The optimization of processes improves quality, shortens the time to market and reduces the total cost of ownership.

To survive in increasingly tougher international competition, today it is more important than ever to consistently tap all optimization potentials throughout the entire lifecycle of a plant. At the same time, the perfect balance between quality, time and costs is the decisive success factor.

With Totally Integrated Automation (TIA) from Siemens, a seamless offering of perfectly matched products, systems, and solutions for all hierarchy levels of industrial automation, you are optimally equipped for this purpose.
As a result of integration into TIA of electrical switchgear with devices for protection and control functions in accordance with the industry standard IEC 61850, it becomes possible to unite switchgear automation and process automation in one process control system.

Homogenous operator control and monitoring using a common control station, uniform configuration with the same engineering system, and consistent utilization of hardware components from the TIA product portfolio result in significant savings with regard to investments, operation and servicing.
Switchgear in the process industry

Basic structure of typical medium-voltage switchgear

Typical applications

In addition to the high process automation requirements in many industrial plants, it is also necessary to integrate the medium-voltage power supply switchgear into a complete automation system.

Components of such plants are electrical consumers with high energy requirements, e.g.

- Large drives
- Heavy-duty fans
- Compressors
- Pumps
- Mills and crushers
- Large centrifuges
- Electrolytic and electroplating plants
- Building supplies
Examples of large electrical consumers in various industries

**Chemicals**
Pumps, compressors, drives, medium-voltage supply

**Pharmaceuticals**
Infrastructure, building supply

**Food & beverages**
Centrifuges, pumps, compressors, medium-voltage supply

**Cement**
Crushers, tube mills, rotary kilns, medium-voltage supply

**Water and wastewater**
Pumps, fans, medium-voltage supply

**Paper and cellulose**
Drives, medium-voltage supply

**Glass and solar**
Electric heating, drives, medium-voltage supply

**Steel**
Drives, medium-voltage supply

**Oil & gas**
Compressors, pumps stations, medium-voltage supply
Merging of process control system and station control system

Task of the protection devices

The task of the protection devices is to actually permit operational overcurrents, but to prevent impermissible loading of cables and devices. Because of dangerous effects in the event of a short-circuit, the associated equipment must be switched off within the shortest possible time. On the other hand, a fault should only result in a power supply interruption for as few consumers as possible. To achieve this, the protection devices present in the network must detect the fault, carry out the switch-off themselves, or output triggering commands for the associated switches.

So-called "Intelligent Electronic Devices" (IEDs) are used as protection devices for control, switching, measuring, and automation. These are intelligent devices which detect abnormal operating states and faults, and provide an autonomous reaction. This is achieved by comprehensive diagnostics and signaling as well as by safe, fast and selective switching-off of the faulty plant components. This type of protective system is usually applied in power supply systems > 1 kV. The applicable variables are measured indirectly by current and voltage transformers. Circuit-breakers and protection devices are used as active elements.

Appropriate selection of the protection devices in accordance with the technological requirements makes it possible to design comprehensive and complex switchgear which meets the requirements in industrial plants.

International standard IEC 61850

IEC 61850 has become established as the global communication standard for the integration of protection devices. This standard of the International Electrotechnical Commission (IEC) describes an Ethernet-based transmission protocol for protection and control technology in medium-voltage and high-voltage electrical switchgear (station automation). The IEC 61850 protocol includes comprehensive definitions with the following objectives:

- Interoperability between devices from different vendors
- Long-term investment security
- Efficient exchange of object-oriented data models

The standard was defined in cooperation with manufacturers and users in order to position protective systems, communication, and control of switchgear on a uniform, future-oriented basis. All renowned manufacturers offer protection devices in accordance with IEC 61850. As the global leader, Siemens has extremely broad experience in this field.

Classical solution – separate systems

In practice, different systems are used for monitoring and controlling the switchgear and for the actual task of process automation: a process control system for the process component and a station control system for the energy component of the plant.

Thus two independent automation worlds which nevertheless have similar technology come face to face in a single plant.

The implications for the operating team and for operation are as follows:

- Separate worlds for the process and energy components of the plant – but a single process that needs to be performed efficiently
- Separate responsibilities as regards operator control and monitoring, maintenance/servicing – but a single plant that has to display optimum running performance
- High integration workload (engineering, commissioning)
- High project risk (coordination, information exchange, responsibility)
- Increased lifecycle costs resulting from two separate systems which are linked via the process and plant

This makes it more difficult for those working at the plant to manage the overall process in the optimum manner and constantly generates higher costs – throughout the plant’s entire lifecycle.
Merging of process control system and station control system. Integration is possible in several manners: directly on the plant bus, via station gateway, via station controller, or via PROFIBUS DP.

Integrated solution – a single system for both worlds

SIMATIC PCS 7 PowerControl is now able to provide a solution for electrical switchgear featuring devices for protection and control functions (IEDs, Intelligent Electronic Devices) that is based on the IEC 61850 standard protocol. The uniform concept for integration of the switchgear automation into the SIMATIC PCS 7 process control system means that both automation worlds can be brought together, thereby increasing the degree of integration of the entire plant.

Switchgear and process automation then have a uniform GUI. This permits holistic plant control which minimizes the danger of maloperations. Standardization of the system platform for the process and energy aspects solves the problems resulting from the classical separation, and reduces the engineering and maintenance workload – with a positive effect on the lifecycle costs.

Benefits of SIMATIC PCS 7 PowerControl

- Simpler plant structures with higher degree of plant integration
- Increased transparency in the technological dependencies Process ↔ Energy
- Integrated engineering and simplified commissioning
- Uniform process control with minimized risk of maloperations
- Lower administration, servicing and training workload
- Effective energy management (evaluation of consumption values of IEDs)
- Significantly reduced lifecycle costs
Protection and switching devices from Siemens

SIPROTEC protection devices and bay controllers

The comprehensive portfolio of SIPROTEC protection devices covers all feeder tasks: protection, control, measuring, and automation.

All devices from the SIPROTEC 4, SIPROTEC Compact, and SIPROTEC 5 ranges support the IEC 61850 standard and can be used with ring and star communication topologies.

The DIGSI operation program is available for configuration and commissioning of all SIPROTEC devices.

SIPROTEC 4
With more than one million devices in use, SIPROTEC 4 has developed into the standard for digital protective systems. Protection, control, measuring, and automation tasks are united in one SIPROTEC 4 device. The possibilities include:

- Overcurrent-time protection
- Distance protection
- Line differential protection
- Transformer protection
- Busbar protection
- Machinery protection

SIPROTEC Compact
The particularly compact range of devices offers flexible protection functions with minimum space requirements. The devices can be used as the main protection or backup protection.

SIPROTEC 5
The SIPROTEC 5 series is based on the long-term field experiences gained with the SIPROTEC series, and is specially designed for the new requirements of modern networks. Thanks to the high modularity of hardware and software, the functionalities can be repeatedly adapted to changing requirements during the complete lifecycle. In addition to reliable, selective protection and comprehensive automation functions, SIPROTEC 5 offers a comprehensive database for operation and monitoring of modern power grids.
Configuration with DIGSI

As engineering software for all relevant tasks, DIGSI is also an interface between the user's PC and the SIPROTEC devices. Especially designed for industrial and power supply uses, DIGSI makes parameterization and evaluation of the SIPROTEC devices extremely simple. The software is available as DIGSI 4 for the SIPROTEC 4 range and DIGSI 5 for the SIPROTEC 5 range.

All tasks encountered in the design, implementation, commissioning, and operation phases can be mastered perfectly using the intuitive GUI, e.g.:

- Production of a single-line diagram
- Device connection to the primary plant
- Adaptation of device hardware
- Definition of communication network
- Creation of automation and interlocking functions
- Design of individual IEC 61850 structures
- Definition of device parameters
- Testing of device with the test suite

The IEC 61850 system configurator is used to define the network structure as well as the scope of data exchange between the participants of an IEC 61850 station.

The CFC logic editor known from SIMATIC PCS 7 can be used to configure interlocks or switching sequences and to link or derive information.

Representation and evaluation of fault recordings from digital protection devices in the Comtrade format is also possible.

The data of the SIPROTEC devices relevant to integration in PCS 7 PowerControl can be exported as an SCD file via the export interface in DIGSI and subsequently imported into the PCS 7 PowerControl engineering.

Integration of the protection devices

SIPROTEC devices offer flexible communication options. They support the electromagnetically compatible fiber-optic transmission and permit the design of redundant ring topologies. Assembly is particularly simple in the case of devices with integrated switch, and the design is particularly compact and rugged.

The protection devices can be integrated in a complete configuration using graded network topologies, e.g. in the form of star, ring or star/ring topologies, and also with redundant rings. Different availability requirements can then be taken into consideration.

Thanks to standardization based on IEC 61850, it is possible to integrate devices from other vendors into PCS 7 PowerControl in addition to the SIPROTEC protection devices from Siemens. Device-specific adaptation may be necessary in such cases.
Communication in switchgear

Switches for harsh industrial environments and power switchgear

The switches of the SCALANCE X-300EEC/XR-300EEC ranges (Enhanced Environmental Conditions) are managed Industrial Ethernet switches with IP30 or IP20 protection. They are designed for use in harsh industrial environments with PROFINET as well as in power switchgear with IEC 61850. They permit the communication of switching and protection devices in low-voltage and high-voltage switchgear. The switches meet all the necessary EMC approvals for this field of application (IEC standard 61850-3). The devices for increased availability requirements are offered with redundant wide-range power supplies (for 60 V to 250 V DC / 100 V to 240 V AC). SCALANCE X-300EEC switches with conformal coating can also be used in harsh environments and are available as compact devices or as modular 19” rack devices.

Bumpless redundancy for PRP and HSR networks

Redundant network structures increase the network availability, but are usually associated with brief delays in data transfer if a switch is made to a different network path when a connection fails.

Such types of message frame delay can be avoided by using Redundant Network Access (RNA) for hardware and software which supports both PRP (Parallel Redundancy Protocol) and HSR (High-availability Seamless Redundancy Protocol).

Example configuration: redundant network topology with PRP and HSR communication

Switches from the SCALANCE X204RNA EEC range are available in versions for two separate networks (PRP) and for ring networks (HSR).

Further RNA products for direct connection of terminal equipment are:

- Communication processor (CP) for connecting a SIMATIC S7-400 or S7-400H PLC to parallel networks via PRP
- SOFTNET-IE RNA as software product which permits integration of PCs in redundant, parallel network structures based on PRP
Network security

It is becoming increasingly important to protect automation systems because of the increased networking of automation plants and the application of open standards. Unauthorized access – by persons or also by malware – must be prevented in order to avoid manipulation or data espionage and also to ensure that plant availability is not endangered.

To avoid expensive plant downtimes, the loss of know-how, and damage to man, machine or environment, concepts are imperative which protect the automation plants and the networks in particular. This includes the supervision of all interfaces, e.g. between office and plant networks or for remote maintenance over the Internet. The standard protection measures include the application of firewalls and the design of a DMZ (demilitarized zone). The industry-compatible security modules of the SCALANCE S range have been especially designed for such applications.

• SCALANCE S602 with firewall
• SCALANCE S612 additionally with VPN function as protection against manipulation or espionage
• SCALANCE S623 as version with additional DMZ port. The DMZ is used to provide data for other networks without permitting direct access to the automation network, thus increasing security.

The secure segmenting of the plant network into individually protected automation cells (cell protection concept) minimizes risks even further. The cells are divided and devices are assigned according to the communication and protection needs. In addition to the security modules of the SCALANCE S range, it is also possible to use communication processors for SIMATIC PLCs which are provided with additional security functions, e.g. CP 443-1 Advanced for SIMATIC S7-400. The security CP 1628 for PCs or the SOFTNET security client can also be used to design secure VPN connections from PCs or operator stations to the cells which are protected by SCALANCE S or security CPs.

RUGGEDCOM switches designed especially for power switchgear

The managed Industrial Ethernet switches of the RUGGEDCOM range have been specially designed for power switchgear. They are extremely rugged (metal enclosure/ no fans) and feature a high temperature range (-40 to +85 °C).
System components of SIMATIC PCS 7 PowerControl

The basis for a tailored solution when integrating switchgear with SIMATIC PCS 7 PowerControl into the SIMATIC PCS 7 process control system is a matched product portfolio comprising hardware and software components.

It is possible to produce solutions for specific plant and customer requirements by means of appropriate combination of PCS 7 standard products and PCS 7 PowerControl products.

SIMATIC PCS 7 controller

The various SIMATIC PCS 7 controllers with their scalable versions are used for typical process automation tasks, but can also be applied to automation of the plant’s energy components. The configuration possibilities available for this permit flexible consideration of the specific requirements of the respective application.

A cost-effective solution is the subordinate integration of protection devices on the PROFIBUS DP into a single or redundant PCS 7 S7-400 automation system using the IEC 61850 basic library. The combination between PCS 7 controller and station gateway is supported for a larger number of IEDs. If high availability is required, redundant configurations of the PCS 7 controller as well as of the station gateway can be used.

SIMATIC PCS 7 operator station for PowerControl

The SIMATIC PCS 7 operator stations are based on modern industrial workstations that are optimized for use as an OS single station, OS client or OS server and can be used in office or industrial environments. Thanks to the homogenous integration of SIMATIC PCS 7 PowerControl visualization into these operator stations, the process control system and station control system are merged at the system management level.

The runtime software of the PCS 7 operator station is additionally provided with the IEC 61850 communication driver by PCS 7 PowerControl and can thus work simultaneously with the PCS 7 controllers and the protection devices, the so-called intelligent electronic devices (IED).

The standard functions of SIMATIC PCS 7 are of course also available to PCS 7 PowerControl, e.g.:

- Operator prompting using display hierarchy and common displays
- Archiving of process values and messages
- Time synchronization of the SIPROTEC protection devices
- Alarm management with time stamping at the source
- Chronological processing of process values and alarms
- Uniform user management with SIMATIC Logon
- Interlocking operations using PCS 7 Interlock blocks
The protection devices are integrated into the PCS 7 operator station using symbols and faceplates which can be used for SIPROTEC protection devices as well as those from other vendors. As far as the operator is concerned, technological functions such as feeder, motor or transformer are in the foreground – the actually used protection device is hidden from the operator.

Station controller

The station controller for SIMATIC PCS 7 PowerControl permits extremely flexible and cost-effective integration of switchgear into the SIMATIC PCS 7 system. It is based on the “modular Embedded Controller” (AS mEC RTX) which has received approval as a PCS 7 controller. It thus offers the full functionality of the powerful soft PLC WinAC RTX, coupled with the pioneering IEC 61850 protocol for integration of the switchgear. The station controller can therefore handle all automation and communication tasks in smaller plants without an additional controller.

The station controller offers a wide range of communication options. Using the standard interfaces, it can communicate with the field level or the operator system via PROFINET, S7 connection or central I/Os. On the other hand, it enables interfacing to the switchgear or higher-level systems by means of the open IEC 61850 and IEC 60870 protocols.

The basic functionality of the station controller is that of the automation system. When connecting switchgear, the station controller additionally acts as an IEC 61850 MMS client. The IEDs are IEC 61850 MMS servers.

All tags provided by IEC 61850 can be addressed via the station controller as MMS client. Time stamp, value, and status of the tags are transferred to the WinAC user program depending on the configuration. The time stamp always originates from the protection device.

The supplied StatCon configuration tool provides support in configuration of the data functions. The CFC block library SC_DRV included in the delivery is available on the PCS 7 side. The driver blocks included in this library enable further processing of the data from the switchgear in the automation program as well as diagnostics of the station controller. Furthermore, this library contains special driver blocks for connection of the SIMATIC PCS 7 PowerControl Library (PCL). Therefore use of the PCL is an ideal supplement to integration of the switchgear with the station controller.

The PC-based station controller unites the functions of a PCS 7 automation system with the integration of protection devices at a highly favorable price/performance ratio.

The IEC 61850 and IEC 60870 protocols can be combined in any manner. For example, additional connection of the automation system and the switchgear to a higher-level system via IEC 60870 slave is possible.
Station gateway

The station gateway for SIMATIC PCS 7 PowerControl integrates intelligent electronic devices (IEDs), e.g. protection devices, into the SIMATIC PCS 7 process control system. It is also suitable for redundant configurations, and is therefore preferable where increased availability requirements exist. With a maximum number of 128 IEDs, it can additionally connect a large number of protection devices.

The station gateway uses S7 connections for data exchange with the automation system. The IEC 61850 MMS protocol is used for communication with the protection devices.

The relevant data of the switchgear in the automation system is available using the station gateway, and can be operated, monitored and archived using standard PCS 7 functions.

During IEC 61850 MMS communication with the IEDs, the station gateway acts like an IEC 61850 MMS client. The IEDs form the counterpart, the IEC 61850 MMS servers. All tags provided via IEC 61850 communication can be addressed via the station gateway. Time stamp, value, and status of the tags are transferred depending on the configuration. The time stamp always originates from the protection device.

The station gateway communicates with the PCS 7 automation system via the latter's CP 443-1 communication module or the internal Ethernet interface. Standard communication mechanisms of SIMATIC PCS 7 are used in this case.

The driver blocks available for various types of device are preparameterized for a standard scope of tags, but can also be reparameterized and extended without problem for special project requirements. The communication library offers comprehensive diagnostics and alarming options. As a result, breaks in communication with the gateway, with the IEDs, or redundancy problems, for example, are stored directly in the PCS 7 signaling system. Furthermore, special driver blocks in the communication library permit connection of the SIMATIC PCS 7 PowerControl Library (PCL). The PCL is therefore an ideal supplement to integration of the switchgear with the station gateway.

A redundant station gateway supports a larger number of protection devices and provides increased availability.
SIMATIC PCS 7 PowerControl Library

The SIMATIC PCS 7 PowerControl Library (PCL) contains blocks for automation of electrical switchgear equipment. The following functions are supported:

- Feeder
- Motor
- Generator
- Transformer
- Line
- Synchronization unit
- Busbar

To enable engineering in conformance with PCS 7, the PCL offers technological blocks for all equipment that can be configured with the CFC editor for use with PCS 7 controller, station controller, and station gateway. These blocks can be used for protection devices from Siemens (SIPROTEC) as well as for those from other vendors.

Operator-friendly symbols and faceplates are available for visualization on the SIMATIC PCS 7 operator station, and correspond to the style of the PCS 7 standard library APL. These can be integrated homogeneously into a PCS 7 project and adapted flexibly to the properties of the respective protection device.

The faceplates are used to display:

- Measured values
- Messages (alarms, warnings)
- Device status
- Maintenance-relevant information (operating hours, switching cycles, etc.)
- User-specific views

All technological objects allow the creation of instance-specific user views. The units for power, voltage, and current can be adapted specific to the project. Non-existent values can be hidden. Arrows next to the symbols for indicating the current direction provide increased clarity.

Feeder
The FEEDER object is highly versatile. It can be used for all incoming or outgoing circuits of a busbar, but can also be configured as an individual circuit-breaker, grounding electrode or disconnector. It is also suitable for switchable machine contactors.

The FEEDER faceplate allows flexible representation of switches. Six fields for up to five switches are available.

The displayed switches can also be switched on or off manually from the faceplate.

Motor
The MOTOR object is based on the FEEDER object. The motor function is adapted by flexible configuration of the fields.

Generator
The GENERATOR object is based on the FEEDER object. It can be adapted to the function of the generator by flexible configuration of the fields.

Transformer
The TRAFO object can be used for all transformer protection devices. The faceplate is only used for visualization, no commands are implemented.
Faceplates of the SIMATIC PCS 7 PowerControl Library: Line, Synchronization unit, Transformer

**Line**
The LINE object is suitable for line differential protection devices. The faceplate is only used for visualization, no commands are implemented.

**Synchronization unit**
The SYNC object is provided for synchronization units. The faceplate is only used for visualization, no commands are implemented.

**Busbar**
The BUSBAR object represents a busbar. There is no faceplate for this object. The symbol is copied manually into the process image and then configured.

**Visualization of switchgear**
The picture below shows an example of the representation of switchgear on the PCS 7 operator station. The layout of the switchgear depends on the manufacturer. Commonly used, illustrative symbols are rapidly understood and mastered by plant personnel. A hierarchical image design supports intuitive navigation.

Example of a plant display for medium-voltage switchgear with curve window and faceplate of a medium-voltage motor
Advantages of representation of electrical equipment using symbols and faceplates:

- Technological representation corresponds to mindset of plant personnel
- Same operating philosophy and same look & feel of power and process components help in the avoidance of maloperations
- Uniform operator control and monitoring concept independent of the switchgear vendor, e.g. for feeder type

IEC 61850 protection devices

IEDs from the Siemens' SIPROTEC ranges as well as corresponding devices from other vendors are supported in SIMATIC PCS 7 PowerControl as protection devices in accordance with IEC 61850. Third-party protection devices are integrated into SIMATIC PCS 7 PowerControl like those from Siemens, and represented as technological objects with symbols and faceplates. This benefits from the standardization and uniform handling for engineering as well as operator control and monitoring.

SIMATIC PCS 7 PowerControl engineering

Configuration of a typical PCS 7 PowerControl project is based on known, proven tools which interact optimally and support efficient engineering.

Configuration of the IEDs is carried out using the device-specific configuration tool – this is DIGSI for the SIPROTEC devices from Siemens. Exporting of the IED data via SCD/ICD file can be used for this to allow application of the existing information in further working procedures. Different engineering paths must be considered depending on the technology used:

- Operator station for PowerControl
- Station gateway
- Station controller

Workflow for engineering of operator station for PowerControl

Engineering of operator station for PowerControl

With PowerControl applications using the OS option, engineering is based on the Data Base Automation technology (DBA), which e.g. is also used for PCS 7 migration, with PCS 7 OpenOS, and with PCS 7 TeleControl. DBA expands the engineering workflow with regard to integration of the protection devices (for Siemens IEDs, but also for IEDs from other vendors). Importing of protection device data via SCD file is used to create the various types of IED and also to generate the IED instances. DBA allows powerful mass data engineering and automatically carries out a number of actions during the compile process which provide great assistance to the planning engineer, e.g.:

- Generation of technological hierarchy and overview area
- Creation of symbols for the technological objects, e.g. feeder, motor, transformer
- Generation of link for each symbol to the corresponding faceplate
- Integration of alarms and messages of the IEDs into the signaling system
System components of SIMATIC PCS 7 PowerControl

Workflow for engineering of PCS 7 PowerControl with station gateway

Configuration of a PowerControl plant with a station gateway is extremely simple: Configuration of the connection from the station gateway to the PCS 7 automation system is carried out in NetPro. A communication block (SC_LINK) is then inserted per IED in the CFC editor and supplied with the applied NetPro connection IDs.

A driver block and a technological block (e.g. feeder) are created for the automation system in the CFC editor. The driver need then only be provided with the IP address and the IED name. It may be necessary with third-party devices to adapt the IED address on the driver block.

Workflow for engineering of PCS 7 PowerControl with station controller

Configuration of station gateway

Two tools are used for configuration of a PowerControl plant with the station controller. The StatCon tool is initially used to import the device configuration data of the IEDs from DIGSI. A technological object (e.g. feeder) is then created and assigned an equipment ID.

A driver block and a technological block (e.g. feeder) are then created in the CFC editor for each protection device, and the driver assigned the corresponding equipment ID.

As usual in SIMATIC PCS 7, the symbols and the faceplates are automatically generated in the corresponding OS image during compilation and loading.
Integration of the protection devices via PROFIBUS DP

In addition to the standard solution based on the IEC 61850 protocol, the classical integration of protection devices via PROFIBUS DP is also supported in the context of SIMATIC PCS 7 PowerControl. The PowerControl PROFIBUS DP driver library is used for this and provides driver blocks for establishing communication between a PCS 7 automation system and the SIPROTEC protection devices connected on the PROFIBUS DP. This approach is primarily intended for the following cases:

- Repeated use of an existing PROFIBUS DP infrastructure
- Avoidance of complete modernization in existing plants
- Implementation of mixed configurations of PROFIBUS DP and IEC 61850 for plant expansion

The engineering of this approach corresponds to that of a PCS 7 standard solution, i.e. the protection devices are integrated via corresponding driver blocks and linked as usual in the CFC editor to the technological blocks of the PowerControl library. The matching symbols and faceplates are therefore also available for visualization.

A wide range of SIPROTEC protection devices is supported, e.g. the 7SJ, 6MD, 7UM, 7UT, 7VE series.

As far as the operator is concerned, the protection devices integrated via PROFIBUS DP are operated and monitored in the same manner as the IEDs integrated via IEC 61850. The GUI based on technological objects is thus totally integrated and uniform even in mixed configurations of the two integration solutions. This makes a significant contribution toward the avoidance of maloperations and toward increasing the plant's operating efficiency.
Selection aid for system components

The various system components of SIMATIC PCS 7 PowerControl can be combined together flexibly to enable integration and automation of medium-voltage switchgear for the complete range from small and simple plants up to comprehensive and complex plants. The above graphic provides you with support for selecting the components for a user-specific solution.
A distinction can basically be made between five use cases. Use cases 1 to 4 are based on the industry standard IEC 61850, whereas use case 5 describes the classical integration of switchgear via PROFIBUS DP.

- **Use Case 1**
  IEC 61850 IEDs connected directly on the plant bus of SIMATIC PCS 7 are only operated and monitored from the PCS 7 operator station. No connections exist to functions in a PCS 7 automation system, e.g. interlocks.

- **Use Case 2**
  Use of IEC 61850 IEDs which are connected to a PCS 7 automation system, e.g. via interlocks. The automation system and the station gateway have a redundant design because of the increased availability requirements.

- **Use Case 3**
  Use of IEC 61850 IEDs which are connected to a PCS 7 automation system, e.g. via interlocks. The automation system is a modular PCS 7 standard controller together with a station gateway.

- **Use Case 4**
  Use of IEC 61850 IEDs which are connected to a PCS 7 automation system, e.g. via interlocks. The automation system is designed as an embedded controller.

- **Use Case 5**
  Use of SIPROTEC protection devices with PROFIBUS DP interface which are connected to a PCS 7 automation system via PROFIBUS.

Typical configurations

**Use Case 1 – Operator station for PowerControl**
In this configuration, a larger number of IEC 61850 IEDs are directly connected on the SIMATIC PCS 7 plant bus.

Typical features of this configuration include the following:

- Protection devices connected via TCP/IP communication with IEC 61850, directly on the PCS 7 plant bus
- Integration of the IEDs in the PCS 7 operator station via SIMATIC PCS 7 PowerControl Library with symbols and faceplates for electrical equipment
- No connections exist to functions in PCS 7 automation systems, e.g. for interlocks
- IEDs can be mutually interlocked, e.g. by wiring or per GOOSE communication
- Communication with the IEDs usually using fiber-optic cables as result of EMC requirements
Use Case 2 – Fault-tolerant configuration with station gateway
In this configuration, a larger number of IEC 61850 IEDs are connected to the SIMATIC PCS 7 system via a redundant station gateway.

Typical features of this configuration include the following:

- Protection devices via TCP/IP communication with IEC 61850 on redundant station gateway (increased availability requirement)
- Configuration of the station gateway is mainly reduced to establishment of the communication connections
- Integration of the IEDs via the SIMATIC PCS 7 PowerControl Library with functions for electrical equipment
- A connection exists to a redundant PCS 7 automation system, e.g. for interlocks
- IEDs can be mutually interlocked, e.g. by wiring or per GOOSE communication
- Communication with the IEDs usually using fiber-optic cables as result of EMC requirements

Use Case 3 – Standard configuration with station gateway
In this configuration, a larger number of IEC 61850 IEDs are connected to the SIMATIC PCS 7 system via a single station gateway.

Typical features of this configuration include the following:

- Protection devices via TCP/IP communication with IEC 61850 on a station gateway (in simple, non-redundant configuration)
- Configuration of the station gateway is mainly reduced to establishment of the communication connections
- Integration of the IEDs via the SIMATIC PCS 7 PowerControl Library with functions for electrical equipment
- A connection exists to a PCS 7 automation system, e.g. for interlocks
- IEDs can be mutually interlocked, e.g. by wiring or per GOOSE communication
- Communication with the IEDs usually using fiber-optic cables as result of EMC requirements
Use Case 4 – Station controller
In this configuration, a larger number of IEC 61850 IEDs are connected to the SIMATIC PCS 7 system via a station controller.

Typical features of this configuration include the following:

• Protection devices via TCP/IP communication with IEC 61850 on a station controller (non-redundant)
• Configuration of the station controller in the usual manner with CFC and technological objects
• Integration of the IEDs via the SIMATIC PCS 7 PowerControl Library with functions for electrical equipment
• Automation functions of SIMATIC PCS 7 can also be implemented in the station controller (reacts like a PCS 7 standard controller)
• IEDs can be mutually interlocked, e.g. by wiring or per GOOSE communication
• Communication with the IEDs usually using fiber-optic cables as result of EMC requirements

Use Case 5 – Integration via PROFIBUS DP
In this configuration, the IEDs are connected to a PCS 7 automation system via the PROFIBUS DP fieldbus.

Typical features of this configuration include the following:

• Protection devices are connected to a PCS 7 automation system via PROFIBUS DP
• Configuration of the automation system in the usual manner with CFC and technological objects
• Integration of the IEDs via the SIMATIC PCS 7 PowerControl Library with functions for electrical equipment
Get more information

Comprehensive information concerning the SIMATIC PCS 7 process control system:
www.siemens.com/simatic-pcs7
www.siemens.com/simatic-pcs7/powercontrol

SIPROTEC protection devices:
www.siemens.com/siprotec

Industrial Communication:
www.siemens.com/scalance
www.siemens.com/ruggedcom

Information material to download:
www.siemens.com/simatic/printmaterial

Service&Support:
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