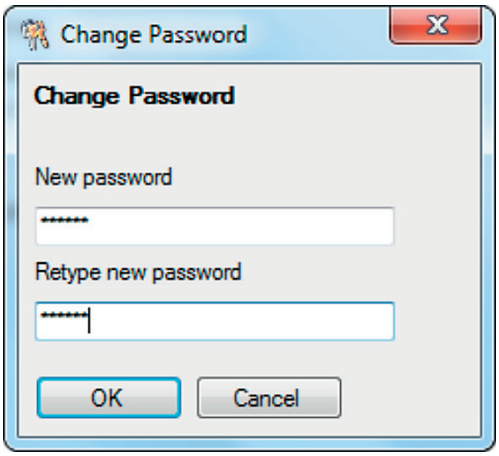

Figure 83: Enter password

5. Click the **Write User Management Settings to IED** button to write the password to the IED.

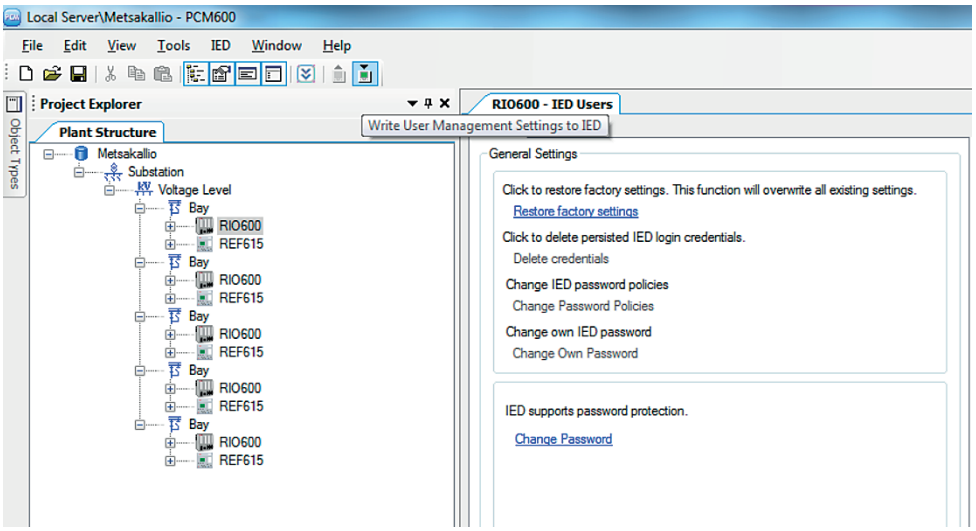

Figure 84: Clicking Write User Management Settings to IED

6. Click **Yes** to confirm the password change.

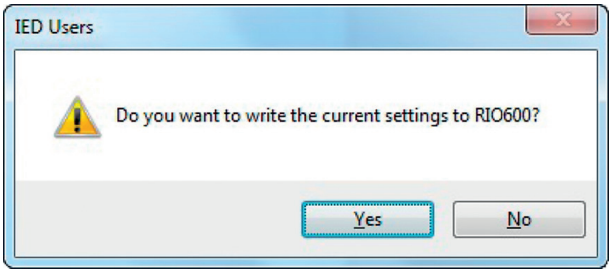

Figure 85: Changing the password in the IED

7. Click **Restore Factory Settings** to restore the default password.
8. Click **Yes** to update the settings with the default settings.

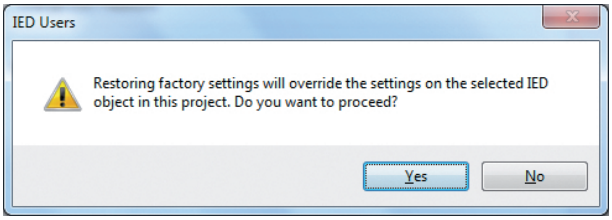

Figure 86: Restoring the default password

It is advisable to change the default "ADMINISTRATOR" password immediately after the configuration.

RIO600 supports only one user credential for “ADMINISTRATOR”.

Section 11 IED Configuration Migration (ICM)

11.1 Starting IED Configuration Migration

The IED Configuration Migration tool is used to update a lower RIO600 version IED configuration to a higher version.

1. In the **Plant Structure**, right-click the device and select **Migrate Configuration**.

The Migrate Configuration option is visible only if the IED is configured in an older version.

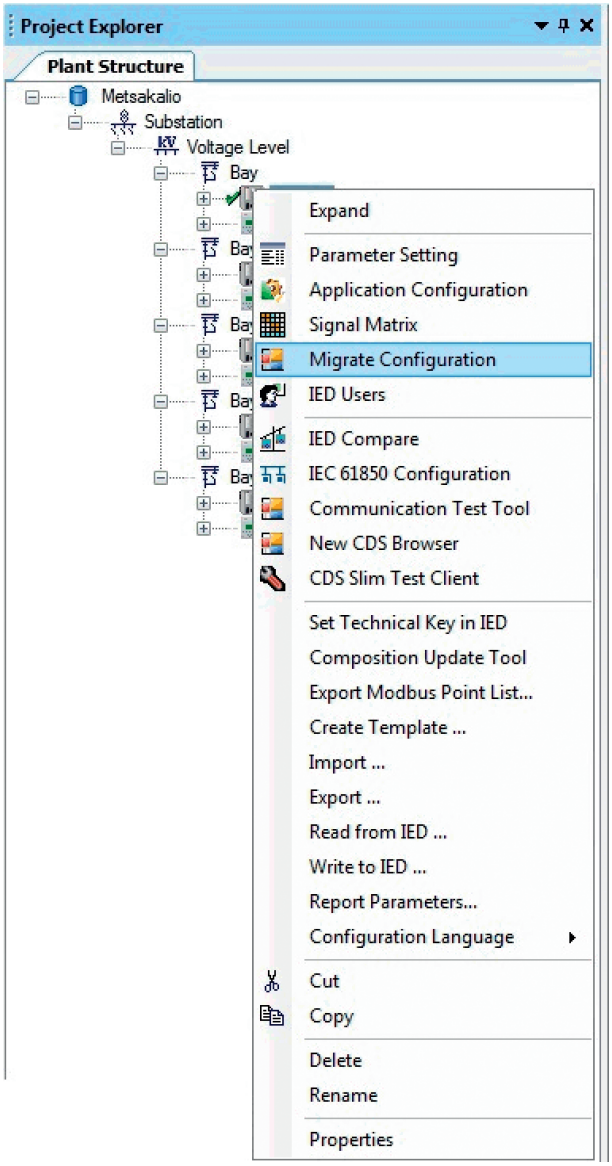

Figure 87: Selecting Migrate Configuration

The **Migrate Configuration** dialog box opens.

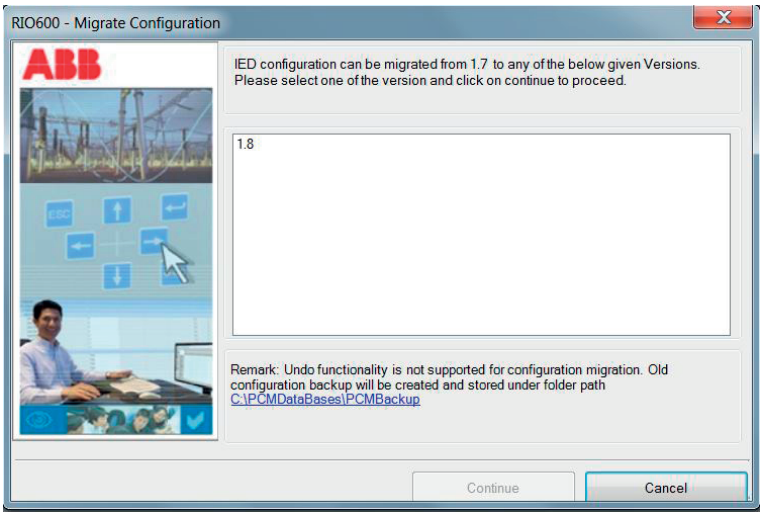

Figure 88: Migrating configuration

2. In the **Migrate Configuration** dialog box, select any of the available higher versions and click **Continue**.

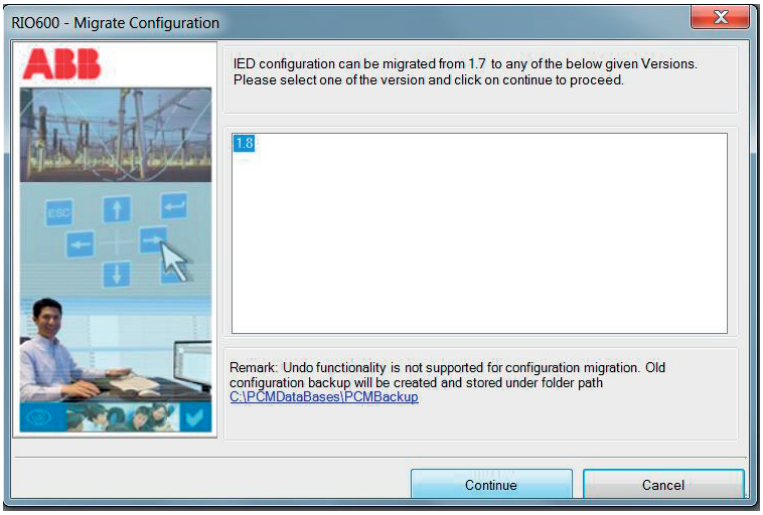

Figure 89: Selecting the IED version

3. In the **IED Configuration Migration Details** dialog box, click **Next** to proceed. Information about the functions and hardware module, which can be replaced in the migration process, is available in the **IED Configuration Migration Details** dialog box.

Version changes shown in the **IED Configuration Migration Details** dialog box do not represent the actual hardware module versions but the function block revisions.

4. In the **IED Configuration Migration** dialog box, wait until all the steps are completed and click **Finish**.

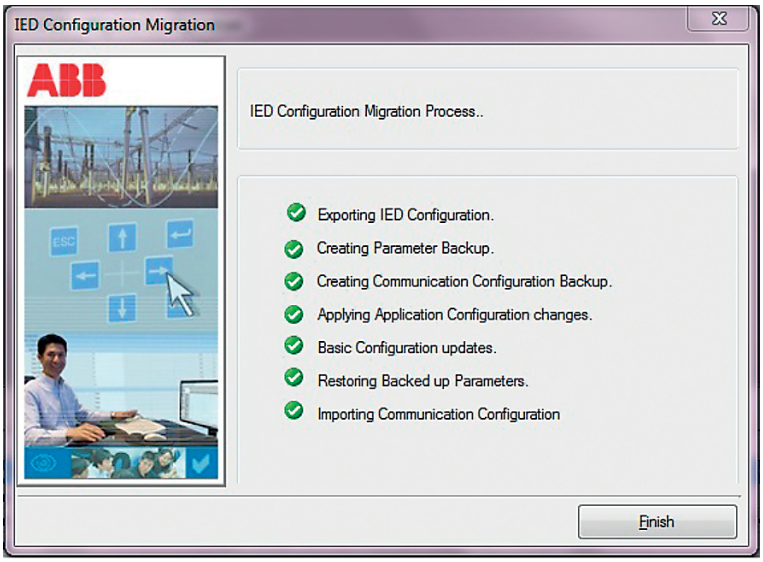

Figure 90: Viewing the IED Configuration Migration progress

5. Click **Finish** to complete the migration process.

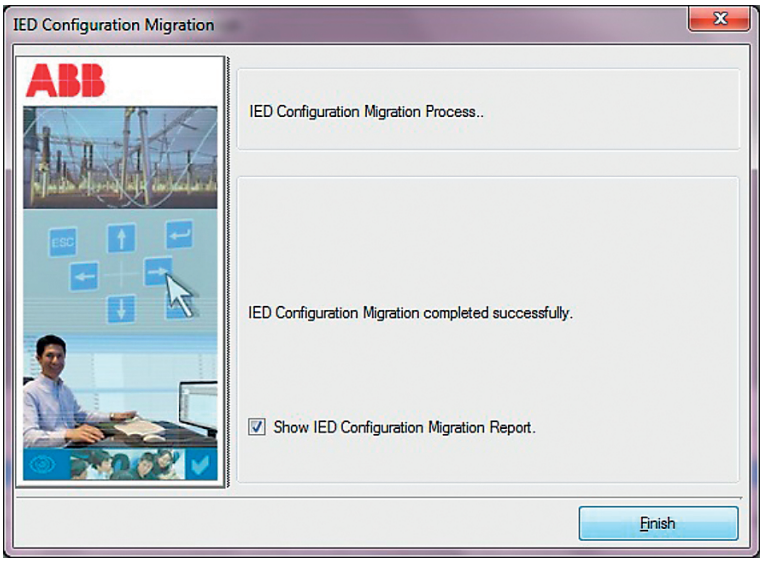

Figure 91: IED Configuration Migration complete

6. Report for migration of configuration is shown after the migration process.

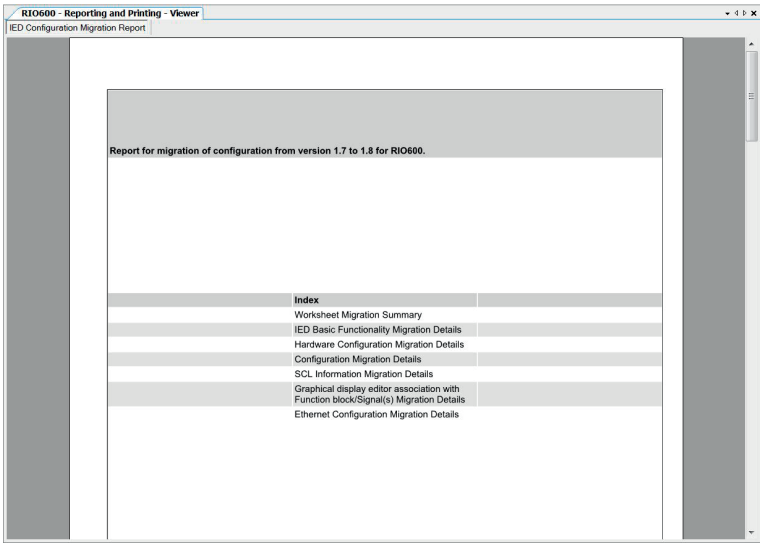

Figure 92: IED Configuration Migration report

Move the overlapping SIM8F function blocks (if any) in Application Configuration after IED migration from version 1.5 to 1.8 or newer.

Section 12 Common Read/Write (CRW)

12.1 Starting Read/Write

The Common Read/Write pane is used for both reading from the IED and writing to the IED.

1. In the **Plant Structure**, right-click the device and select **Read from IED** or **Write to IED**.

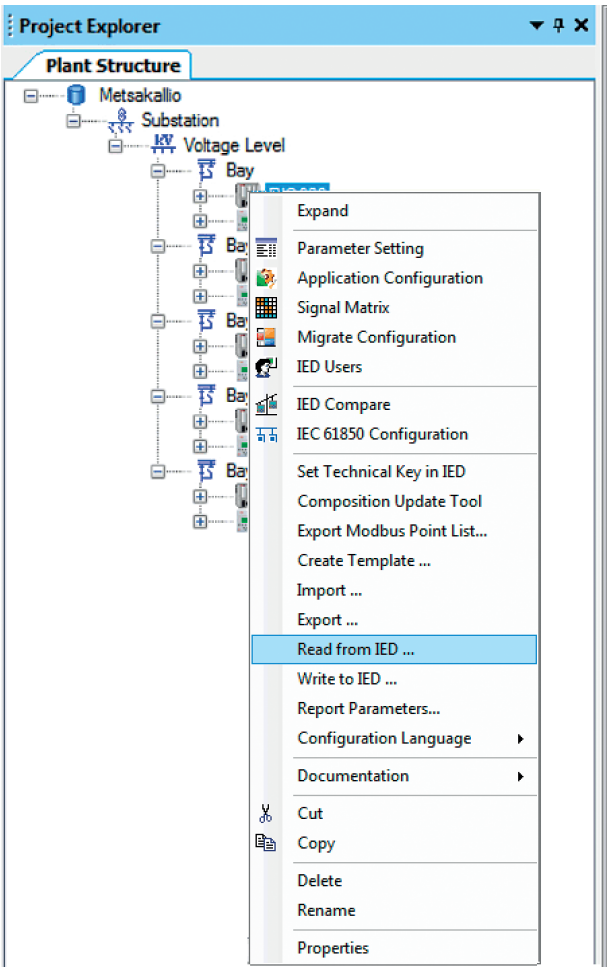

Figure 93: Reading configuration from the IED

The **Common Read/Write** pane is added to the tool.

2. In the **Read/Write** dialog box, click **Yes** to proceed.

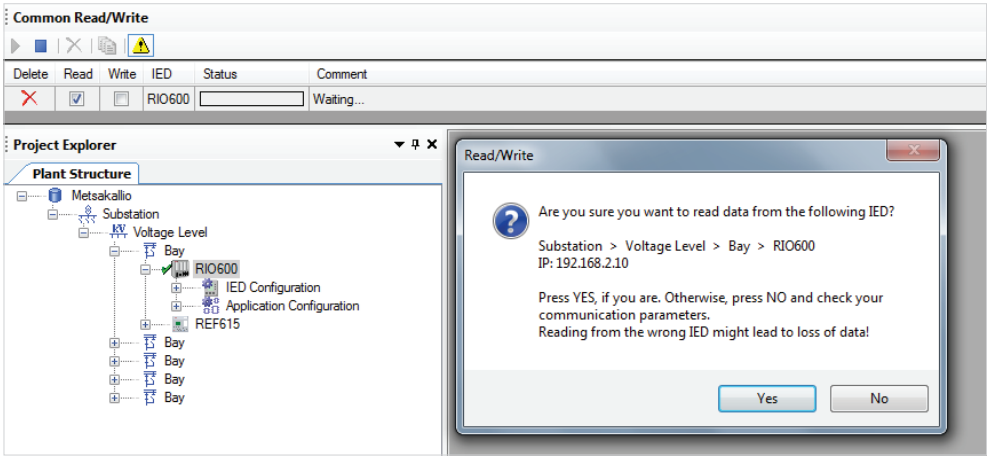

Figure 94: Confirming the read operation

- Click **No** to cancel the read or write operation.

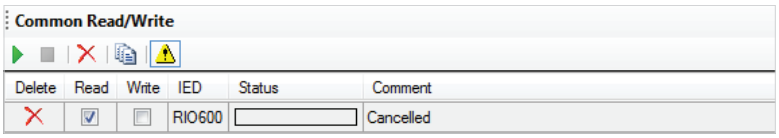

Figure 95: Cancelling the operation

- To switch between the read and write operations, use the check boxes in the **Common Read/Write** pane.

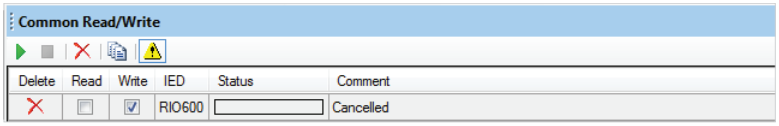

Figure 96: Switching between the operations

- To restart the read or write operation, click in the **Common Read/Write** pane. If the technical keys in both the IED and PCM600 match, the writing operation begins. The status progress bar and the comment fields show the progress.

If the communication settings of the IED do not match with the communication settings of the Parameter Setting tool, the IED Write dialog box opens.

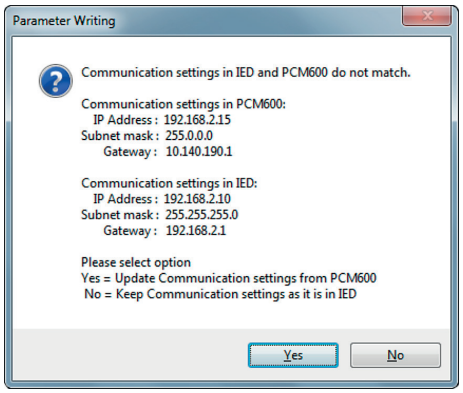

Figure 97: Mismatch between the communication settings of the IED and Parameter Setting

If there is no GOOSE engineering in the IED, for example, because of a missing configuration, the IED Write dialog box opens.

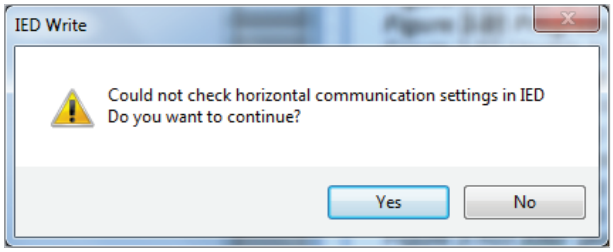

Figure 98: Failing to check IED's GOOSE settings

If the IEC 61850 SCL editions of the IED and PCM600 differ, the Error dialog box opens during the common read and write operations.

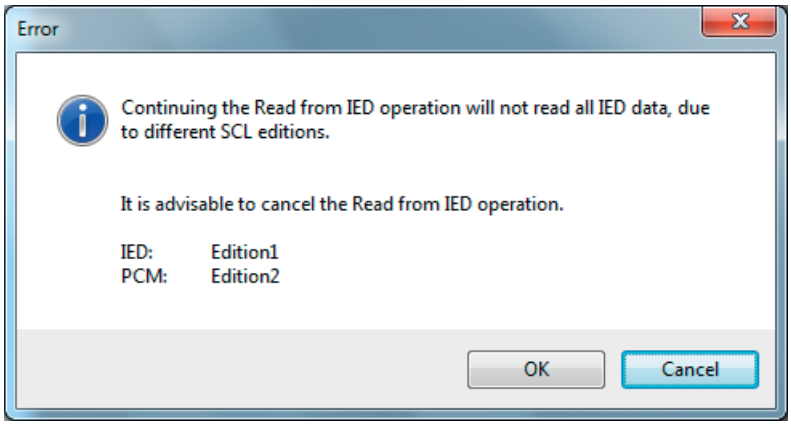

Figure 99: Difference in SCL versions during the common read operation

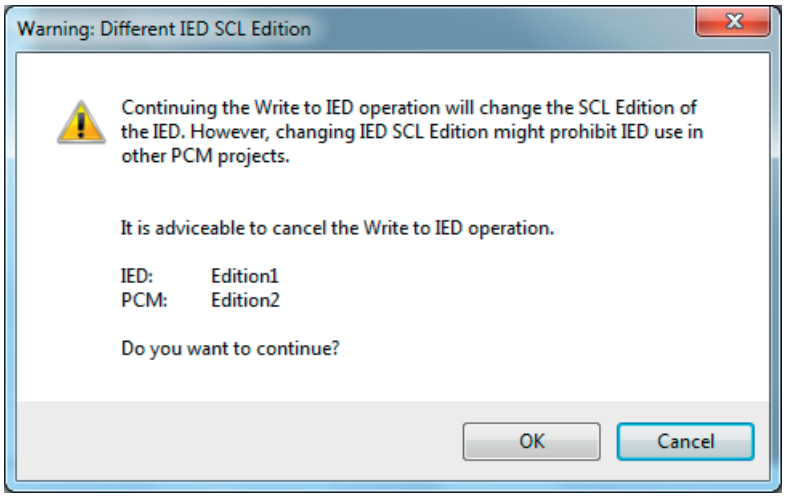

Figure 100: Difference in SCL versions during the common write operation

If the RIO600 stack contains two SIM8F/SIM4F modules at the maximum and is configured with GOOSE, the Question dialog box opens if the *GCB Mintime* and *Maxtime* settings are not within the suggested limits.

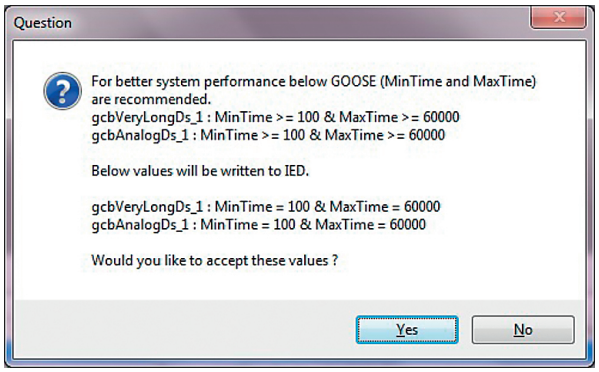

Figure 101: Failing to check the IED's GCB settings with two SIM8F/SIM4F modules at the maximum

If the RIO600 stack contains more than two SIM8F/SIM4F modules and is configured with GOOSE, the Question dialog box opens if the *GCB Mintime* and *Maxtime* settings are not within the suggested limits.

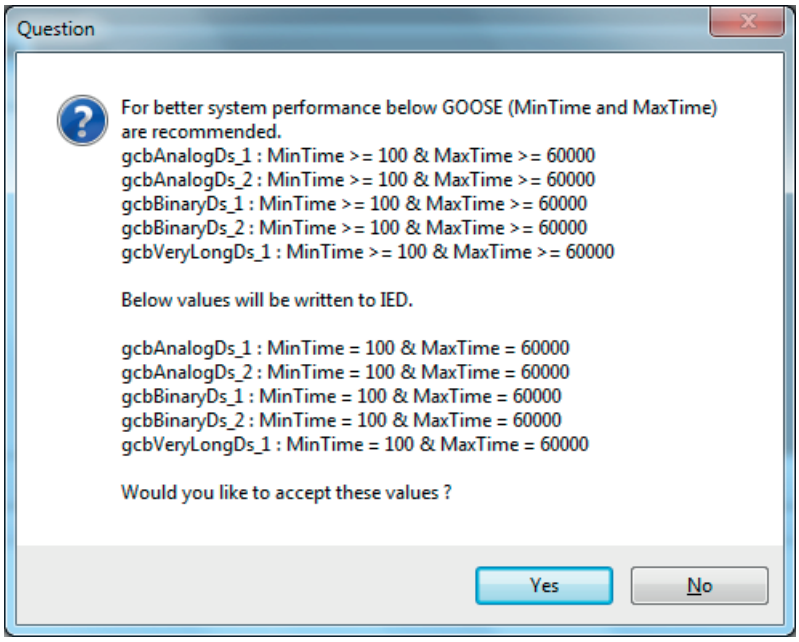

Figure 102: Failing to check the IED's GCB settings with more than two SIM8F/SIM4F modules

If the RIO600 stack consists of more than two SIM8F/SIM4F modules, the preferred *GCB Mintime* and *Maxtime* settings are set to all GOOSE control blocks in the IED object.

The accepted values of *GCB Mintime* and *Maxtime* are updated in PCM600 only after a common read operation.

If the GOOSE configuration in the IED does not match with the GOOSE configuration in PCM600, the IED Write dialog box opens. The GOOSE option should either be selected to write the GOOSE configuration in PCM600 to IED or cleared to keep the GOOSE configuration as it is in the IED.

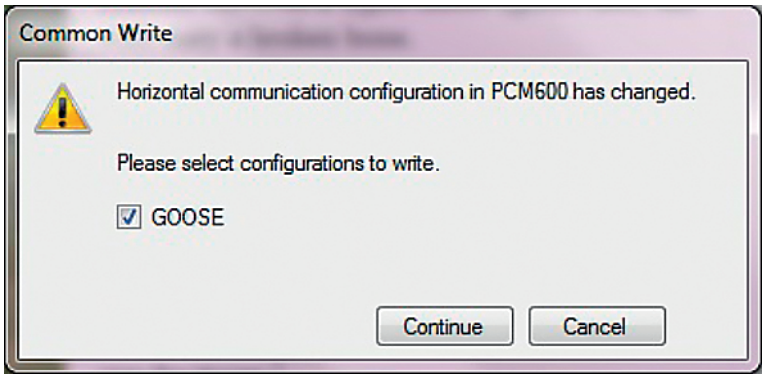

Figure 103: Mismatch between the GOOSE settings of the IED and PCM600

If any of the module firmware revisions in PCM600 do not match with the actual hardware modules in the stack, a mismatch dialog box opens. It provides position information of the firmware revision that does not match between PCM600 and RIO600 stack. A composition update is needed to proceed further.

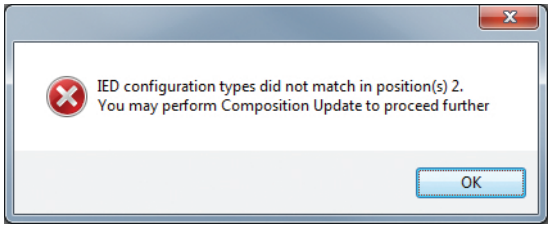

Figure 104: Revision mismatch dialog box

The IED reboots after all the required data is written to the IED. The procedure is the same when reading data from the IED, except that the IED should not be restarted in between operation.

The new installation parameter is not written during the common write operation.

The common write operation is cancelled under certain circumstances.

- If any structured data set entry is added
- If any single input is mapped to multiple outputs in Signal Matrix apart from the GOOSE receiver blocks
- If RIO600 subscribed to more than five GOOSE control blocks

Section 13 Using the Composition Update tool

The RIO600 composition is defined by the configuration wizard at the time the device is inserted to the project. Later the composition of an existing IED can be modified with CUT, for example, when removing or adding new modules to RIO600.

13.1 Configuring the device offline

1. In the **Plant Structure**, right-click RIO600 and select **Composition Update Tool**.

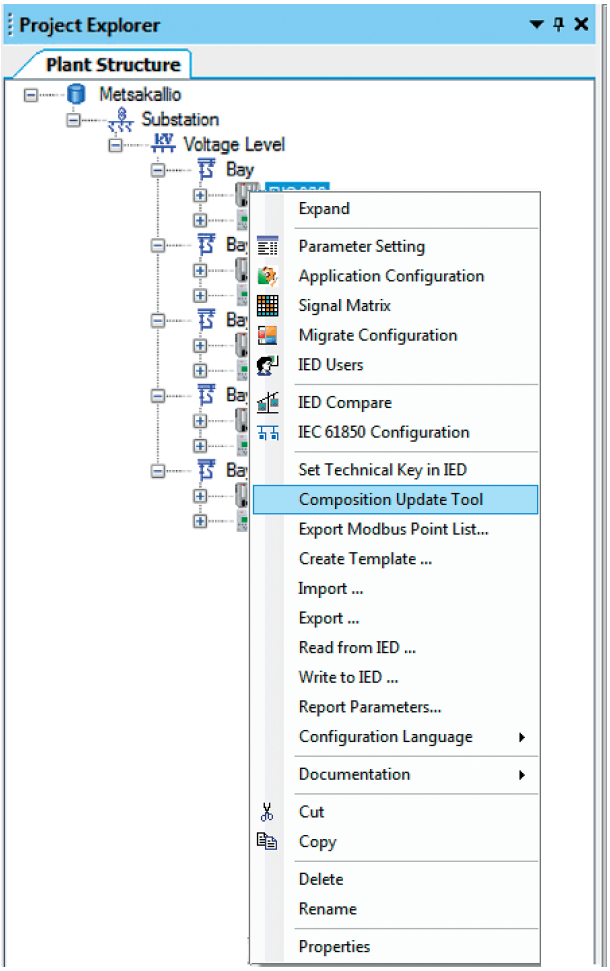

Figure 105: Selecting the Composition Update Tool

The **Composition update mode selection page** dialog box opens.

2. Under **Composition update mode selection**, select **Offline update** to configure the IED in offline mode and click **Next**.

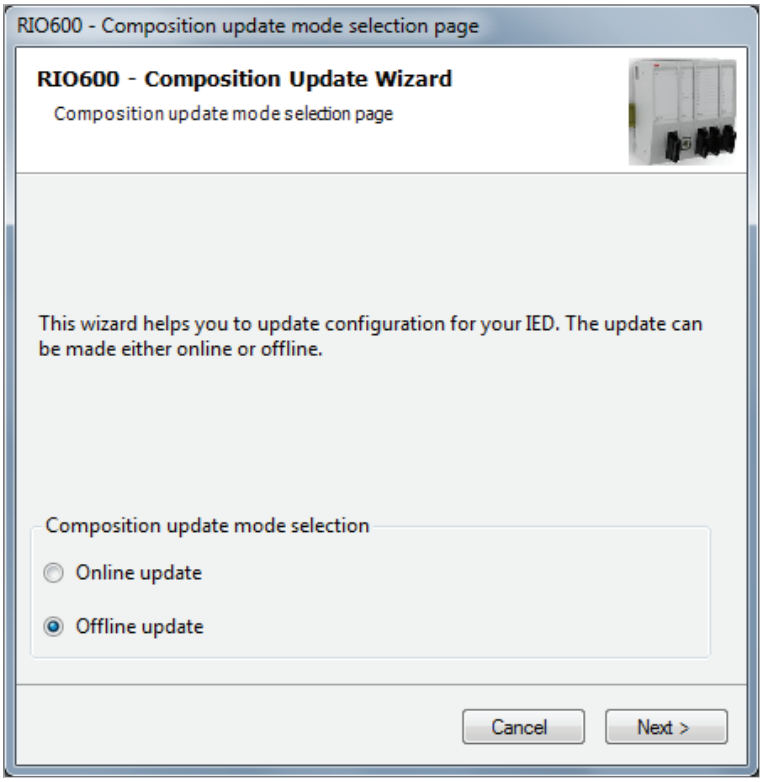

Figure 106: Selecting offline update in Composite Update tool

The **Composition selection page** dialog box opens and shows the existing configuration of the selected IED.

3. In the **Composition selection page** dialog box, add or remove modules or update the existing ones and click **Next** to navigate to the **Application Type selection page**.

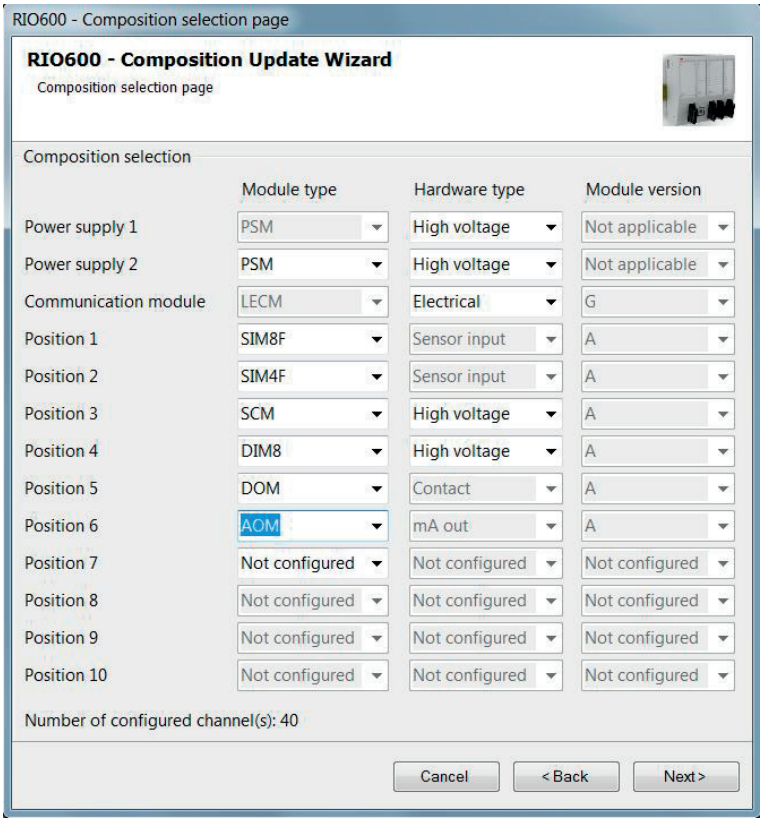

Figure 107: Modifying the current configuration

GOOSE re-engineering is required if a module is removed from the stack.

4. In the **Application Type selection page** dialog box, update the application types of the SCM modules, if required, and click **Next** to go to the IEC 61850 **Version Selection Page**.

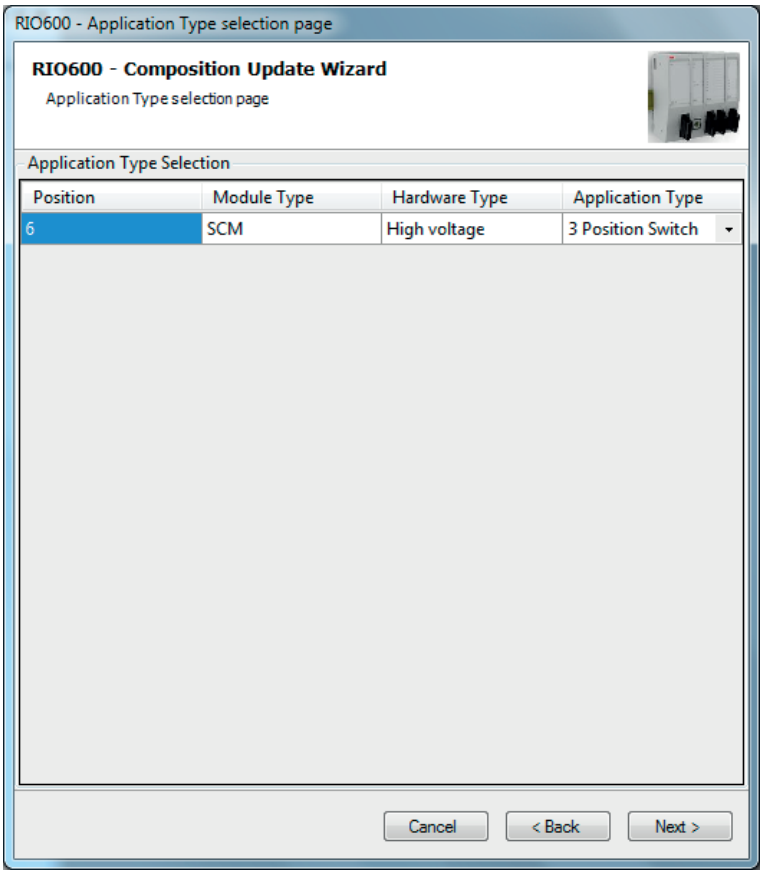

Figure 108: Selecting application types of the SCM modules

The **Application Type selection page** dialog box opens only, if at least one SCM module has been selected in the **Composition selection page**.

5. In the **Version Selection Page** dialog box, click **Next**.

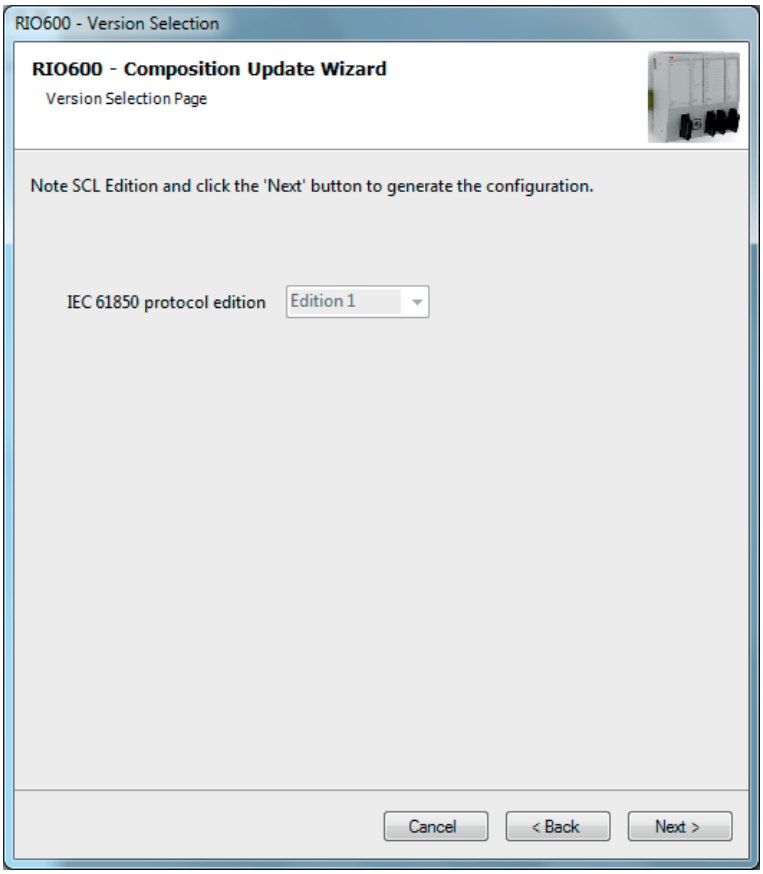

Figure 109: Selecting the IEC 61850 protocol edition

The **Composition Update Tool** dialog box opens with a message about the changes in the composition configuration.

6. In the **Composition Update Tool** dialog box, select one of the alternatives.
   - Click **No** to abort the operation.
   - Click **Yes** to generate the functions.

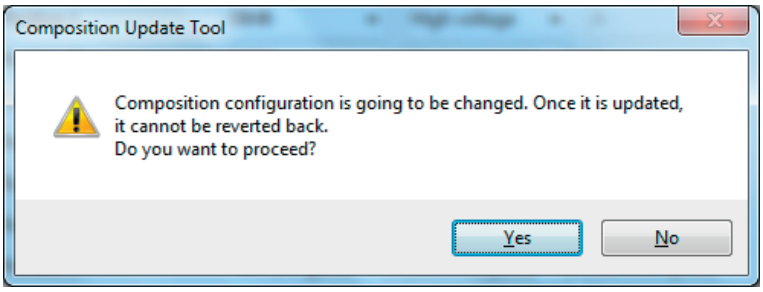

Figure 110: Detecting change in composition configuration

A progress bar is provided to show the status of the function generation.The **Setup complete page** is shown when the composition update is completed.

7. In the **Setup complete** dialog box, click **Finish**.
8. In the **Set Technical Key** dialog box, click **OK** to close the configuration update wizard.
   The **Plant Structure** is updated according to the hardware configuration. The available power supply modules in the RIO600 stack are represented as **PSMH/L** in **Plant Structure** under the **HW Configuration** node. Only the modules available under the **HW Configuration** represent the physical stack.

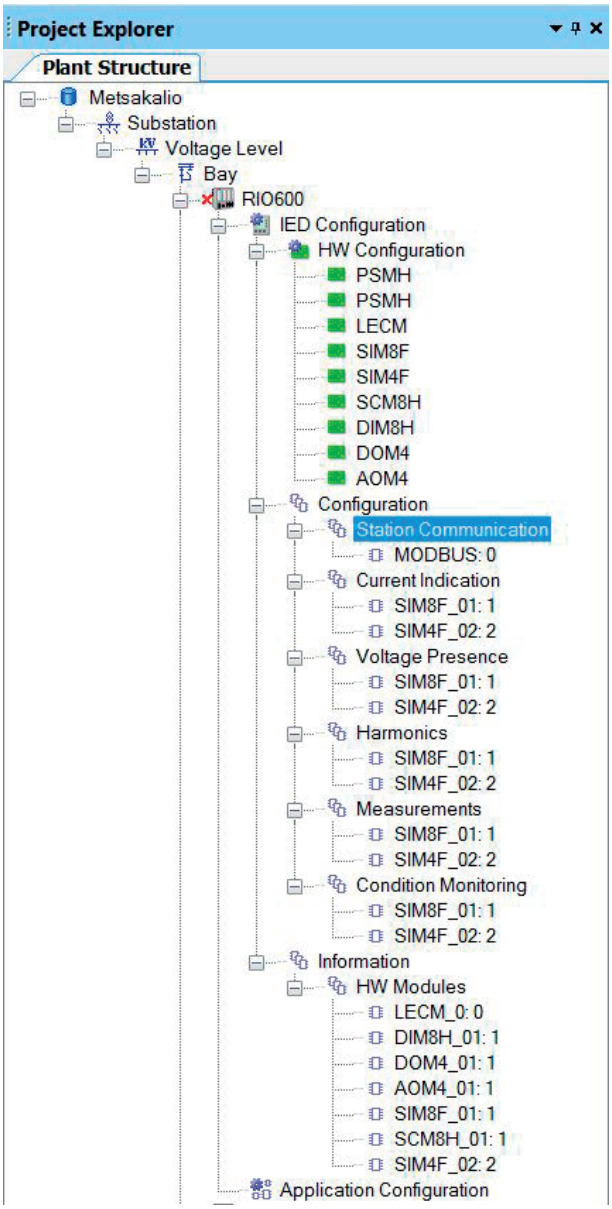

Figure 111: Updating the Plant structure

The module instances are created based on the module type.

Default data sets for the new modules are not created if the maximum supported number of data sets has been reached. The changes made to the default data sets are not retained on addition of modules to the stack. Data set entries appended into the existing data sets during the Composition Update Tool operation are not reflected to the subscribed IEDs before the data set is resubscribed (unsubscribed and subscribed) in the IEC 61850 Engineering tool. The Signal Matrix signal mapping in the subscribed IED is not retained for the modified data sets and re-engineering is required. The default data sets created for a stack with more than two SIM8F/SIM4F modules contain only the data entries of first two SIM8F/SIM4F module instances.

During the offline configuration, some modules, such as DOM4, AOM4 or SIM8F, are created with the latest module versions. However, during commissioning, the versions can be updated using the online composition update tool. In online configuration, the configuration is generated based on the available versions of the modules in the physical stack.

13.2 Configuring the device online

1. In the **Plant Structure**, right-click RIO600 and select **Composition Update Tool**.
   The **Composition update mode selection page** dialog box opens.
2. Under **Composition update mode selection**, select **Online update** to configure the IED in online mode and click **Next**.

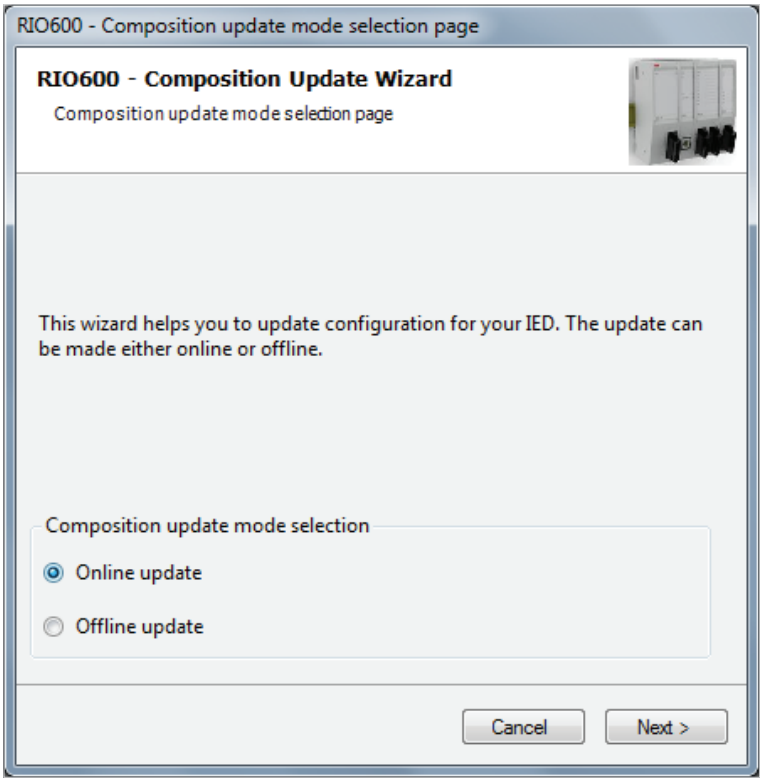

Figure 112: Selecting online update in Composite Update tool

The **Composition detection page** dialog box opens and the hardware configuration is read from the device.

GOOSE re-engineering is required if a module is removed from the stack.

3. In the **Composition detection page** dialog box, wait until the hardware configuration is read from the device and click **Next** to navigate to the **Application Type selection page**.

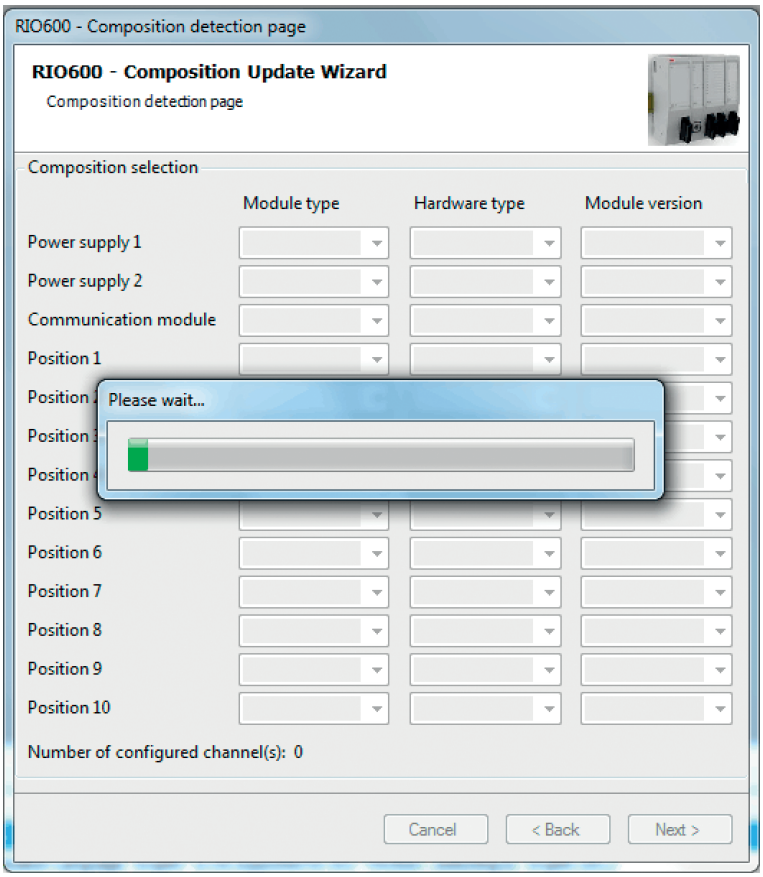

Figure 113: Viewing the composition scan

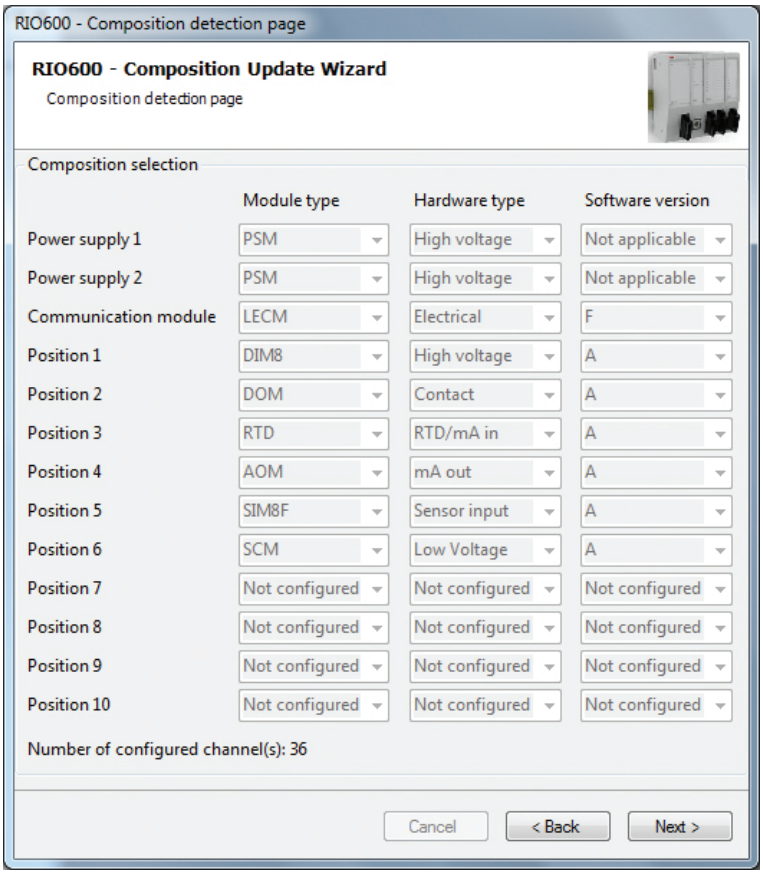

Figure 114: Viewing the current configuration in online mode

4. In **Application Type selection page** dialog box, configure the application types of all the SCM modules in the stack.

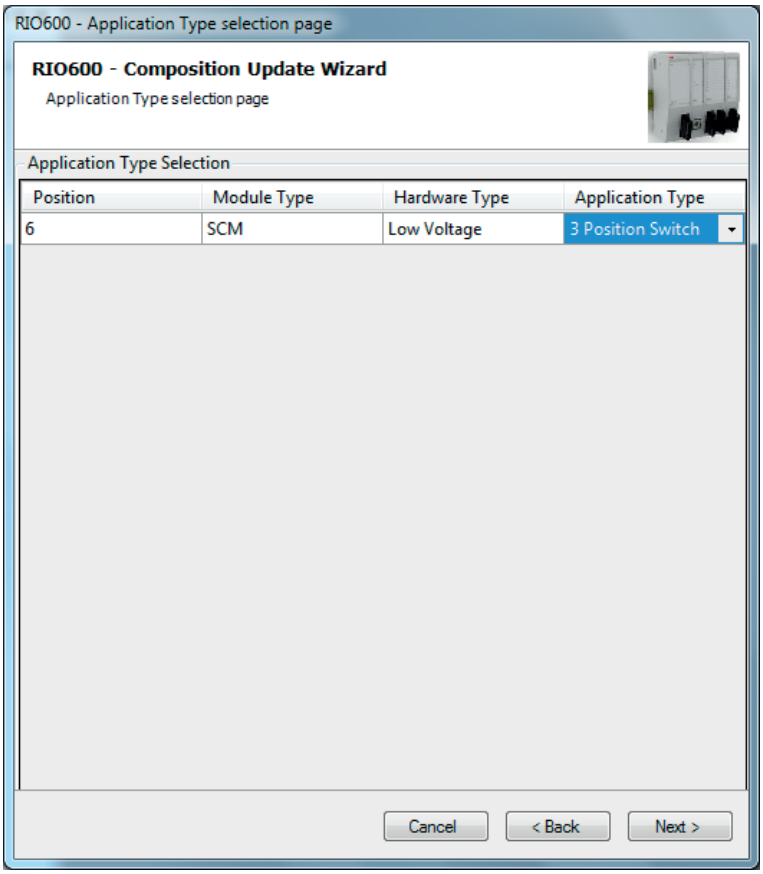

Figure 115: Selecting application types of the SCM modules

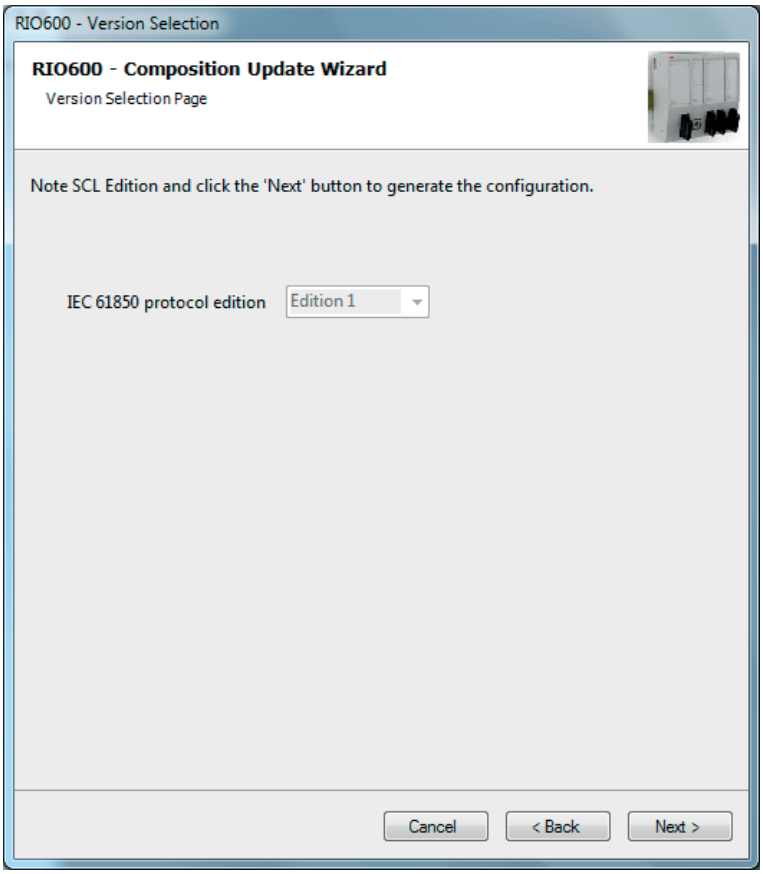

Figure 116: Viewing the IEC 61850 protocol edition

4.1. Click **Next** to navigate to the IEC61850 **Version Selection Page**.
4.2. Click **Yes** to confirm the function generation and wait until the composition has been updated.
The **Setup complete page** dialog box is shown when the generation has been successfully completed.

Application Type selection page is shown to the user only, if the **Composition detection page** contains at least one SCM module.

5. In the **Setup complete** dialog box, click **Finish**.

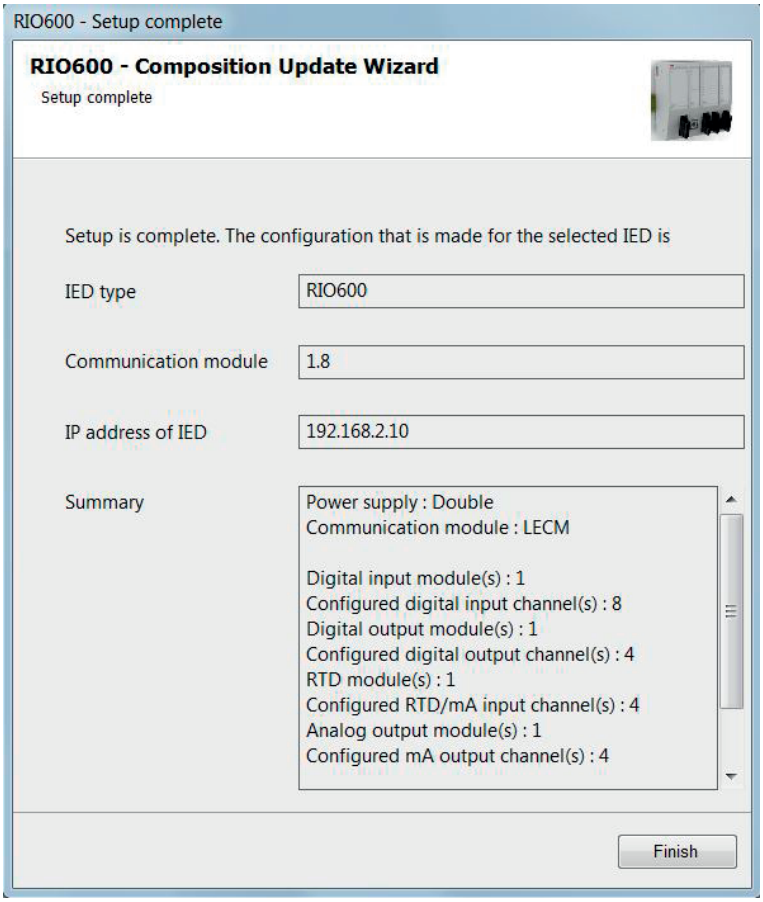

Figure 117: Viewing the updated summary page in online mode

The **Plant Structure** is updated according to the hardware configuration and the summary of the configuration wizard selections is displayed. Click **Finish** to close the configuration wizard setup and the **Plant Structure** is updated for the selected IED.
The available power supply modules in the RIO600 stack are represented as **PSMH/L** in **Plant Structure** under the **HW Configuration** node. Only the modules available under **HW Configuration** represent the physical stack.

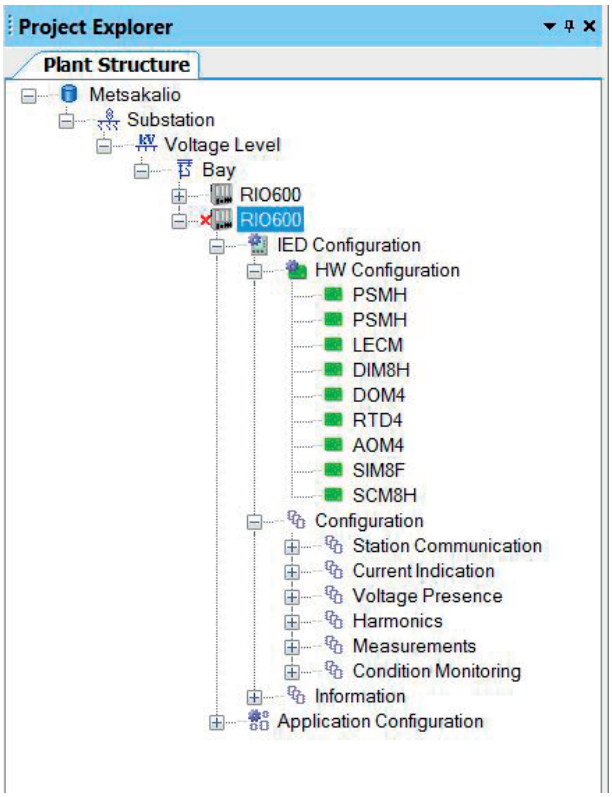

Figure 118: Viewing the updated Plant Structure

The module instances are created based on the module type.
Default data sets for the new modules are not created if the maximum supported number of data sets is reached. The changes made to the default data sets are not retained on addition of modules to the stack. Data set entries appended into the existing data sets during the Composition Update Tool operation are not reflected to the subscribed IEDs before the data set is resubscribed (unsubscribed and subscribed) in the IEC 61850 Engineering tool. The Signal Matrix signal mapping in the subscribed IED is not retained for the modified data sets and re-engineering is required. The default data sets created for a stack with more than two SIM8F/SIM4F modules contain only the data entries of first two SIM8F/SIM4F module instances.

Section 14 Using Export Modbus Point List

14.1 Exporting Modbus Point List

The Modbus data points of the configured RIO600 stack can be exported and saved either as a PDF or a CSV report.

For more information on the Modbus functionality and point list, see the installation and commissioning manual.

1. In the **Plant Structure**, right-click a device and select **Export Modbus Point List**.

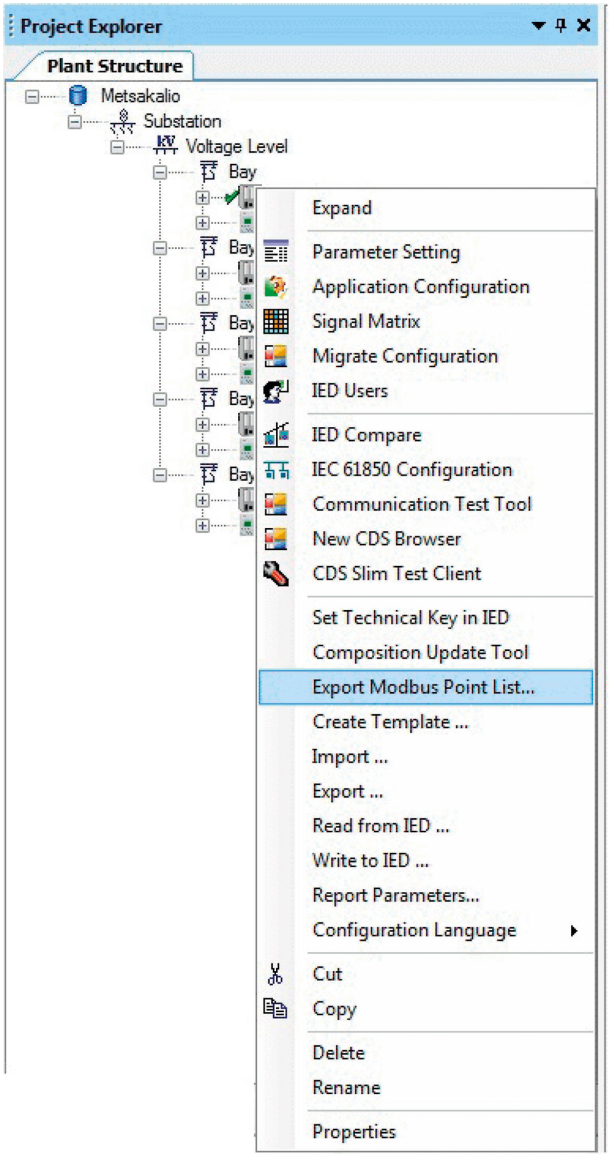

Figure 119: Selecting Export Modbus Point List

2. Generate the Modbus Point List in one of the alternative formats.
   - PDF Report
   - CSV Report

The report is generated based on the RIO600 stack and displayed in PCM600. Regardless of the Modbus format, the point list report contains the details of the configured stack with the corresponding position and Modbus data points for signals/channels.

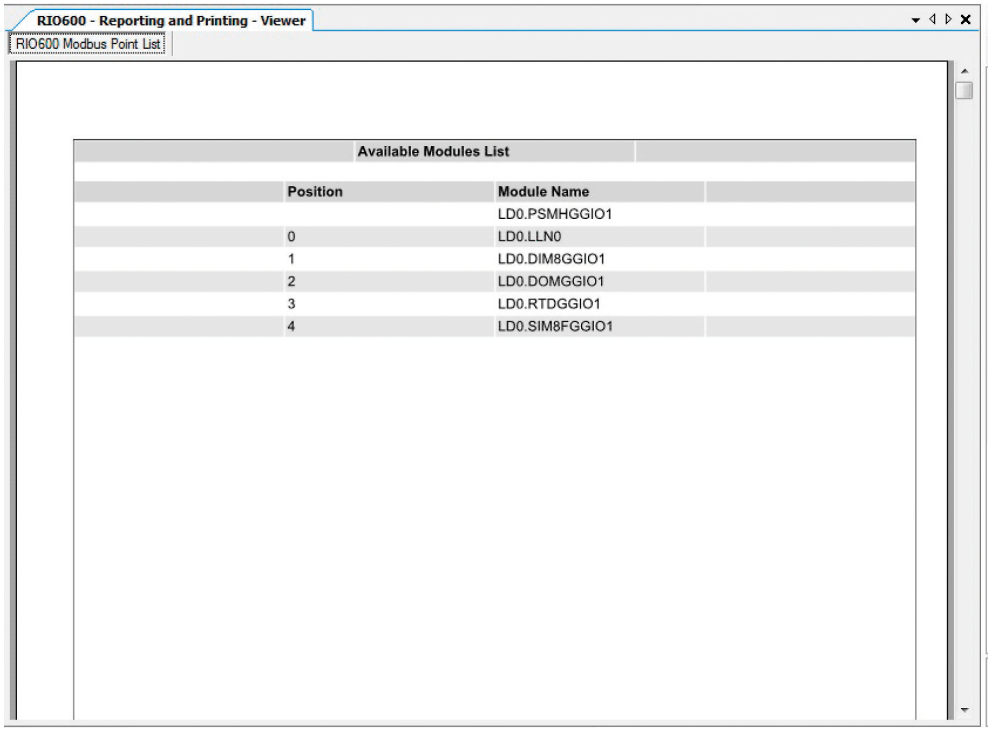

Figure 120: Modbus Point List in the PDF format

The position information for power supply modules is not in the report. The position index always starts from 0 and is fixed for LLN0, that is, LECM communication module.

Modbus data points for the available modules are categorized into different tables.

- 0X Mappings
- 1X Mappings
- 3X Mappings
- 4X Mappings

For more information on the Modbus standard data types, see the installation and commissioning manual.

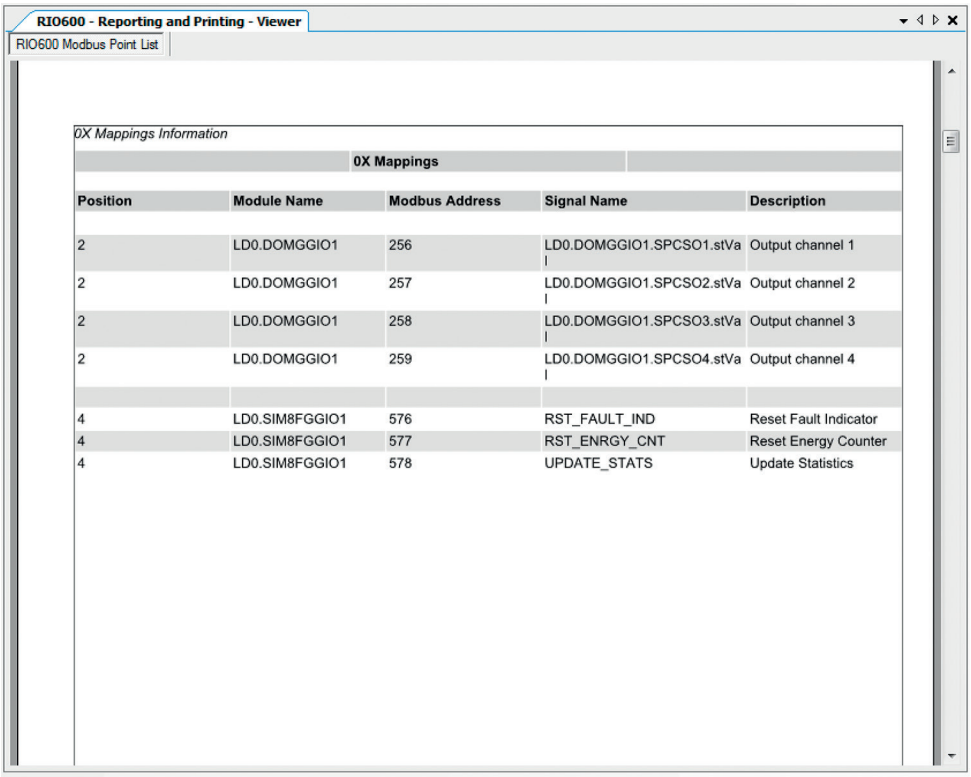

Figure 121: 0X Mapping in the PDF format

All the 0X Modbus addresses are provided under the 0X Mappings table with the position of the module, module name, Modbus address, signal name and signal description. The other standard data type addresses are also provided in the respective tables.

14.1.1 Generating PDF reports

1. In the **Select Report Type** dialog box, select **PDF Report** from the **File Type** list.
2. Click **OK** to generate the report in PDF format.
   - Click **Cancel** or **Close** button to cancel the operation.

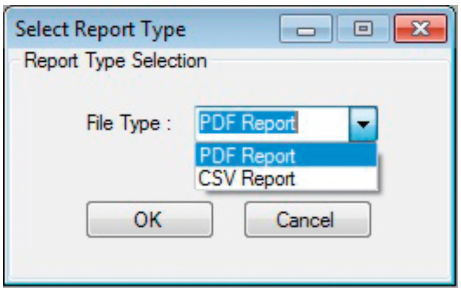

Figure 122: Selecting report type

3. To save the generated PDF Modbus Point List report, select **Save** on the toolbar.

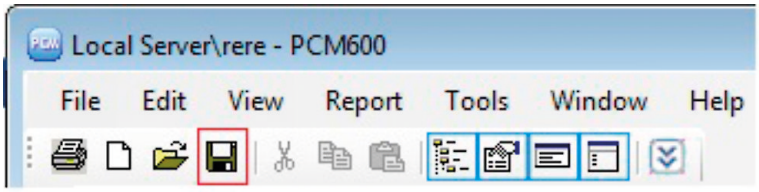

Figure 123: Saving the PDF report

4. To print and generate the PDF Modbus Point List, select **Print** on the toolbar.

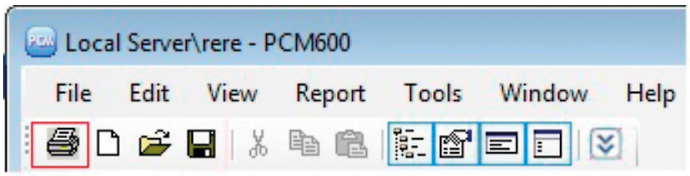

Figure 124: Printing the PDF report

5. To navigate between the available pages in the Modbus Point List report, use the options available on the **Report** menu.

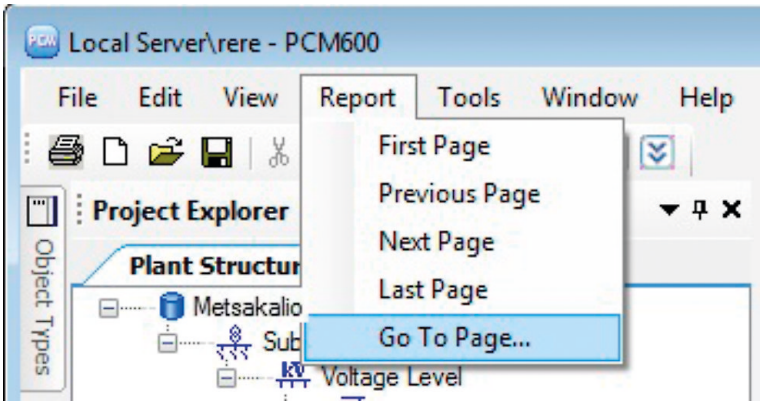

Figure 125: Navigating between the pages

14.1.2 Generating CSV reports

1. In the **Select Report Type** dialog box, select **CSV Report** from the **File Type** list.
2. Click **OK** to save the report in CSV format.

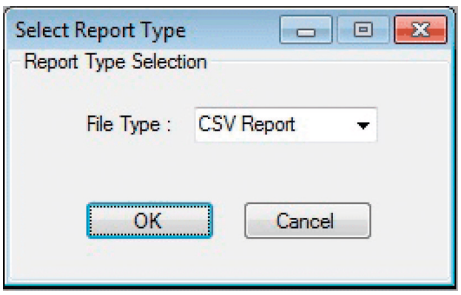

Figure 126: Selecting the report type

3. In the **Save as** dialog box, select the file destination and click **Save**.
   - Click **Cancel** to cancel the operation.

After the save operation, the file destination is provided in the Output pane in PCM600. The message includes the technical key information of the IED.

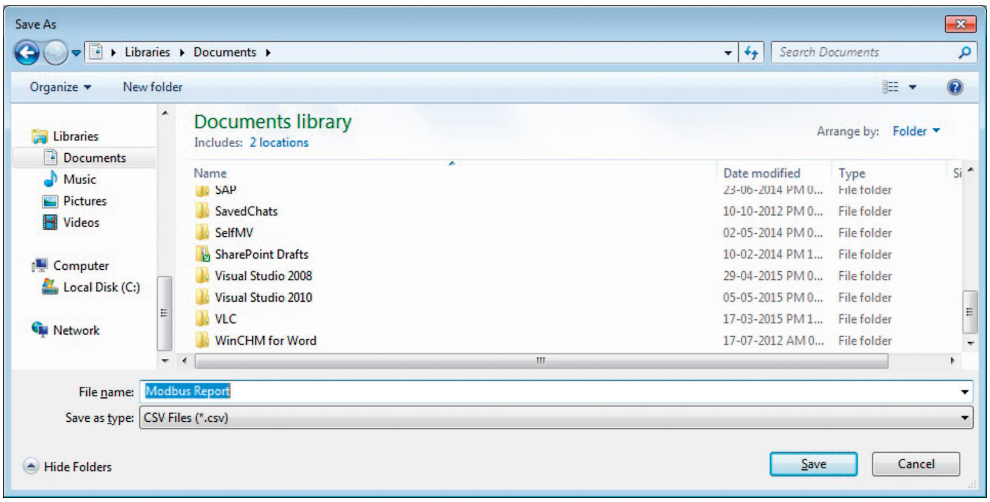

Figure 127: Saving the CSV report

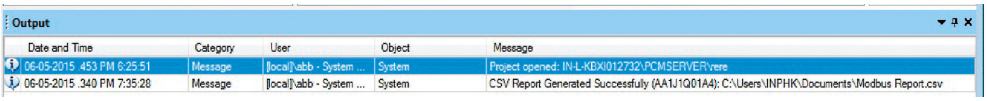

Figure 128: Information in the Output pane

Section 15 Using Export Configuration Files

15.1 Exporting Configuration Files

The configuration files for the RIO600 stack configured in PCM600 can be exported and saved in the local workstation. All the information related to configuration, parameters and application configuration layout can be exported to a ZIP file.

The final configuration ZIP file contains a number of XML files.

- RioConf.xml contains IEC 61850 information and signal mappings in Application Configuration and Signal Matrix
- IOParams.xml contains the parameter settings
- RIO_ACTLayout.xml contains the application configuration layout changes

The common write operation is used to export the configuration files. The Export Configuration Files option in the RIO600 tools menu is used to enable or disable the export operation. By default, the Export Configuration Files selection is cleared.

1. In the **Plant Structure**, right-click a device and select **Export Configuration Files**.

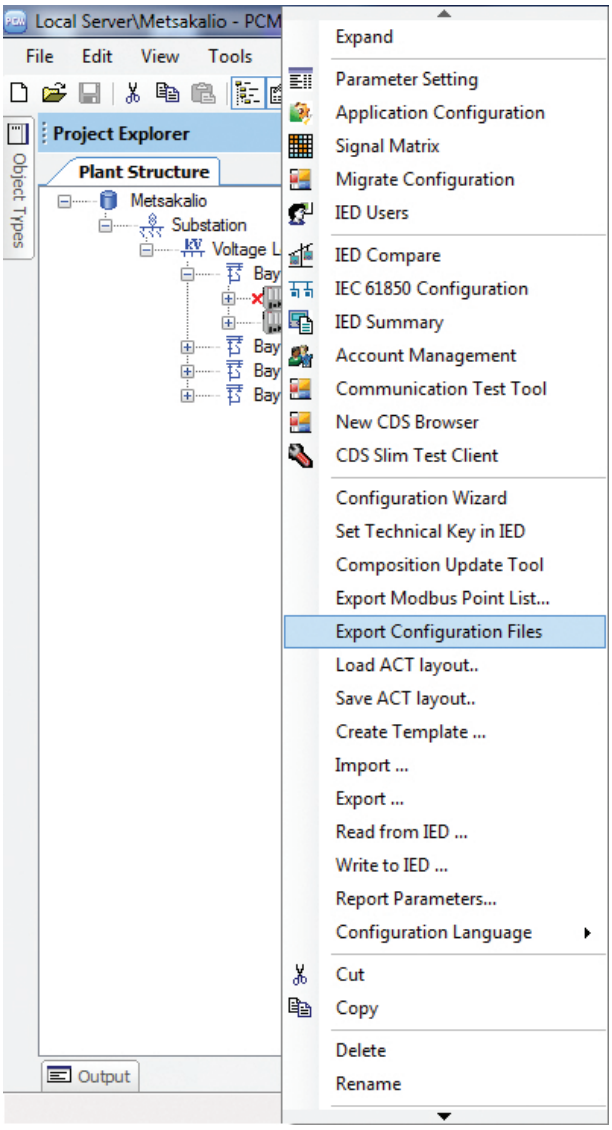

Figure 129: Selecting Export Configuration Files

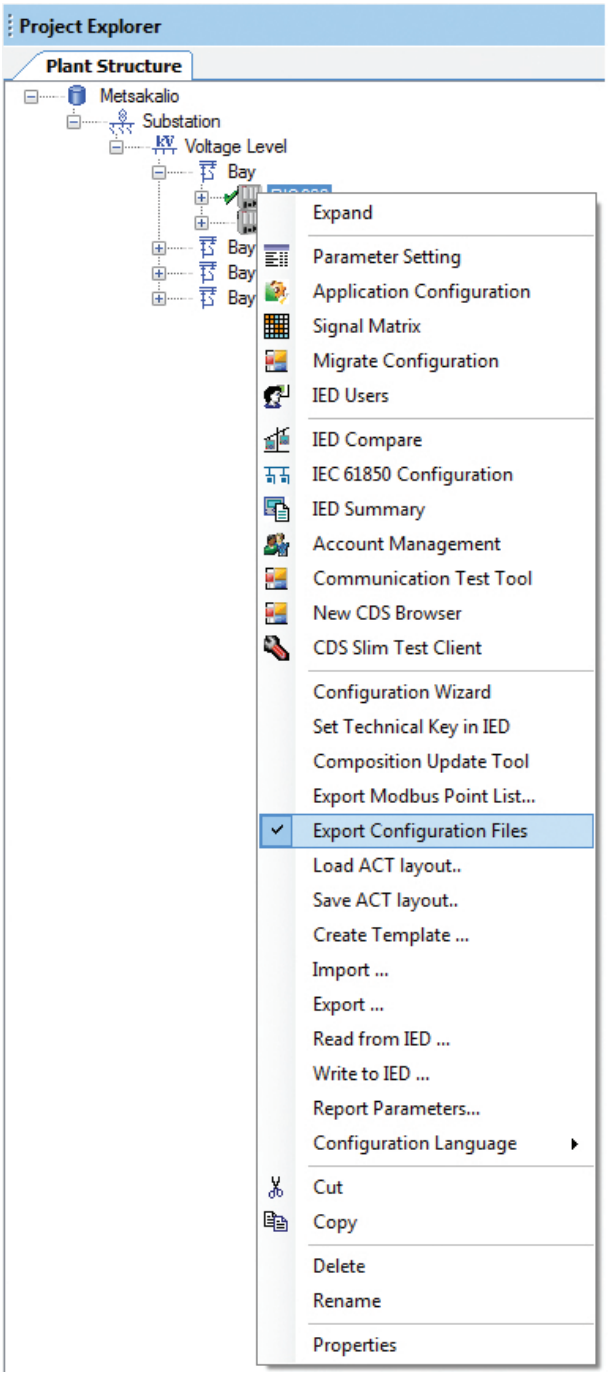

Figure 130: Enabling Export Configuration Files

Selecting **Export Configuration Files** enables the check box. The common write operation can export the configuration files to a local work station only if the **Export configuration Files** option is checked.

2. Click **Write to IED** to start the write operation.

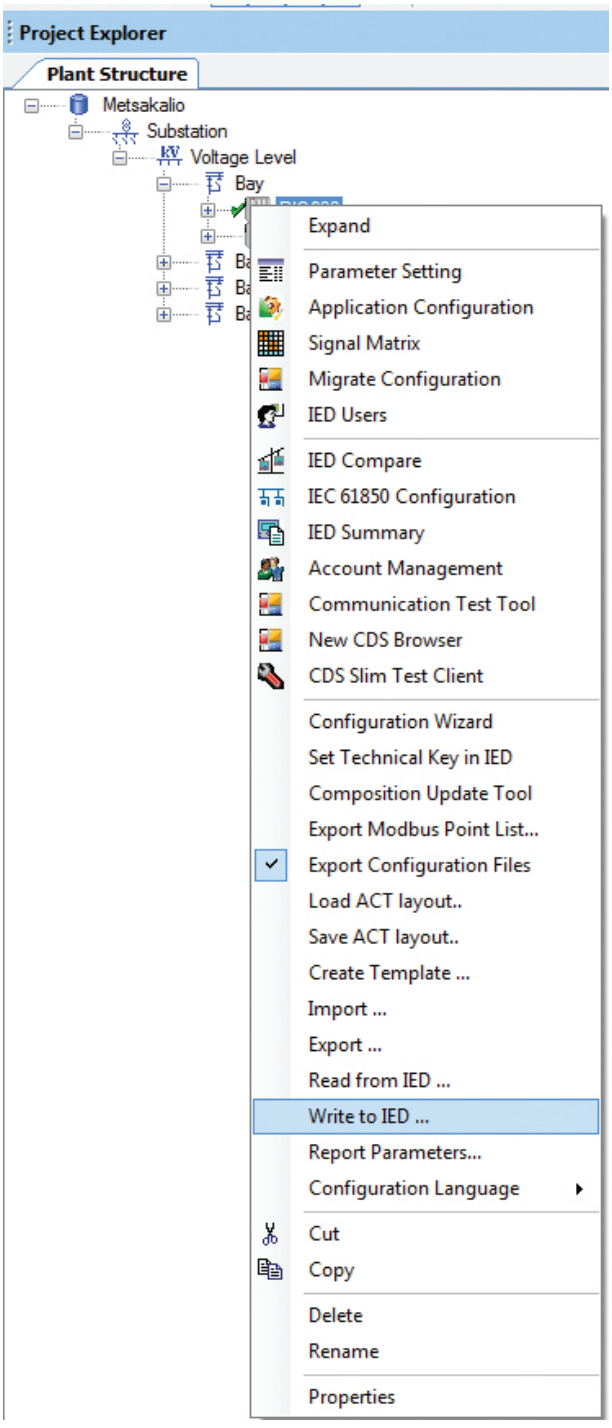

Figure 131: Selecting Write to IED

3. Click **Yes** to continue.

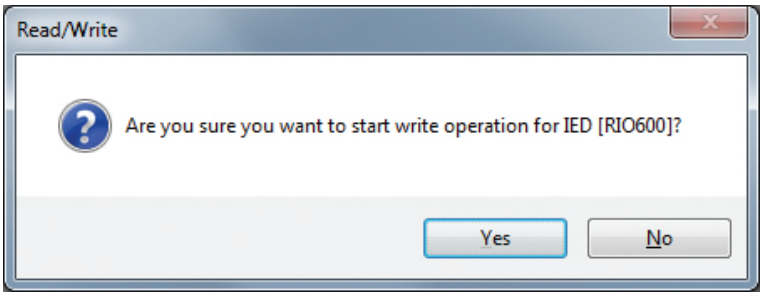

Figure 132: Starting the write operation

4. In the **Browse for Folder** dialog box, select a destination directory to save the configuration ZIP file and click **OK**.

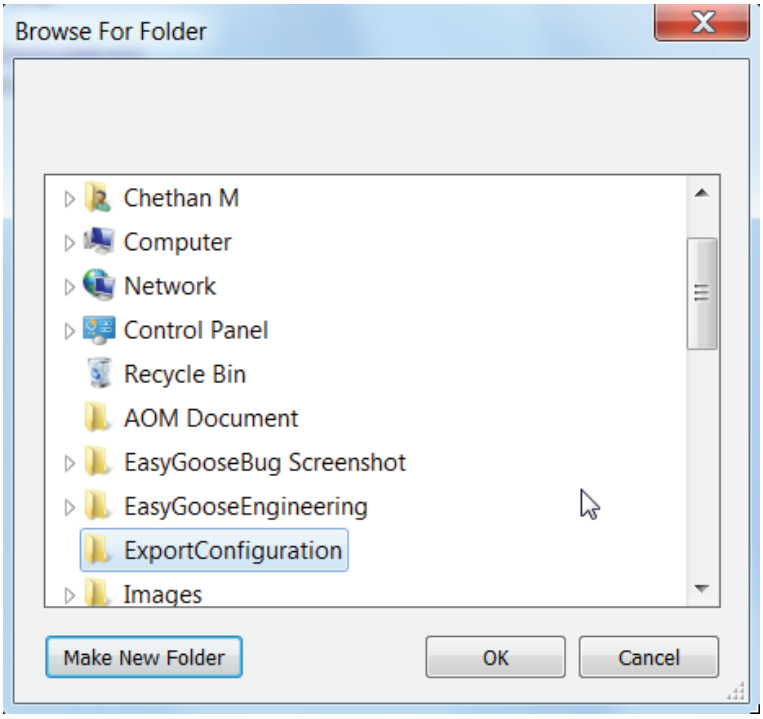

Figure 133: Selecting destination directory

After a successful write operation, all the configuration files are available in a ZIP file in the selected destination directory. The exported configuration file path is provided in the PCM600 Output message pane.

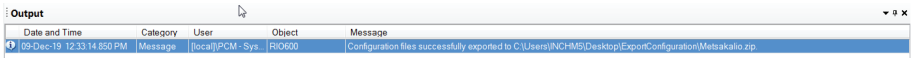

Figure 134: Exporting configuration successfully

The final folder structure is Destination directory\PCM600 Project name.zip.

Keep a local copy as a backup of the configuration written to the IED.

Section 16 GOOSE engineering

RIO600 exchanges data between IEDs by using GOOSE service over the IEC 61850 station bus. The IEC 61850 GOOSE is configured with the IEC 61850 Configuration tool in PCM600. When the published data is defined in the IEC 61850 Configuration tool, RIO600 sends it to the other IEDs and subscribes the data that the other IED sends.

16.1 Creating GOOSE data sets

The RIO600 connectivity package provides automatically the default GOOSE data sets. The connectivity package collects all the available inputs and module health data to these data sets. They can be directly taken into use in PCM600's IEC 61850 tool by creating a GOOSE control block and linking the available data set to it. If the user wants to create their own data sets, it is recommended to delete the existing ones and create a new one.

RIO600 supports a maximum of seven data sets in the application.

There are default data sets based on modules.

- One data set per each DIM8 H/L module
- One data set per two RTD modules
- One data set per all DOM/AOM modules
- One data set per each SIM8F/SIM4F module's analog data
- One data set per two SIM8F/SIM4F module's binary data
- One data set per two SIM8F/SIM4F module's very long data (Metering statistics)
- One data set per each SCM H/L module

1. In the **Plant Structure**, right-click **Substation** and select **IEC 61850 Configuration**.

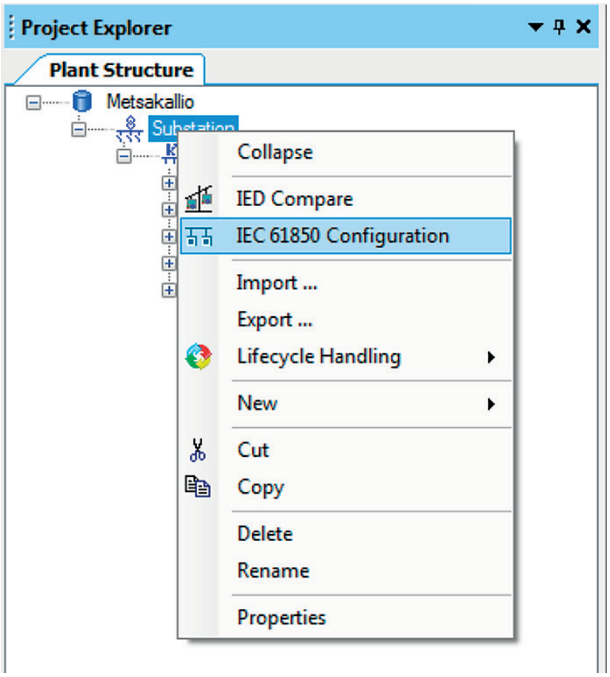

Figure 135: Selecting the IEC 61850 Configuration

2. Click the IED node to select a publisher IED.
3. To add a new data set, right-click on the area containing the data set names and select **New**.

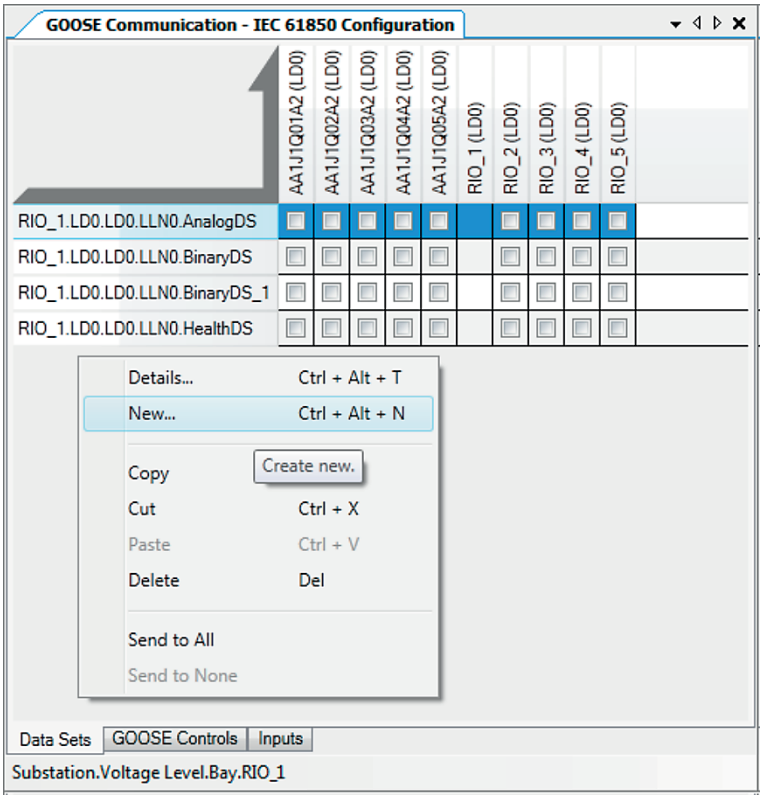

Figure 136: Creating a new row under the Data Sets tab

4. In the **Create New Data Set** dialog box, define a data set name and click **OK**. A row representing the new data set is created under the **Data Sets** tab.

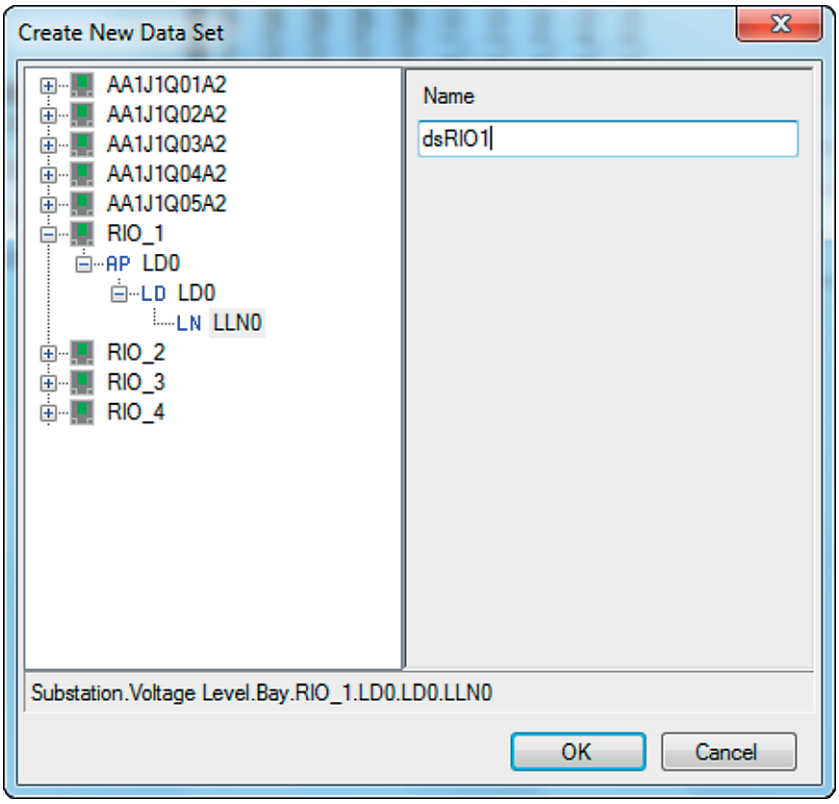

Figure 137: Creating a new data set

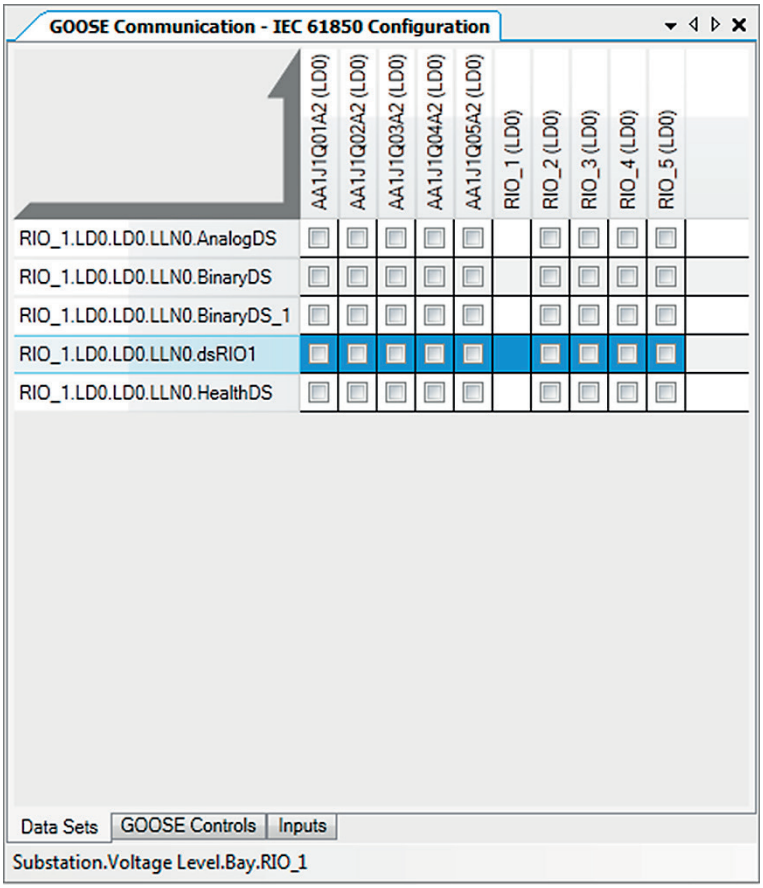

Figure 138: Creating a new row under Data Sets tab

16.1.1 Defining data attributes

1. Select the **Data Sets** tab on the editor pane.
2. Right-click a GOOSE data set and select **Details**.

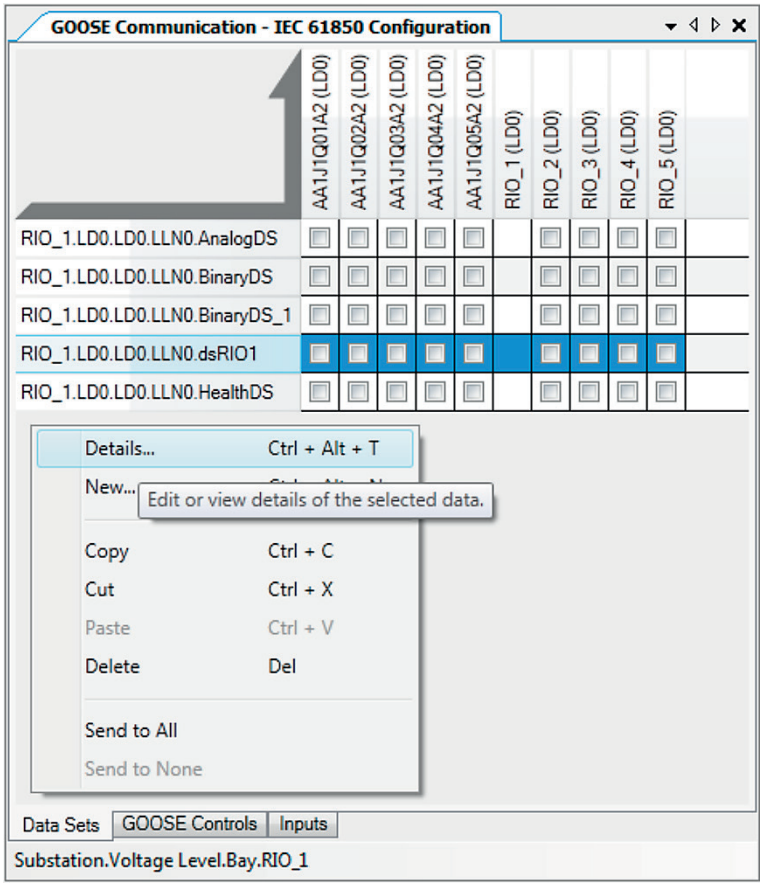

Figure 139: Details of a data set

3. Select **LD/LN/DObject/DAttr/FC** and click **Insert** to add the data in the data set.

RIO600 supports only unstructured data sets in GOOSE.

A single data set in RIO600 contains a maximum of 100 data attributes.

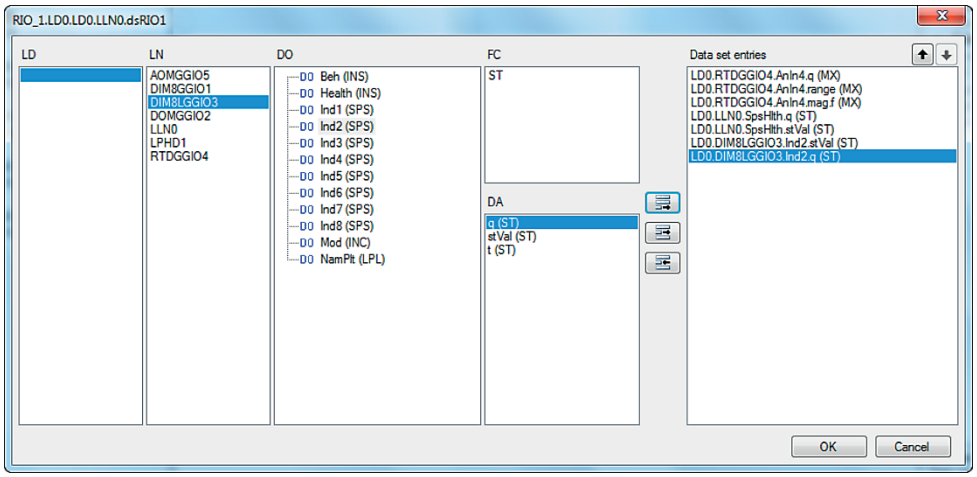

Figure 140: Adding data in the data set

16.2 Configuring GOOSE control blocks

1. In the **Plant Structure**, select the IED node.
2. In the editor pane, select the **GOOSE Controls** tab.
3. To add a new GOOSE control block, right-click the editor pane and select **New**.

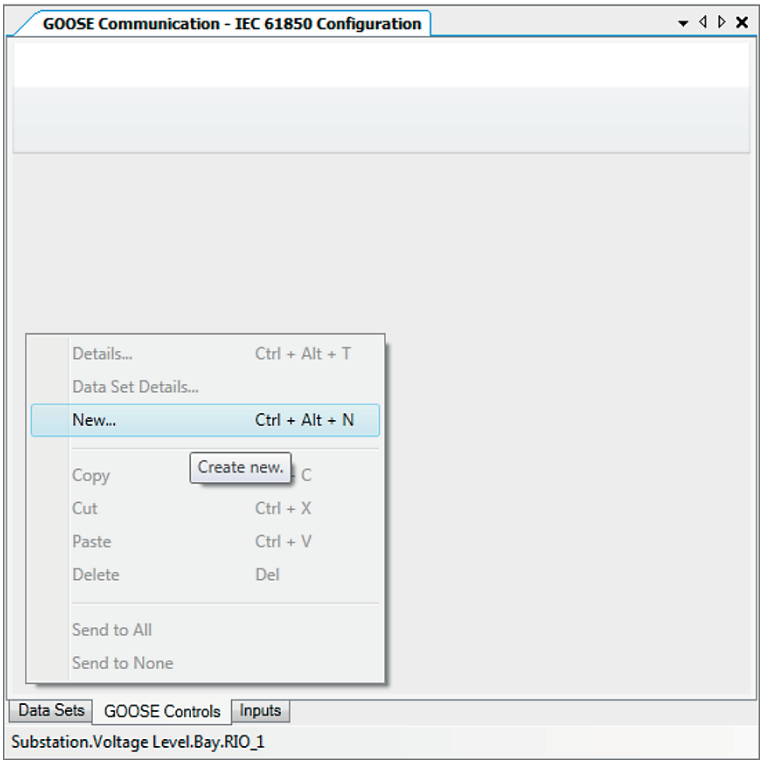

Figure 141: Creating a new row under the GOOSE Controls tab

4. In the **Create New GOOSE Control** dialog box, define a GOOSE control block name, select the previously created data set from the **Data set** drop-down list and click **OK**.
   A new row is created under the **GOOSE Controls** tab.

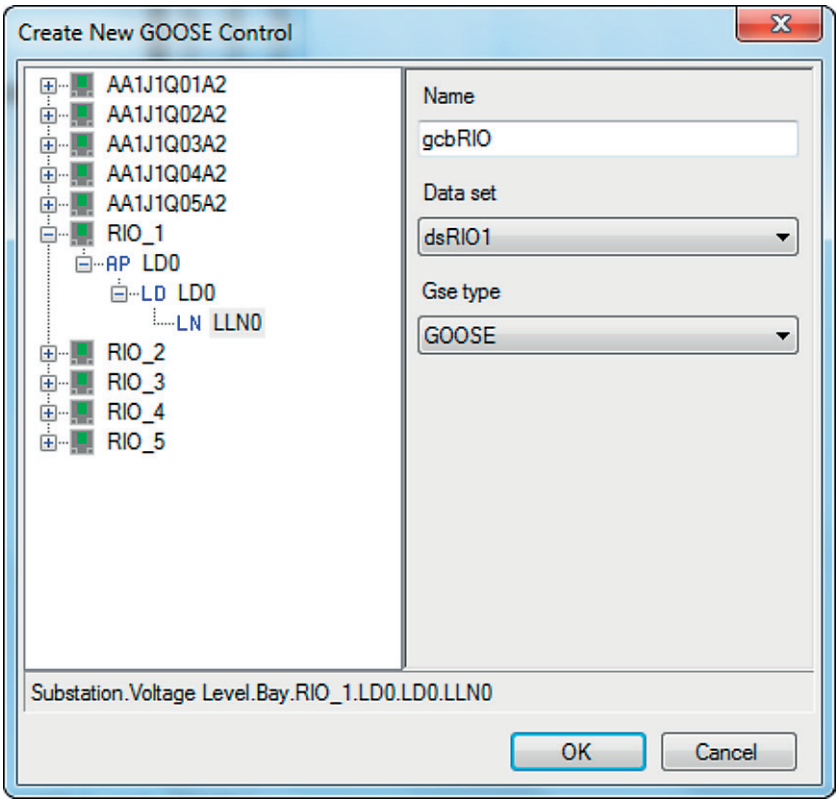

Figure 142: Creating a new GCB

5. In the **GOOSE Controls** tab, update GoCB attributes in object properties.

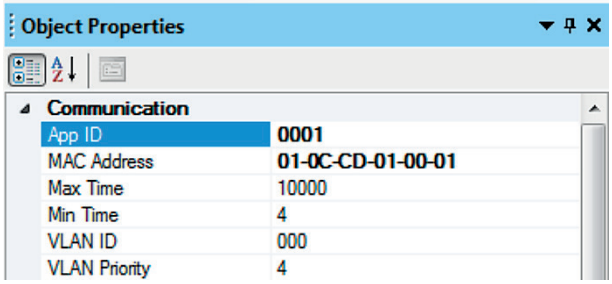

Figure 143: Updating the GoCB attributes

Use a unique *Multicast MAC address* and *APP ID*.

Table 4: Selected GOOSE control block properties

GoCB property	Description
GOOSE Control	GOOSE control block name
Application Id	A unique GoID for each GoCB in the system. Recommendation is to define a device-specific value and not to use the default empty value.
Min Time	Indicates the maximum response time in milliseconds to data change. This time can be used by the receiver to discard messages that are too old. In principle, t(min) can vary depending on the data type.
Max Time	Indicates the background "heartbeat" cycle time in milliseconds; the default value is “10 000 ms”. If there are no data changes, the IED still resends the message with the heartbeat cycle to enable the receiver to detect communication losses, that is, the communication is supervised.
Config Revision	Contains an integer value that is sent in every GOOSE message. The integer indicates the amount of changes in the data set. The receiver checks the message for configuration mismatches. “Configuration Revision” cannot be manually edited in IET600.
MAC Address	Multicast MAC address to which the specific GOOSE data is sent. The receiving IED filters the frames and starts to process them if a specific multicast address is defined in the configuration. It is recommended to have one unique multicast address per GoCB. The address range for GOOSE Multicast addresses is 01-0C-CD-01-00-00...01-0C-CD-01-01-FF.
App ID	Unique HEX value application identifier for sending the GoCB within the system. It identifies the purpose of this particular data set. The value range is 0000...3FFF.
VLAN ID	Used if the Ethernet switches in a station bus support VLAN. If static VLAN identifiers are defined, it also affects the switch port configuration. Value “000” indicates a non-configured VLAN and switches do not filter these messages on a port basis. This is the recommended, if there is no need to split the logical network. The VLAN identifier is a 3-character HEX value with range 000...FFF.
VLAN Priority	Used in networks supporting VLANs. The priority is used with network switches. The default value for GOOSE is “4” and the value range is 0...7.

The multicast *MAC address* is usually unique, and *APP-ID* must be unique for each GoCB in the same IEC 61850 system.

16.3 Configuring a GOOSE Subscriber

The GOOSE data sets that RIO600 is subscribing from the peer IED must be configured on the data attribute level. Functional constrained data objects are not allowed. Also, the subscribed data sets must contain status value and quality attributes in this order.

1. In the **Plant Structure**, select **Substation node**.
2. Connect the publishers and subscribers.

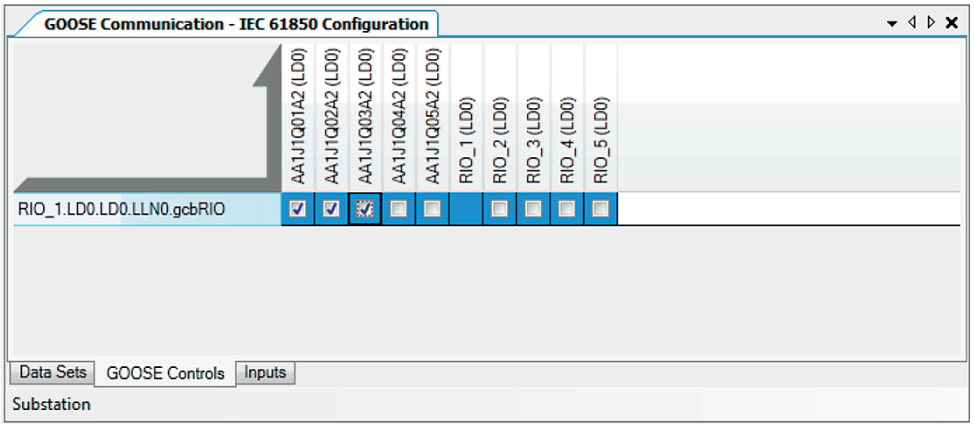

Figure 144: Making the connection between the publisher and subscriber

3. Save the configuration and close the **IEC 61850 Configuration**.

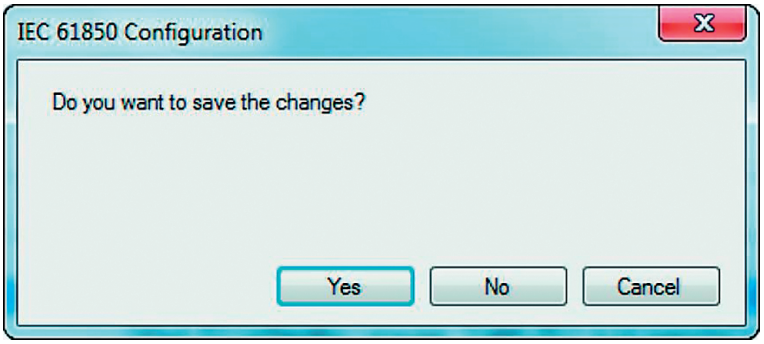

Figure 145: Saving the IEC 61850 Configuration

16.4 Easy GOOSE engineering in Application Configuration

Easy GOOSE engineering enables configuration of GOOSE communication between two or more IEDs in a single tool, Application Configuration. GOOSE data sets and GOOSE control blocks are created automatically when the configuration is done in Application Configuration. Easy GOOSE engineering does not replace GOOSE engineering in Signal Matrix or the IEC 61850 Engineering tool.

Easy GOOSE engineering is supported for both IEC 61850 Edition 1 and IEC 61850 Edition 2 configured IEDs.

Easy GOOSE engineering is supported from PCM600 Hotfix 2 or later. To configure easy GOOSE and make the GOOSE connection through Application Configuration, see the PCM600 help manual, which can be opened by pressing the F1 function key in PCM600.

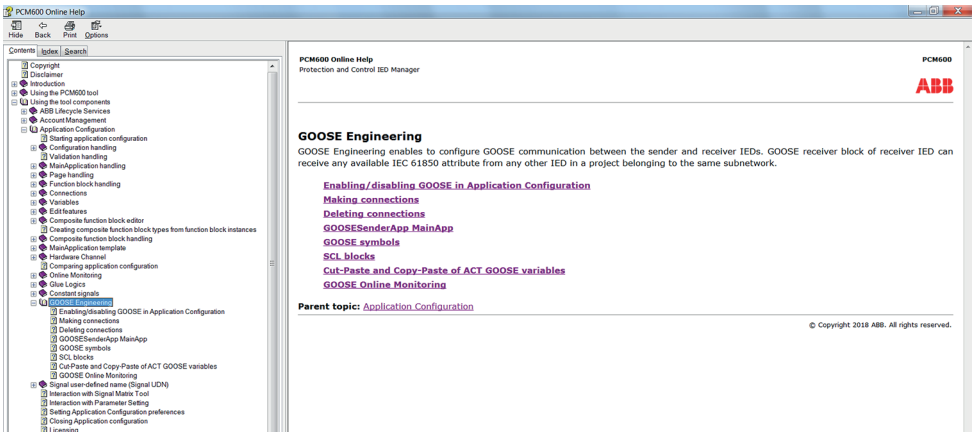

Figure 146: GOOSE engineering in PCM600 online help

16.5 GOOSE engineering examples using RIO600 and a 615 series IED

16.5.1 Connecting a generic SPCGGIO output from a 615 series IED to a RIO600 binary output

1. In the **Application Configuration** tool in PCM600, add the SPCGGIO function block to the configuration of the 615 series IED.

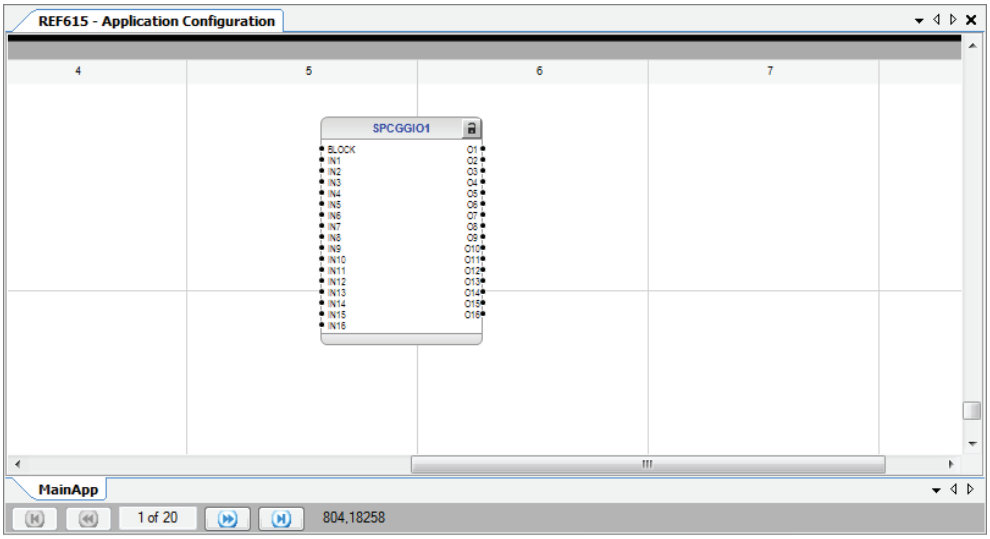

Figure 147: Adding a SPCGGIO function block to the 615 series IED

2. In the **Plant Structure**, select the 615 series publisher IED.
3. In the **Data Sets** tab in the editor pane, right-click and insert a new row.

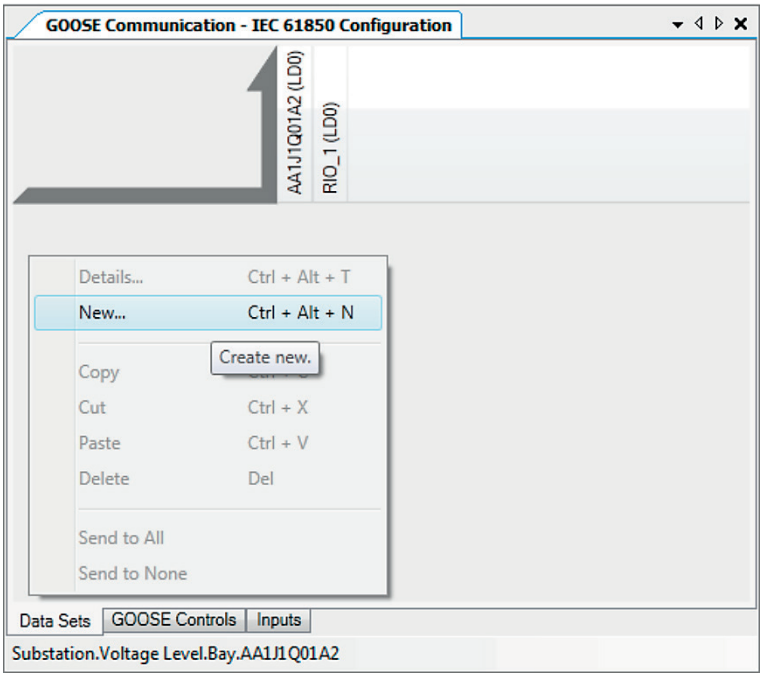

Figure 148: Creating a new row under the Data Sets tab

4. In the **Create New Data Set** dialog box, define a data set name and click **OK**.

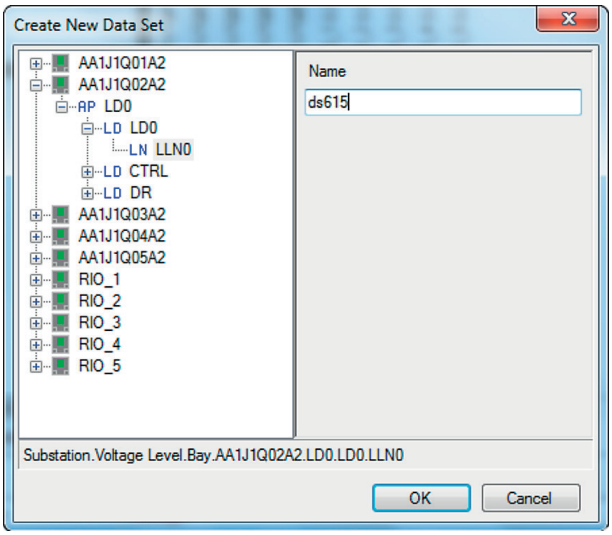

Figure 149: Creating a new data set

A row representing the new data set is created under the **Data Sets** tab.

5. Right-click the newly created data set row and select **Details**.

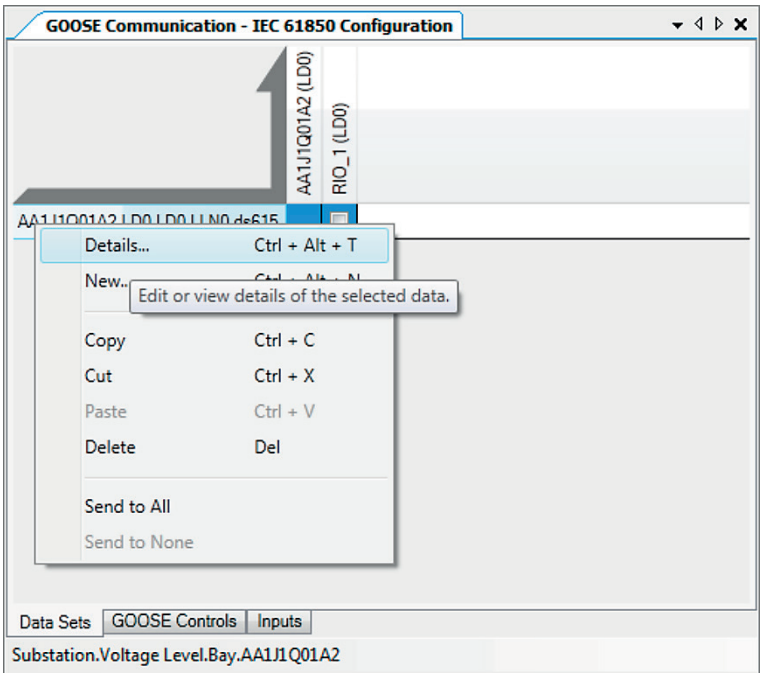

Figure 150: Adding details in the data set

6. Select the data set entries, click the **Insert** button to add the data in the selected data set and click **OK**.

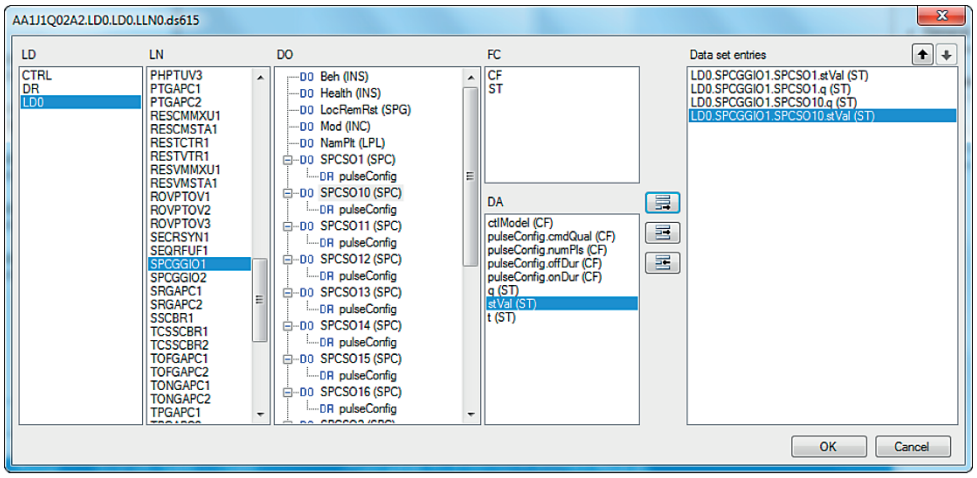

Figure 151: Adding data in the data set

7. In the **GOOSE Controls** tab, insert a new row to add a new GOOSE control block.

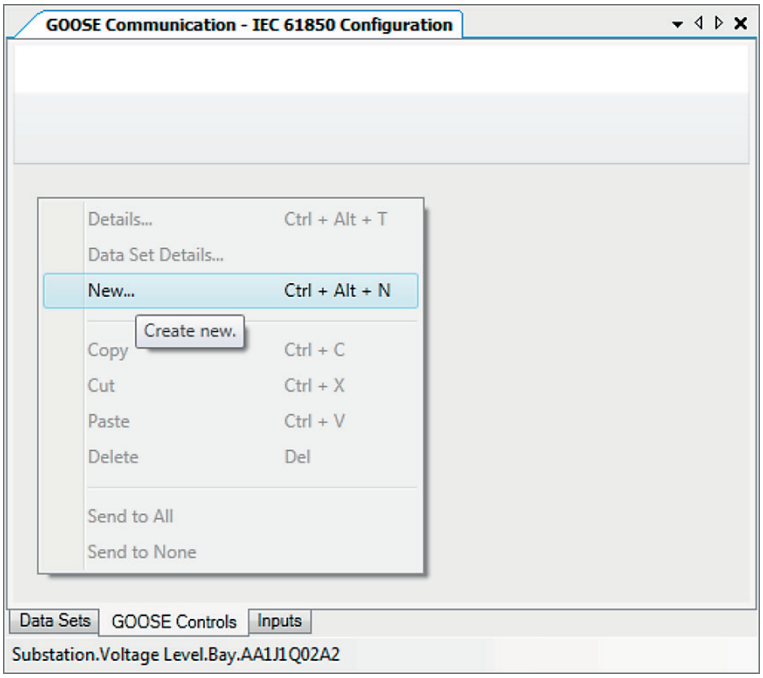

Figure 152: Creating a new row under the GOOSE Controls tab

8. In the **Create New GOOSE Control** dialog box, define a GOOSE control block name under **LLN0**, select the previously created data set from the **Data set** drop-down list and click **OK**.

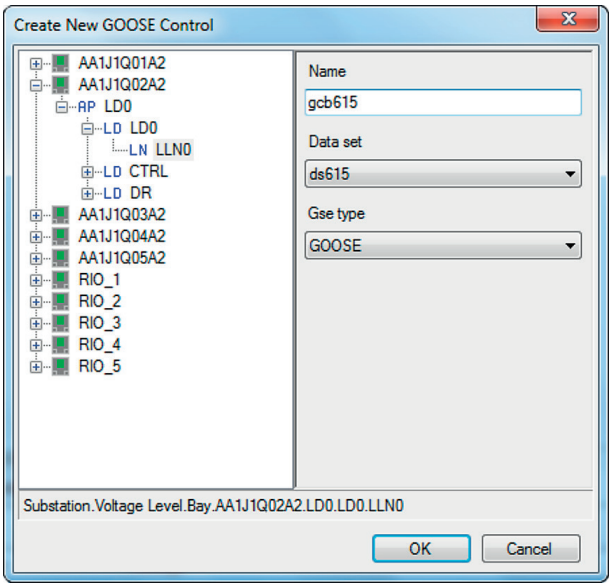

Figure 153: Creating a new GCB

A new row is created under the **GOOSE Controls** tab.

9. In the **GOOSE Controls** tab, connect the publisher and subscribers.

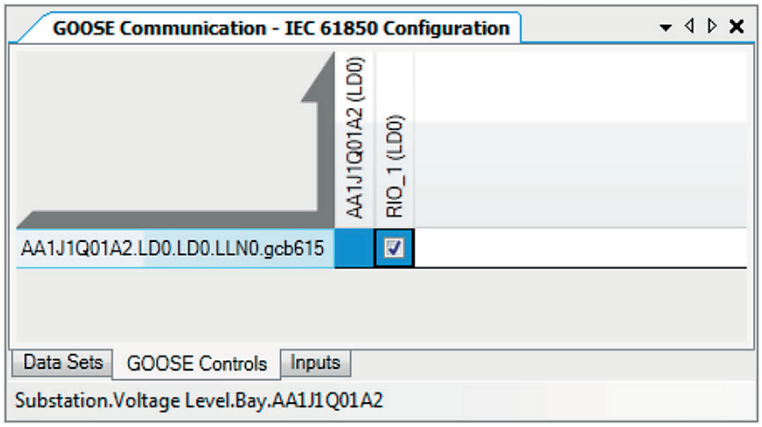

Figure 154: Making the connection between publisher and subscriber under the GOOSE Controls tab

RIO600 can subscribe from a maximum of five different GOOSE control blocks either from one or multiple relays. A unique combination of MAC id and App id is required for the GOOSE control blocks.

10. Save the configuration and close the **IEC 61850 Configuration** dialog box.

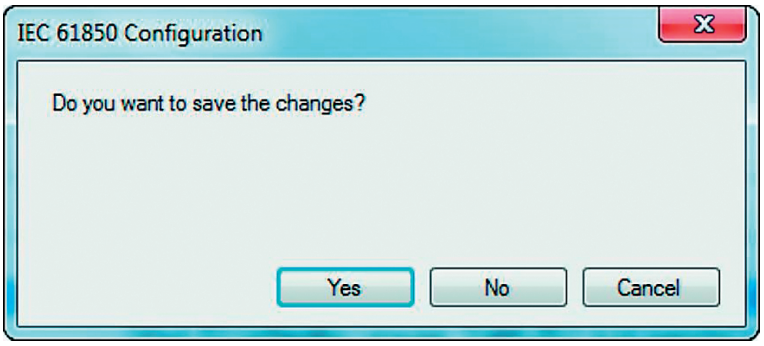

Figure 155: Saving the IEC 61850 Configuration

11. In the **Plant Structure**, right-click the RIO600 IED and select **Application Configuration**.

    11.1. Connect `GOOSERCV_BIN` outputs to SCMHP1 function block and make the connections. GOOSE data is received by *GOOSERCV* function block and data is passed to SCM function *SCMHP1*.

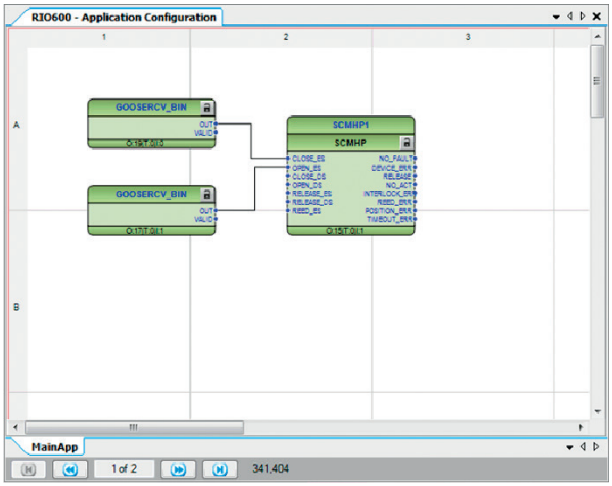

Figure 156: Making connections between the function blocks

    11.2. Save the configuration and close **Application Configuration**

12. In the **Plant Structure**, right-click the RIO600 IED and select **Signal Matrix**.

    12.1. In the **GOOSE** tab, make the connections.
    12.2. Save and close **Signal Matrix**.

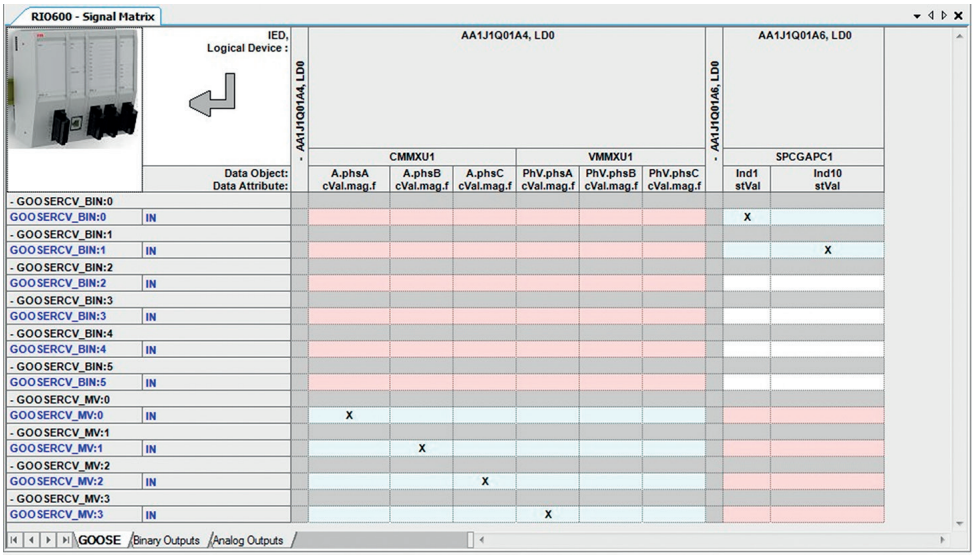

Figure 157: Making the connections with Signal Matrix

13. Download the configuration to both the 615 series IED and RIO600 using the “Write to IED” operation.

16.5.2 Connecting two RIO600 binary inputs to the 615 series IED disconnector status

1. In the **Plant Structure**, right-click the RIO600 publisher IED and select **IEC 61850 Configuration**.
2. In the **GOOSE Controls** tab, right-click and insert a new row.

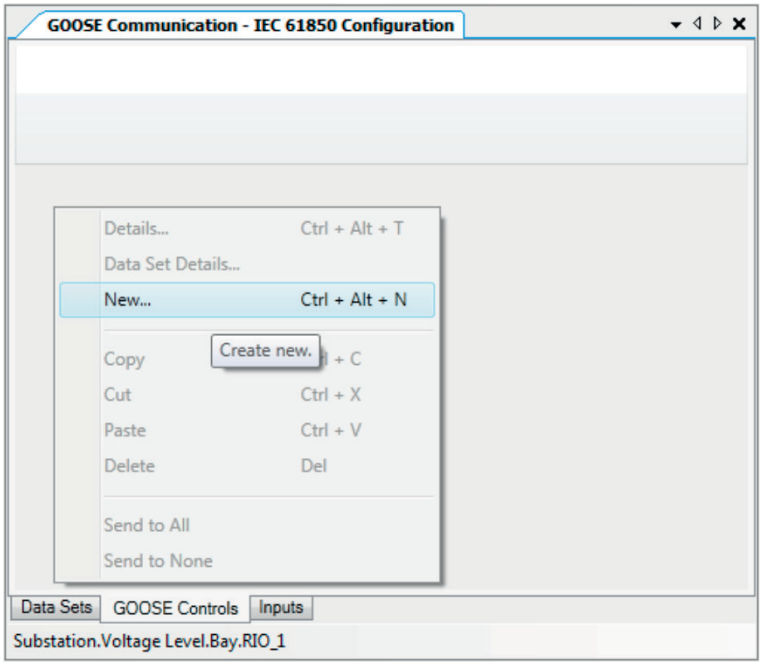

Figure 158: Creating a new row under the GOOSE Controls tab

3. In the **Create New GOOSE Control** dialog box, define a GOOSE control block name, select the correct data set in the **Data set** drop-down list and click **OK**. A new row is created under the **GOOSE Controls** tab. Default data sets are pre-configured by RIO600 Connpack, but the modifications can be done as required.

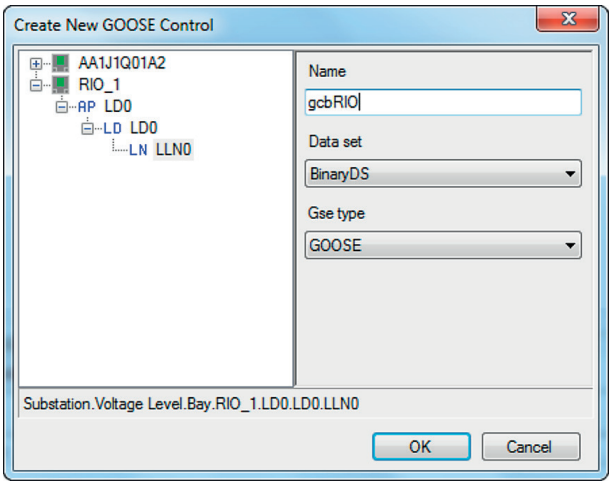

Figure 159: Creating a new GCB

4. In the **GOOSE Controls** tab, connect the publisher and subscribers.

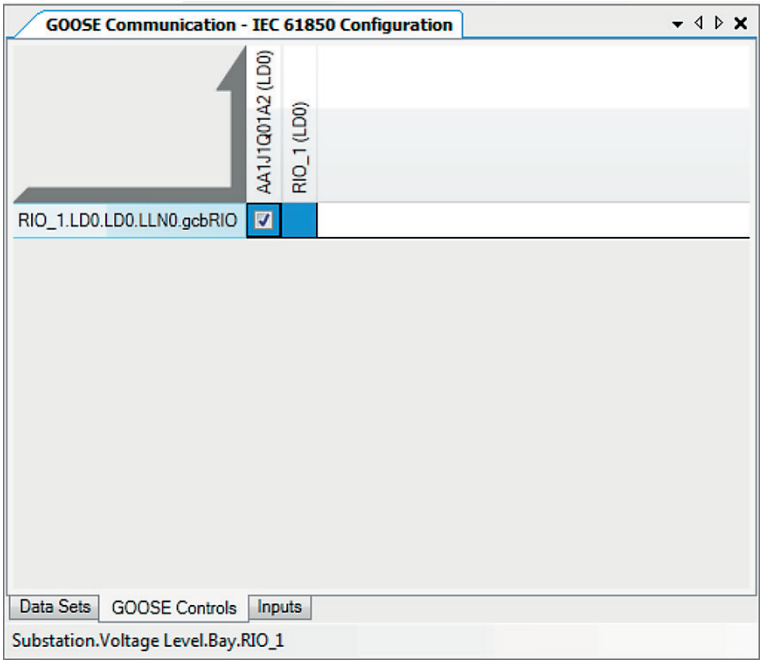

Figure 160: Connecting the publisher and subscriber

5. Save the configuration and close the **IEC 61850 Configuration** dialog box.

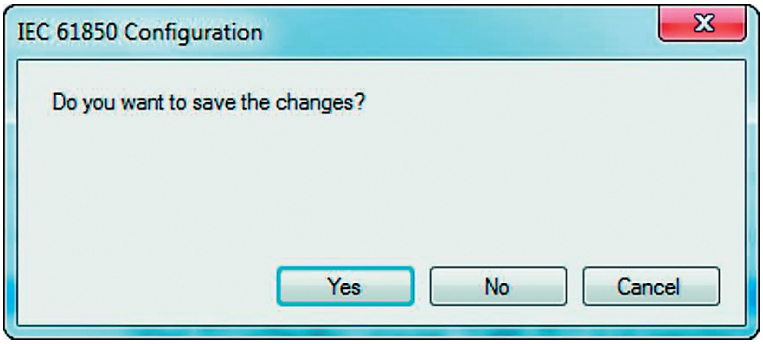

Figure 161: Saving the IEC 61850 Configuration

6. In the **Plant Structure**, right-click the 615 series IED and select **Application Configuration**.

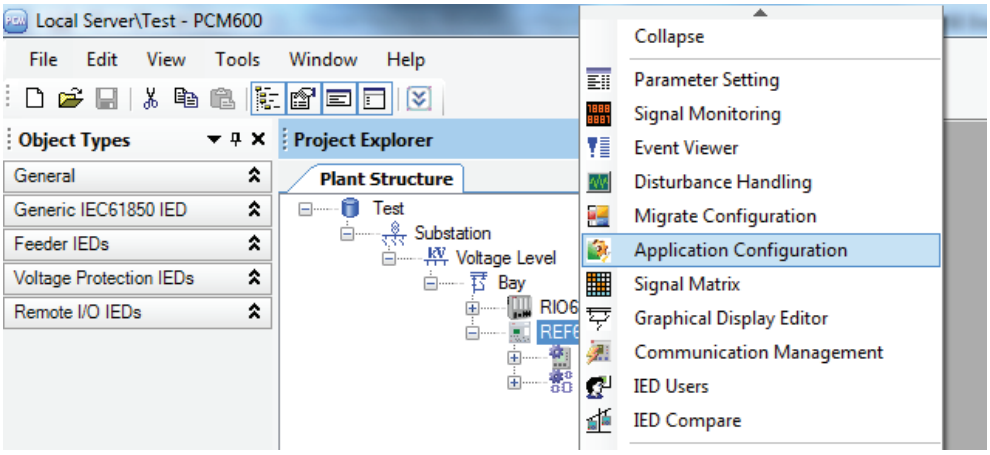

Figure 162: Selecting Application Configuration

7. Add two GOOSERCV_BIN and DCSXSWI function blocks and make the connection.
   GOOSE data is received by GOOSERCV function block and data is passed to disconnector DCSXSWI.

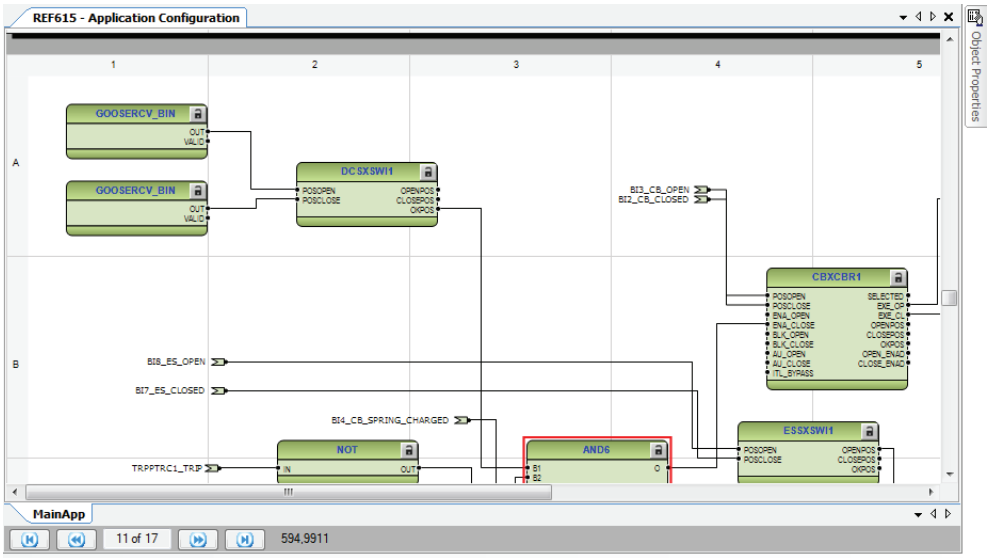

Figure 163: Making connections between the function blocks

8. Save the configuration and close **Application Configuration**.
9. In the **Plant Structure**, right-click the 615 series IED and select **Signal Matrix**.

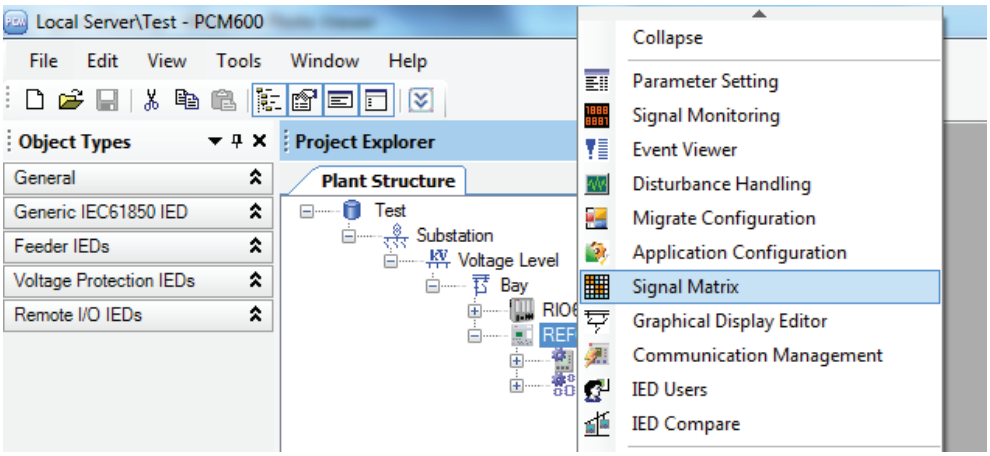

Figure 164: Selecting Signal Matrix

10. In the **GOOSE** tab, make the connections.

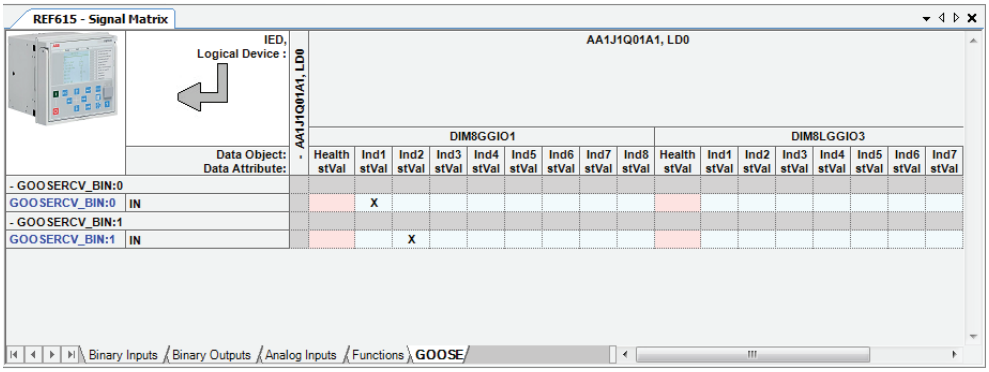

Figure 165: Making connections in the GOOSE tab

11. Save and close **Signal Matrix**.
12. Download the configuration to both the 615 series IED and RIO600 using the "Write to IED" operation.

Section 17 Troubleshooting

17.1 Troubleshooting the technical key in online mode

1. Ensure that each IED in the plant structure has a unique technical key.
   If the device is created in online mode and the technical key is already set to another device instance in the plant structure, a dialog box opens and an error is displayed in the Output pane. In online mode, the technical key is retrieved from the device and set to the device instance's technical key in PCM600.

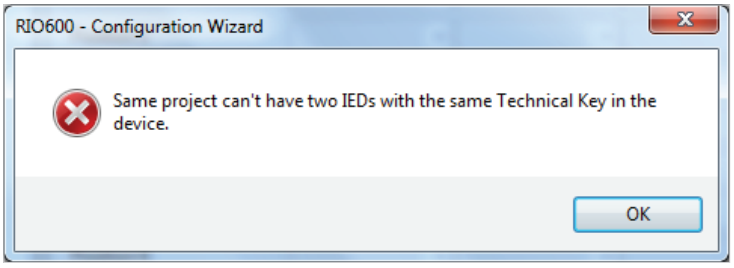

Figure 166: Detecting failure in setting the technical key

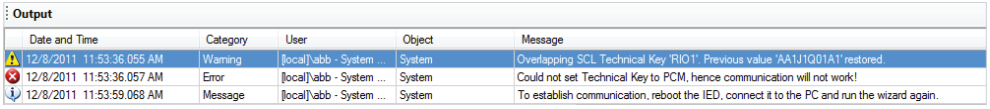

Figure 167: Error message in the Output pane

2. Define the device type and communication parameters correctly in the configuration wizard in the online mode.
   If the device is not responding or is connected to other IED type, a dialog box opens when the **Scan** button is clicked.

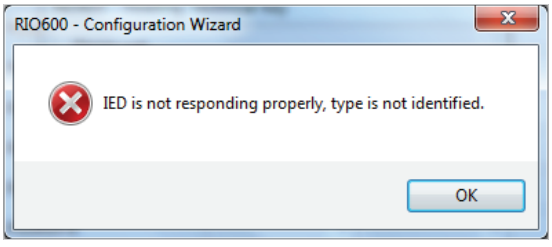

Figure 168: Detecting an unresponsive IED or incorrect IED type

Check the communication settings and the physical connection to the device.

3. Accept the technical keys suggested by PCM600.
   If the device's technical key is, for example, "RIO600" or "BAY1" and a new device instance is created in online mode, a dialog box opens.
   - Click **Yes** to change the technical key.
   - Click **No** to abort the scan.

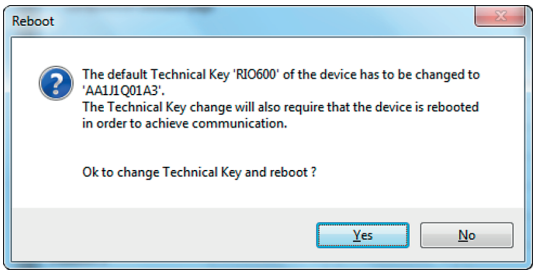

Figure 169: Changing the default technical key and rebooting

17.2 Troubleshooting the reading and writing of parameters

Common validations while reading and writing parameters

- Ensure that the device is online.
- Ensure that the device contains a valid configuration. Composition of IED and IED object in PCM should match.
- Ensure that the composition selection matches with the device. Technical key in IED and PCM should match.
- Ensure that the technical key is correct.

Validations while writing parameters

- Check that the physical MAC Address is given in XX-XX-XX-XX-XX format where X can be [0-9], [a-f] or [A-F].

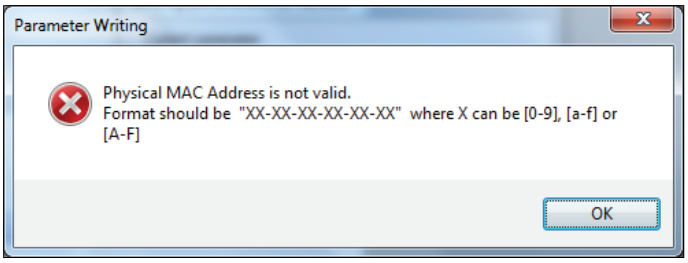

Figure 170: Checking physical MAC Address format

- Check that the *Oscillation Suppression Hysteresis* of the Digital input module is lower than the *Oscillation Upper limit*.

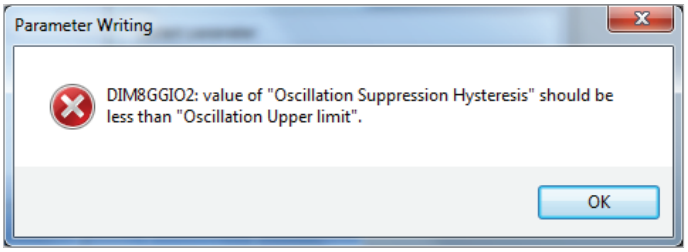

Figure 171: Checking Oscillation Suppression Hysteresis

- Check that the module versions in the device and PCM600 match.

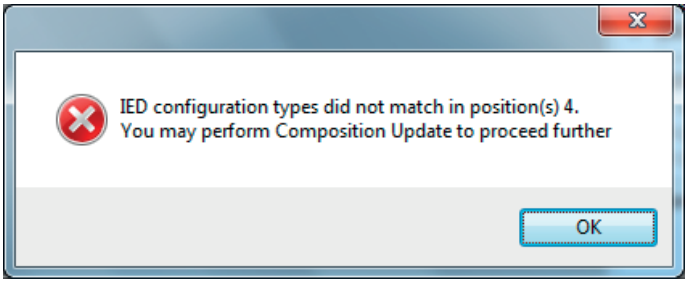

Figure 172: Validation for modules with different versions

17.3 Troubleshooting the glue logic connection

1. Instantiate the maximum number of OR, AND or NOT logic gates in Application Configuration.
2. Open Signal Matrix and try to make the glue logic connection.
   An error message appears in Signal Matrix if all instances of logic blocks are instantiated in Application Configuration and no new blocks can be created from the background.

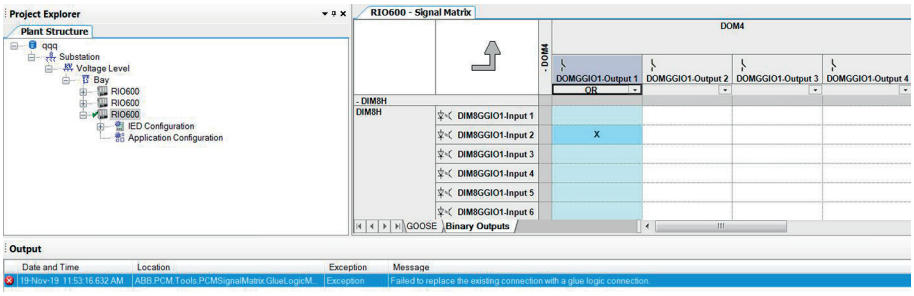

Figure 173: Error message in Signal Matrix

Section 18 Technical reference

18.1 Model conformance statement

The Model Implementation Conformance Statement (MICS) of the standard data object model elements supported by RIO600 are common data attribute classes, common data classes and controllable single point classes. Some data may not be retrieved from the IED but they are included in RIO600 as a default.

18.1.1 Quality

Table 5: Quality type definition

Attribute name	Attribute type	Value	RIO600 comments
Validity	CODED ENUM	good invalid reserved questionable	Supported
detailQual	PACKED LIST		
Overflow	BOOLEAN		Not supported
outOfRange	BOOLEAN		Supported
badRefererence	BOOLEAN		Not supported
Oscillatory	BOOLEAN		Supported
Failure	BOOLEAN		Supported
oldData	BOOLEAN		Not supported
Inconsistent	BOOLEAN		Not supported
Inaccurate	BOOLEAN		Not supported
Source	CODED ENUM	process substituted DEFAULT process	Not supported
Test	BOOLEAN	DEFAULT FALSE	Supported
Operator Blocked	BOOLEAN	DEFAULT FALSE	Supported

The DEFAULT value must be applied, if the functionality of the related attribute is not supported. The mapping may specify to exclude the attribute from the message, if it is not supported or if the DEFAULT value applies.

18.2 Common data classes

18.2.1 Single point status

Table 6: Common data class of single point status (SPS)

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
Data attribute				
Status				
stVal	BOOLEAN	ST	dchg	TRUE or FALSE
q	quality	ST	qchg	
t	TimeStamp	ST		

18.2.2 Single point control (SPC)

Table 7: Common data class of single point control (SPC)

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
Data attribute				
Status				
stVal	BOOLEAN	ST		TRUE or FALSE
q	Quality	ST		
t	Time stamp	ST		
ctlModel	CtlModels	CF		Status-only

18.2.3 Integer status (Health)

Table 8: Common data class of integer status (INS)

Attribute Name	Attribute Type	FC	TrgOp	Value
Data Name	Inherited from Data Class (refer to IEC 61850-7-2)			
Health				
stVal	ENUM	ST	dchg	1 = OK 2 = Warning 3 = Alarm
q	Quality	ST	qchg	
t	TimeStamp	ST		

18.2.4 Measured value (MV)

Common data class of MV

Table 9: ABBRIO_MV

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
mag	Analogue value	MX	dchg	
range	ENUM	MX	dchg	0 = normal 1 = high 2 = low 3 = high-high 4 = low-low
q	Quality	MX	qchg	
t	Time stamp	MX		

Table 10: ABBRIO_MVx

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
mag	Analogue value	MX	dchg	
q	Quality	MX	qchg	
t	Time stamp	MX		

18.2.5 Complex measured value (CMV)

Table 11: Common data class of Measured Value (CMV)

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
cVal	Vector	MX		
q	Quality	MX	qchg	
t	Time stamp	MX		

18.2.6 Controllable analog process value (APC)

Table 12: Common data class of APC

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
MxVal	Analog value	MX		
q	Quality	MX		
t	Time stamp	MX		
ctlModel	CtlModels	CF		status-only

18.2.7 Binary counter reading (BCR)

Table 13: Common data class of BCR

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
actVal	INT128	ST		
q	Quality	MX		
t	Time stamp	MX		
pulsQty	FLOAT32	CF		status-only

18.2.8 Phase to ground related measured values of a three phase system (WYE)

Table 14: Common data class of WYE

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
phsA	CMV			
phsB	CMV			
phsC	CMV			

18.2.9 Phase to phase related measured values of a three phase system (DEL)

Table 15: Common data class of DEL

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
phsAB	CMV			
phsBC	CMV			
phsCA	CMV			

18.2.10 Activation information (ACT)

Common data class of ACT

Table 16: ABBRIO_ACTef

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
general	BOOLEAN	ST	dchg	
q	Quality	ST		
t	TimeStamp	ST	qchg	

Table 17: ABBRIO_ACToc

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
general	BOOLEAN	ST	dchg	
PhsA	BOOLEAN	ST	dchg	
PhsB	BOOLEAN	ST	dchg	
PhsC	BOOLEAN	ST	dchg	
q	Quality	ST		
t	TimeStamp	ST	qchg	

18.2.11 Directional activation information (ACD)

Common data class of ACD

Table 18: ABBRIO_ACDef

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
general	BOOLEAN	ST	dchg	
dirGeneral	ENUM	ST	dchg	0 = unknown 1 = forward 2 = backward 3 = both
q	Quality	ST		
t	Time stamp	ST	qchg	

Table 19: ABBRIO_ACDoc

Attribute name	Attribute type	FC	TrgOp	Value
Data name	Inherited from data class (see IEC 61850-7-2)			
general	BOOLEAN	ST	dchg	
dirGeneral	ENUM	ST	dchg	0 = unknown 1 = forward 2 = backward 3 = both
phsA	BOOLEAN	ST	dchg	
dirPhsA	ENUM	ST	dchg	0 = unknown 1 = forward 2 = backward 3 = both
phsB	BOOLEAN	ST	dchg	
dirPhsB	ENUM	ST	dchg	0 = unknown 1 = forward 2 = backward 3 = both
phsC	BOOLEAN	ST	dchg	

Table continues on next page

Attribute name	Attribute type	FC	TrgOp	Value
dirPhsC	ENUM	ST	dchg	0 = unknown 1 = forward 2 = backward 3 = both
Q	Quality	ST		
t	Time stamp	ST	qchg	

Section 19 Glossary

ACSI	Abstract communication service interface
AOM	Analog output module
Attribute	Named element of data and of a specific type
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
CUT	Composition Update tool in PCM600
Data attribute	Defines the name, format, range of possible values and representation of values while being communicated
DIN rail	A standardized 35 mm wide metal rail with a hat-shaped cross section
EMC	Electromagnetic compatibility
Ethernet	A standard for connecting a family of frame-based computer networking technologies into a LAN
FPI	Measured value, short floating point information
FPI	Fault passage indicator
GCB	1. GOOSE control block 2. Generator circuit breaker
GoCB	GOOSE control block
GoID	GOOSE control block-specific identifier
GOOSE	Generic Object-Oriented Substation Event
HW	Hardware
I/O	Input/output
IEC	International Electrotechnical Commission
IEC 61850	International standard for substation communication and modeling
IED	Intelligent electronic device
LECM	Communication module
MAC	Media access control
MFA	Multifrequency admittance
MICS	Model implementation conformance statement

Modbus	A serial communication protocol developed by the Modicon company in 1979. Originally used for communication in PLCs and RTU devices.
Multicast address	An identifier for a group of hosts that have joined a multicast group
MV	Medium voltage
PCM600	Protection and Control IED Manager
RIO600	Remote I/O unit
RJ-45	Galvanic connector type
RTU	Remote terminal unit
SCADA	Supervision, control and data acquisition
SCL	XML-based substation description configuration language defined by IEC 61850
SCM	Smart control module
SIM4F	Sensor input module (4 currents)
SIM8F	Sensor input module (4 currents and 4 voltages)
SNTP	Simple Network Time Protocol
SPS	Single-point status
stVal	Status value
TCP/IP	Transmission Control Protocol/Internet Protocol
WHMI	Web human-machine interface
XML	Extensible markup language

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