SPPA-T3000

Integration of auxiliary power supply in SPPA-T3000 based on IEC 61850

• Technical Description

The bridge between the auxiliary power supply and the unit I&C

April 2009
# Table of contents

Table of contents ............................................................................................................................................... 2

1. System overview ........................................................................................................................................... 3
   1.1 Integration of auxiliary power supply ............................................................................................... 4
   1.2 Design of SPPA-T3000 I&C system ................................................................................................. 5

2. Integration of auxiliary power supply with IEC 61850 ............................................................................... 6
   2.1 Integration instead of linkage ............................................................................................................ 6
   2.2 Communication within the system ................................................................................................... 8
   2.3 Clock time synchronization ............................................................................................................. 9
   2.4 Auxiliary power supply server and expert tools ............................................................................. 10
   2.5 Operational diagnostics - Function diagnostics ............................................................................ 11
   2.6 Handling of event and disturbance records ................................................................................... 12
   2.7 Data transfer to external systems via IEC 61850 ............................................................................ 13
   2.8 Data transfer to external systems without IEC 61850 .................................................................... 14

3. Engineering of the auxiliary power supply .............................................................................................. 15

4. IEC 61850 compatible components ........................................................................................................... 17
   4.1 SIPROTEC 4 .................................................................................................................................... 17
   4.2 I/O boxes ....................................................................................................................................... 18
   4.3 Transformer voltage regulator ....................................................................................................... 19
   4.4 Network components .................................................................................................................... 19

5. Network design and examples ................................................................................................................... 20
   5.1 Design of IEC 61850 network ......................................................................................................... 20
   5.2 Linking of protection devices/bay controllers in the MV network ................................................... 21
   5.3 Integration of LV auxiliary power supply bays ............................................................................. 23
   5.4 Integration of central data points via I/O boxes ............................................................................. 24
   5.5 Protection of individual network sections via firewall or router .................................................... 25
   5.6 Unit-by-unit separation of the auxiliary power supply .................................................................... 26

6. Abbreviations .............................................................................................................................................. 27
1. System overview

Integration of the auxiliary power supply based on the connection of components in accordance with the new IEC 61850 standard is a further innovative step in the direction of a fully integrated I&C system for power generation plants of all performance classes and for all energy sources.

The SPPA-T3000 I&C system is scalable from small applications in heating plants through to the main I&C system of large power plant units. It is based on an object-oriented data structure with a strictly hierarchical separation of the process interfaces (data acquisition), the server level with the automation (real-time processing) and application (no real-time processing) servers and the operation level (thin client).

One of the main objectives of SPPA-T3000 is the avoidance of black boxes and unnecessary links to ancillary systems. Integration of the auxiliary power supply is an important step towards achieving this objective. With its object-oriented data structure and the Ethernet network as a communication platform, the innovative and future-oriented concept of IEC 61850 is an ideal match for the concept behind the system structure of SPPA-T3000. For this reason and thanks to the positive experience gained in initial pilot projects with IEC 61850 in the field of power distribution, the decision was made at an early stage to implement the direct integration of the auxiliary power supply in accordance with IEC 61850.
1.1 Integration of auxiliary power supply

Creating a link to and integrating information from the auxiliary power supply is nothing new. Up to now plants have generally acquired or output this information via bit-parallel or analog input/output modules. With bit-parallel links, information has had to be supplied to the I&C system via marshaling racks. This is a complex procedure involving between 1000 and 5000 signals depending on the size of the unit and the energy source. These signals are output locally via contacts and need to be engineered, cabled and commissioned.

The introduction of digital protection equipment into MV, HV and EHV systems brought with it the disadvantage that the time stamp of the acquired signals could not be transferred with the signals.

If greater convenience was to be achieved for the auxiliary power supply, a separate switchgear control system had to be set up as an alternative so as to permit the exchange of information between the two control systems over a dedicated link. Only a small selection of information would usually be transferred via this interface, with the result that the scope of information available to the main I&C was limited. This was especially inconvenient in the event of fault evaluations, as the data for comparison were distributed between two archives and comparison of the time stamps was only conditionally possible.

Since IEC 61850 was accepted as the worldwide standard for power distribution systems in 2004, it has successfully established itself in all areas of power distribution. Implemented systems range from traction networks (400 kV) to distribution networks (110, 20, 10 kV), through power supply companies, municipal utilities and infrastructure services to industrial locations. Today IEC 61850 is the globally accepted communication standard for switchgear systems and can already be regarded as the state of the art.

IEC 61850 is based on fast, primarily Ethernet-based communication, making it especially suitable for use in modern I&C systems. Switchgear-specific functions, such as system interlocking or intertripping, are moved to the plant level and do not need to be simulated in the I&C system for this reason.

The disadvantages of the bit-parallel link and the disadvantages of an additional switchgear control system no longer exist in the integrated solution which has now become available.

Digital devices with communication interfaces are already implemented in switchgear systems, in unit protection and in other components of the auxiliary power supply. The number of devices available with IEC 61850 is increasing steadily and devices for all the tasks of the auxiliary power supply are already available today. The devices are connected via an Ethernet network and to the automation bus of the I&C system.
1.2 Design of SPPA-T3000 I&C system

SPPA-T3000 has a clearly structured system concept comprising three hierarchy levels:

**Process interfaces:**
Local data acquisition can be implemented by means of FUM modules, SIMATIC ET200M or by directly connecting intelligent field components via Profibus or, in the case of the auxiliary power supply, via IEC 61850.

**Server level:**
Data are processed in automation servers (SIMATIC S7-400 (F)(H) and CM104). These handle the open- and closed-loop controls for the connected process and ensure reliable operation even if the higher-level I&C systems fail. The application server is the central component. It handles all the processes which do not require real-time execution capability. Such processes include the alarm sequence display (ASD), archives and archive evaluations, curve displays, engineering and diagnostics for the entire system, and display processing for the operator terminals.

**Operation level:**
All process operation takes place at this level. The requisite number of operator terminals is available for this purpose. These terminals are connected to the application server as thin clients, generally via a dedicated bus system, and visualize the process on a web interface.
2. Integration of auxiliary power supply with IEC 61850

2.1 Integration instead of linkage

The application of the IEC 61850 philosophy in the auxiliary power supply of the power plant is oriented towards the specific requirements of the auxiliary power supply distribution networks in the power plant. Importance has therefore been attached to the close integration of the auxiliary power supply in the main I&C rather than to implementing a link to a separate system. This is especially reflected in the following features:

- Standard solution without company-specific special features.
- Clearly defined interface to auxiliary power supply equipment through import of SCD files and direct further processing of these data.
- Operating philosophy is similar to that of the solution in the main I&C.
- Rights management ensures exclusive access by qualified personnel.
- Time synchronization of main I&C system is extended to include the IEC 61850 bay control devices.
- Shared data archive for process data and data from the auxiliary power supply.
- Extension of main I&C system diagnostics to include the IEC 61850 components.
- Automatic retrieval of event and disturbance records and archiving on a central server.
However, integration also means direct integration of the data from the auxiliary power supply in the data inventory of the I&C system. The data are available in the automation, on the user interface and in the archive with a priority equal to that of data from the process.

The concept for linking the IEC 61850 network can be compared with the link from the process automation to the automation servers.

In the process automation, Profibus components, such as SIMATIC ET200M and FUM modules, are connected to an automation server of the type S7-400H(F). In the auxiliary power supply, the link takes the form of an Ethernet network connection to an automation server of the CM104 family. This CM104 automation server is an integral part of the I&C system and can handle a wide variety of tasks, such as process optimization, simple automation tasks, external protocol links, in addition to integration of the auxiliary power supply by means of the IEC 61850 interface.

The CM104 automation server can be configured redundantly or not depending on the importance of the auxiliary power supply. Here redundant means that two servers are connected independently to the IEC 61850 network and each server is also connected to the automation bus of the I&C system via a separate interface. The two servers are connected via two further Ethernet interfaces and monitor each other. Both servers are operated in hot mode and bumpless changeover is effected for the most part as required. Data losses are ruled out entirely.
2.2 Communication within the system

Communication within the IEC 61850 network, i.e. below the level of the CM104 automation server, is IEC 61850 compliant. The bay control devices communicate with each other by means of the GOOSE function (GOOSE - Generic Object Oriented Substation Event). This fast sideways communication between field components can be used for setting up electrical protection functions, such as reverse interlocks and plant interlocks. By definition the GOOSE data exchange is not evaluated by the I&C system. Transfer of GOOSE messages to the automation bus of the I&C system is effectively prevented by the automation server.

Communication between the IEC 61850 field components and the automation server takes place by means of reports. These reports are converted to the internal SPPA-T3000 communication structure in the automation server of the auxiliary power supply and transferred to the addressed recipients. Recipients can be other automation servers with a lower-level IEC 61850 network, automation servers from the process automation, or one or more application servers. Needless to say, redundancy criteria are taken into account here.
2.3 Clock time synchronization

The clock times of the auxiliary power supply components connected via IEC 61850 are synchronized via NTP (Network Time Protocol) directly from the central time server of the I&C system. This ensures that all the I&C system components on the Ethernet network have access to synchronized time information and that the time stamps of items of information can be compared on this basis.

All information from field components which are in a position to time stamp binary and analog information upon its acquisition or generation and to transfer it to the I&C system is also transferred to the data inventory of the I&C system via the CM104 bearing this time stamp.

The uniform system-wide time facilitates accident analyses and other archive evaluations.

![Diagram of system-wide uniform time down to the IEC 61850 field components]

- Thin clients
- Application bus
- Application server
- Automation bus
- Automation server
- System-wide uniform time
- CM104
- Direct connection of key control devices/integration in SPPA-T3000

System-wide uniform time simplifies fault analysis and archive evaluation.
2.4 Auxiliary power supply server and expert tools

In some cases linking of the auxiliary power supply may involve a large number of devices from different suppliers and different device families. All devices or device families have specific engineering and diagnostic tools (e.g. DIGSI for SIPROTEC4 and ToolBox for SICAM 1703).

These expert tools are generally operated by the relevant experts and not by control room personnel. They are used for tasks such as device parameterization and device function diagnostics, e.g. checking of actuation or trip criteria.

One or more auxiliary power supply servers as required can be connected to the IEC 61850 network in order to permit work with these tools. Access by these servers to auxiliary power supply components via the application or automation bus is prevented by integrated protection mechanisms. This is designed to prevent excessive loads on the individual bus systems.

The tasks of the auxiliary power supply server include specific tasks, such as:

- Device engineering/parameterization
- Upload/download of parameter sets
- Diagnostics for internal device functions
- Backup of engineering data
- Archiving of event and disturbance records

Integration of auxiliary power supply server for expert tools in auxiliary power supply system

![Diagram showing integration of auxiliary power supply server for expert tools in auxiliary power supply system.](image-url)
2.5 Operational diagnostics - Function diagnostics

Integration in the I&C system means that all the important operational functions, such as IEC 61850 network diagnostics, operational diagnostics for the IEC 61850 components and time clock synchronization are possible directly from the I&C system.

The entire IEC 61850 network, including the active components and connecting cables, is monitored by the diagnostics function of the I&C system via the SNMP protocol and displayed on the user interface of the I&C system.

In addition, electrical engineering experts have the option of selecting components via an auxiliary power supply server using the dedicated expert tools for the connected IEC 61859 field components. This permits specialists to access the auxiliary power supply components without affecting the I&C networks.
2.6 Handling of event and disturbance records

Event and disturbance records are output when network or machinery protection equipment at the MV, HV or EHV levels responds or trips due to a fault in the auxiliary power supply network. An evaluation of these event and disturbance records can identify the cause of the protection trip.

The integrated solution of the IEC 61850 link also includes the automatic retrieval of these event and disturbance records from the protection devices and archiving of these files on a central server in the network. The CM104 automation server scans the connected protection devices cyclically for new event and disturbance records and transfers these to a freely definable computer (IP address) in the network.

Because the evaluation of these event and disturbance records is based on expert tools (e.g. SIGRA), the auxiliary power supply engineering server is the obvious location for archiving.

Archiving of these event and disturbance records on the application server, though technically possible, is not necessarily a good thing. In large systems, this places an additional load on the storage capacity of the server, thus reducing the storage capacity of the process archive.
2.7 Data transfer to external systems via IEC 61850

In cases where data and information also have to be transferred from the IEC 61850 field components to other systems, this is implemented directly from the field components via additional logical links. To this end the standard allows each server component to be connected to several client applications, e.g. five logical links can be set up between one SIPROTEC 4 device and other systems.

Because the I&C system is a client function, the direct transfer of information from the I&C system by means of IEC 61850 communication is not possible.
If data also need to be transferred from the IEC 61850 field components by means of remote control protocol, e.g. to a grid control center, this is performed using an additional CM104 automation server which then ensures communication via IEC60870-5-101 or -104 or Modbus, for example.
3. Engineering of the auxiliary power supply

The IEC 61850 is the first standard to include the engineering process in its definition. The philosophy is oriented towards the usual structures in power distribution, i.e. from the low level to the high level or, more accurately, from the field to the I&C. First the bay control devices are parameterized using their dedicated engineering tools (e.g. DIGSI for SIPROTEC devices) and the ICDs (Intelligent Electronic Device Configuration Description) defined in IEC 61850 are generated. In a second step, these ICDs are grouped to form SCDs (Substation Configuration Description). SCD files generally represent a switchgear system. For this purpose the ICD files are loaded into a system configurator, e.g. DIGSI, and IP addresses and GOOSE functions are added. If not otherwise specified in the project, these services are provided by the supplier of the switchgear system.

SPPA-T3000 is capable of importing these SCD files, thus avoiding dual input of switchgear information. Ideally the data import will correspond to the engineering approach of SPPA-T3000 whereby all data are only ever input at one location - either directly in the system or by means of data import. This noticeably helps to avoid configuration errors, resulting in lower engineering costs, shorter commissioning times and an overall increase in the quality of the engineered solution.
IEC 61850 distinguishes between two reporting procedures:

- Static reporting
- Dynamic reporting

If devices communicate using the **static reporting** procedure, this means that the engineering tool of the bay control device selects all the information visible to the I&C which can be retrieved using this tool. This selection is visible in the SCD file and is therefore detected by the I&C system.

A large number of the bay control devices, however, use the far more flexible principle of **dynamic reporting** whereby all the information in the bay control devices is available to the I&C. This is why the SCD also includes all the available data points - anything up to 1200 data points are possible with a SIPROTEC device. During configuration the I&C selects the 20 to 40 items of information which are required.

In other words the 1150 items of information which are not required would have to be deleted when the SCD file is imported, which would again be susceptible to errors. For this reason the signal list is imported in addition to the SCD file and is used for the determining the message scope during the clarification phase. The signal list is also used for translating the IEC 61850 data structure into the appropriate tag (KKS) structure. Importing the signal list automatically deletes all the data points which are not required from the SCD file.

The signal list is created by the switchgear supplier if not otherwise specified in the project.

When the control system logs onto the bay control device as a client on startup, the I&C sends a record control block to the bay control device, thereby requesting only the data contained in this logon.

Further processing of engineering data from the SCD files and the signal list is performed using the standard tools of the I&C system, i.e. the link to the automation, archiving, the display of data points, the derivation of alarms, etc.

If changes become necessary in auxiliary power supply components, a delta import of the SCD file or signal list is possible, i.e. the import interface detects the changes and reduces or adds to the data inventory accordingly. This procedure is mainly necessary if the connected IEC 61850 components only support static reporting.

If the connected IEC 61850 components support dynamic reporting, however, and if additional information is required in the I&C, this only needs to be added to the I&C system engineering. Upon activation the I&C requests the extended record control block in the bay control device, whereupon the data are made available to the I&C system. Since no changes are necessary in the bay control devices, the SCD file does not need to be reimported.

Standardization of the structure and content of the SCD files means that they can also come from different system suppliers.
4. IEC 61850 compatible components

The driver implemented in the SPPA-T3000 I&C system for communication in accordance with IEC 61850 is device-independent with respect to the connected bay control devices. All devices which operate according to the principle of unbuffered reporting can be connected. However because IEC 61850 is not completely unambiguous in all points we recommend that the IEC 61850 components be tested in conjunction with the control system prior to their initial use.

Part 10 of IEC 61850 defines the test criteria and certification of bay control devices. The use of certified devices must be given preference in all cases, as their general compliance with the standard has already been demonstrated, thus minimizing the amount of testing which may prove necessary in conjunction with the I&C.

The devices below are currently in use in implemented projects and their functional operation has been tested in conjunction with SPPA-T3000:

4.1 SIPROTEC 4

Devices of the SIPROTEC 4 family are used in MV auxiliary power supply distribution and in unit protection. All the available devices are approved for use, including protection devices, bay controllers and combined protection devices/bay controllers. The connection to the I&C can be implemented in a redundant or non-redundant configuration, with fiber-optic or RJ45 data links.
4.2 I/O boxes

I/O boxes are used for the acquisition of binary and analog information and for the local output of commands. Data are acquired or output without any further processing in the bay control device.

Devices from the SIPROTEC range, such as 6MD61 or devices from the SICAM 1703 range, can also be used as hardware alternatives.

- **Compact devices such as SIPROTEC 6MD61**
  are especially suitable if small quantities of data are acquired, primarily in a distributed structure, and devices are installed in the vicinity of the switchgear or other EMC-critical zones.

- **I/O boxes from the SICAM 1703 range**
  are modular in design and can be extended from small data quantities to data quantities from 1000 I/Os. These must be installed in control cabinets. The link to the data network is configured non-redundantly.

---

**IEC 61850 components  
Structure of peripheral elements for I/O-Box**

| PS-6630 | Power supply module 24-60VDC EMC+  |
| PS-6632 | Power supply module 110-220VDC EMC+  |
| PE-6400 | For Ax electrical peripherals bus (USB, 3m)  |
| PE-6401 | For Ax optical peripherals bus (PCF, 200m)  |
| DI-6100 | Binary input 2x8, 24-60VDC, 10ms resolution  |
| DI-6101 | Binary input 2x8, 110/220VDC, 10ms resolution  |
| DI-6102 | Binary input 2x8, 24-60VDC, 1ms resolution  |
| DI-6103 | Binary input 2x8, 110/220VDC, 1ms resolution  |
| DO-6200 | Binary output transistor 2x8, 24-60VDC  |
| DO-6212 | Binary output relay 8x 24-220VDC/230VAC  |
| AI-6300 | Analog input 2x2 ±20mA/±10V  |
| AI-6307 | Analog input 2x2 ±5mA  |
| AI-6310 | Analog input 2x2 Pt100/Ni100  |
| AI-6303*) | Analog input (converter,4xU,3xI) EMC+  |
| AO-6310 | Analog output 4x ±20mA/±10mA/±5V/±10V  |
| TE-6420 | Speed measurement 2x2 24VDC/5VDC/NAMUR  |
| TE-6450 | Position measurement 2x2 SSI/RS-422  |

*) not modular, 1 autonomous peripheral element
4.3 Transformer voltage regulator

The Gossen transformer regulator can be used. This regulator has an IEC 61850 interface and has been tested in conjunction with SPPA-T3000.

4.4 Network components

Network switches from the Canadian company RuggedCom are used as active components. RuggedCom has a high level of competence in the field of networks and was the first company to launch network switches which satisfied the stringent requirements of IEC 61850.

- RS 8000: with 8 x fiber-optic interfaces (MTRJ)
- RS 8000H: with 4 x RJ45 and 4 fiber-optic switches (ST)
- RS 8000T: with 6 x RJ45 and 2 fiber-optic switches (MTRJ)

These three devices with different interface configurations have been directly integrated in the monitoring and diagnostic functions of the I&C system. These three different switches lend a high degree of flexibility to the network design while at the same time reducing type diversity. This restriction also brings advantages in connection with spare parts management.
5. Network design and examples

5.1 Design of IEC 61850 network

IEC 61850 standardizes a 100 Mbit Ethernet network as the communication platform. The preferred network structure is a ring structure with fiber optic connections. Although a star-shaped network design is actually permitted by the standard, it is not to be recommended due to the lack of redundancy.

The ring structure and ring management, which is also standardized in IEC 61850, ensures the necessary fault tolerance in the network such that, in the event of failure of a component, all the other components in the network continue to be accessible and the failure only has minimal effects on operation of the other equipment. Ring management operates in accordance with the rapid spanning tree protocol, which reconfigures the ring in the event of faults in the network such that all nodes become accessible if at all possible. This reconfiguration of the ring is performed with changeover times << 100 ms. This means that, if GOOSE functions are used, system interlocks and protection functions remain fully operational in the event of a fault.

The detailed design of the network is largely determined by the communication interfaces of the connected components. The simplest form is an RJ45 interface. This permits the device to be connected to a network switch. If the device has two interfaces, a redundant switch can also be connected. A very convenient solution was realized by Siemens in the SIPROTEC 4 devices. These feature two fiber optic interfaces at the rear and the switch functionality was integrated directly in the device. The devices can be connected directly to the fiber optic rings without the need for an external switch.

In practice the network will usually be a mixture of a ring structure and a star structure. A ring structure was exclusively configured in the MV network and in the link to the unit protection. In the LV network and in the links to other auxiliary power supply components, the network switches are integrated in fiber-optic ring structures. The links to bay control devices and IEC 61850 components are implemented in a star configuration with RJ45 connecting cables.
5.2 Linking of protection devices/bay controllers in the MV network

If devices from the Siemens SIPROTEC 4 range are used, they can be connected by two different methods:

- By means of a direct link to the fiber-optic rings or
- By means of RJ45 links to additional network switches

Direct integration in the fiber-optic ring must always be given preference due to its superior electromagnetic compatibility (EMC) if bay control devices are installed directly in the LV section of the switchgear system.

Use of the network switches from RuggedCom is necessary with this variant as the ring management of the SIPROTEC devices is designed specifically for these network components. No switches from other suppliers are currently released for use.
If the devices are installed in switchgear cabinets or on protection panels in electronic equipment rooms, they can also be connected via external network switches.

**Supply limit for Ethernet network:**

The supply limit should be the switchgear connection to the network or the protection panel or cabinet, i.e. the device installation and the internal switchgear/cabinet/panel fiber-optic links are to be supplied by the system supplier. The incoming fiber-optic cables from the I&C network cabinet are supplied and installed by I&C.
5.3 Integration of LV auxiliary power supply bays

If auxiliary power supply panels, i.e. incoming feeder panels and coupler panels, are to be integrated into the IEC 61850 data network in LV distribution systems, I/O boxes are used for this purpose. Unlike MV protection devices and bay controllers, I/O boxes have no field-specific functions, i.e. information is simply acquired and output.

The process-related outgoing feeders in LV distribution systems are usually equipped with SIMOCODE components and integrated directly in the automation equipment via a PROFIBUS DP connection.

Devices from the SIPROTEC 4 and SICAM 1703 ACP ranges are currently available as tested I/O boxes. SIPROTEC devices, such as 6MD61, come with a fixed number of signal quantities but can be integrated in the data network like any other SIPROTEC devices.

I/O boxes from the SICAM 1703 range are modular in design and can therefore be adapted to suit the configuration requirements of the particular system. Because these devices only feature one IEC 61850 interface to the I&C (1 xRJ45), an external network switch must always be implemented for network integration. The lack of network redundancy can, however, be compensated for through systematic division of actuators between the two independent buses of the power supply system and the appropriate allocation of I/O boxes.

The supply limit for the network must be agreed project-specifically. If nothing is stipulated, the recommendations for MV integration apply.

The integration of LV auxiliary supply bays in the IEC 61850 network is meaningful in cases where it is seen to be important that the entire auxiliary power supply is mapped in the I&C system in accordance with a uniform structure.

Alternatively it is also possible to integrate the LV auxiliary power supply bays in the Profibus lines.
5.4 Integration of central data points via I/O boxes

If data need to be acquired at a central point in the power plant, e.g. marshaling racks in the area of the FGD plant, I/O boxes from the SICAM 1703 ACP range can also be used for this purpose.
5.5 Protection of individual network sections via firewall or router

If individual sections are to be protected from access by other nodes of the network, e.g. access to unit protection devices via central engineering tool, the link to individual network sections can be protected by means of firewalls or network routers.

It must be ensured, however, that the bay control devices in this protected network section are routing-capable or that they can communicate via a standard gateway.
5.6 Unit-by-unit separation of the auxiliary power supply

If a project comprises several power plant units and some shared common equipment, the I&C is also structured according to units as a consequence. This separation is reflected in the overall I&C structure, the benefit here being that the I&C of each unit can be shut down without affecting operation of the rest of the plant.

This requirement generally also applies to the auxiliary power supply.

For the IEC 61850 network this means that the network rings are configured separately for the units and the common equipment. All network rings end in a network cabinet in the I&C equipment room. This is also where the redundant connection to the automation bus of the main I&C is implemented.
## 6. Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM104</td>
<td>SPPA-T3000 automation server</td>
</tr>
<tr>
<td>DIGSI</td>
<td>Engineering software for Siemens protection devices</td>
</tr>
<tr>
<td>ECS™</td>
<td>Embedded Component Services</td>
</tr>
<tr>
<td>EMC</td>
<td>Electromagnetic compatibility</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>GOOSE</td>
<td>Principle of communication for bay control devices in accordance with IEC 61850 (Generic Object Oriented Substation Event)</td>
</tr>
<tr>
<td>HV</td>
<td>High voltage</td>
</tr>
<tr>
<td>ICD</td>
<td>Intelligent Electronic Device Configuration Description</td>
</tr>
<tr>
<td>KKS</td>
<td>Kraftwerks-Kennzeichnungs-System (power plant identification system)</td>
</tr>
<tr>
<td>FO</td>
<td>Fiber-optic cable</td>
</tr>
<tr>
<td>ASD</td>
<td>Alarm sequence display in SPPA-T3000</td>
</tr>
<tr>
<td>MV</td>
<td>Medium voltage</td>
</tr>
<tr>
<td>LV</td>
<td>Low voltage</td>
</tr>
<tr>
<td>NTP</td>
<td>Network time protocol</td>
</tr>
<tr>
<td>R4</td>
<td>SPPA-T3000 Release 4</td>
</tr>
<tr>
<td>SCD</td>
<td>Substation Configuration Description</td>
</tr>
<tr>
<td>SIGRA</td>
<td>Evaluation tool for event and disturbance records</td>
</tr>
<tr>
<td>SIMOCODE</td>
<td>Intelligent field units for LV switchgear</td>
</tr>
<tr>
<td>SIPROTEC</td>
<td>Siemens device family for protection devices and bay controllers (MV and HV level)</td>
</tr>
<tr>
<td>SNMP protocol</td>
<td>Simple network management protocol</td>
</tr>
<tr>
<td>SPPA</td>
<td>Siemens Power Plant Automation</td>
</tr>
<tr>
<td>SPPA-E3000</td>
<td>Siemens Power Plant Automation - Electrical Solutions</td>
</tr>
<tr>
<td>SPPA-T3000</td>
<td>Siemens Power Plant Automation - DCS</td>
</tr>
</tbody>
</table>