

Digital Substations

Overview

Digital substations are characterized by a higher integration of communication networks, namely by replacing analogue signalling subsystems by real time and electronic communications, turning the substation into an advanced integrated platform for automation, control, protection, and monitoring, leveraging a data-centric approach towards a more efficient asset operation and maintenance.

The main advantages are the simplification of installations and processes, the improvement of flexibility and expandability and the increase of interoperability within the substation which, ultimately, contributes to a better operational performance, as well as to the overall improved reliability and safety of the substation.

Leveraged by its technology background and significant references in substation automation, Efacec developed a new set of intelligent electronic devices, comprising bay controllers, protection relays and merging units, to cope with the new digital substation paradigm, specifically addressing the requirements of process bus, cybersecurity, time synchronization, and communications resilience.

Key benefits

- **Efficiency and Safety** → Simplified installations and more flexible processes, thus providing a more reliable and safe operation of the overall power networks
- **Flexibility** → Simpler system expansion and evolution, thus leveraging decentralized and innovative solutions for substation automation
- **Digitalization** → Turning the substation into an advanced data platform, allowing the deployment of future-proof applications suitable for enhanced system upgrade
- **Improved Levelized Cost of Ownership** → More efficient asset lifecycle management, from design and configuration to installation and commissioning, enhancing system operation and maintenance

Main features

- IEC 61850-9-2 process bus
- IEC 61131-3 programming
- RSTP & PRP/HSR redundancy
- PTPV2 time synchronization
- Cybersecurity
- Web-based HMI

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New Features of CLP 500SAS

Challenges for Substation Automation

- More complexity and change of both the T&D infrastructure and the business model
- Need for optimized asset use
- Increased requirements on T&D availability and QoS
- Sustainability for O&M: people, skills, and supply during the lifecycle
- Increased focus on TCO optimization
- Reduced lead times for project execution

Buzz-words

- Technology skills and culture
- Cybersecurity
- Innovation cycles
- System design
- Testing and commissioning
- Interoperability

The Efacec solution for the digital substation relies on a new version of the CLP 500SAS portfolio, which is a proven technology used in conventional substation automation. The basis for this approach are:

- Proven technology widely used in substation automation in tier 1 and emerging markets;
- Driven by the digital substation enabling standards, Efacec upgraded the existing IED and station server, so that the CLP 500SAS solutions serve the emerging digital substation market;
- A new IED was developed, which corresponds to the Efacec solution for merging units;
- As the digitalization new trend also applies to substation automation, Efacec developed a new software tool for asset management, fully compatible with digital substations;
- State of the art cybersecurity features in all substation automation portfolio.

Enhanced Products Overview

Efacec developed new features for bay controllers and protection relays, as well as for merging units, enhancing its product family range for substation automation.

TPU 500 ed.2/BCU 500 ed.3 P&C IED series evolution

Efacec proudly announces the new TPU 500 ed.2 (protection relays family range), TCU 500 ed.2 (transformer control unit) and BCU 500 ed.3 (general purpose bay control units) new versions, which cope with the IEC 61850-9-2 process bus digital interface.



Key features

- IEC 61850 ed.2 MMS Server and GOOSE publisher/subscriber
- IEC 61850-9-2LE or IEC 61869-9 sampled values subscriber
- Two dual Ethernet interfaces for station/process bus supporting PRP/HSR, plus single Ethernet interface for remote administration
- Accurate time synchronization by PTPv2 or IRIG-B
- Redundant power supply in option
- Half-rack option available

Advantages

- Standard-based solution (supporting both IEC 61850-9-2LE and IEC 61869-9) with proven interoperability
- Support of mixed mode (synchronized sampled values subscription and hardwired analogue signals in the same IED)
- Line differential protection prepared for lines between substations with different technologies (merging units in one line end and hardwired connections in the other line end)
- Redundant sampled values subscription scheme from duplicated merging units, with real-time self-recovery mechanism
- Real-time recovery algorithm for lost samples
- Advanced diagnostic available for easy commissioning and operation

MCU 500

New process level IED

Efacec also announces the new MCU 500 merging unit, which expands its original portfolio in substation Automation, also coping with the IEC 61850-9-2 process bus digital interface.



Key features

- IEC 61850-9-2LE or IEC 61869-9 sampled values publisher
- IEC 61850 ed.2 MMS Server and GOOSE publisher/subscriber
- Two dual Ethernet interfaces supporting PRP/HSR
- Accurate time synchronization by PTPv2 or IRIG-B
- Up to 16 current or voltage analogue inputs, with 0.2% accuracy
- Up to 80 binary inputs or 60 binary outputs
- Redundant power supply in option

Advantages

- Standard-based solution (prepared for both IEC 61850-9-2LE and IEC 61869-9) with proven interoperability
- Compact and modular device, easy to install and maintain
- Both protection and measurement CT cores in the same IED
- Both protection and power quality profiles (80 or 256 samples per cycle according to IEC 61850-9-2LE)
- High-speed tripping through dedicated binary outputs
- Integrated CT, VT, trip circuit and circuit breaker and switch supervision
- Integrated measurement and monitoring (including disturbance recording) for easy operation
- Test and simulation modules for easy commissioning

UC 500 ed.3

Station server and gateway evolution

The core of the substation automation system was also improved. As a result, Efacec announces the renewed UC 500 ed.3, which performs as station server and gateway.



Key features

- Higher processing capacity
- Increased RAM memory, system, and data disk capacity
- Support for Windows 10 and 64-bit operating systems
- Redundant power supply for all options
- Several communications interfaces
- Hardware-based PRP interface
- IEC 61850 client and server applications
- Integrated application redundancy schemes
- Integrated topology-based interlocking (rule-based solution)

Advantages

- Data collection for integrated supervision and control of the digital substation
- Full IEC 61850 station-bus compliance, therefore suitable to integrate data from multiple IED vendors
- User-friendly web-based HMI

System Point

New system management tool

Finally, Efacec has also developed a new software tool called System Point, suitable for asset, system, and data management for substations.



Key features

- Server based platform
- Vendor neutral
- Based on IEC 61850 and IEC 62351
- Multiple deployment configurations
- Fully customizable

Advantages

- Instant access to system status, anywhere
- Fully customizable
- Centralized management
- Secure remote accessibility
- Unified operational, security data and user management
- Standards-based solution (IEC 61850 and IEC 62351)
- Minimum configuration



Medio Mundo 220/66/20 kV Substation
ENEL Peru (Peru)

First digital substation at ENEL Peru

- Multi-vendor Digital Substation Automation System with proved interoperability
- TPU 500 and BCU 500 with process bus interface
- Integration with 3rd party stand-alone merging units
- Line differential protection with process bus interface in Medio Mundo substation and conventional hardwired analogue inputs in remote stations



Gertsevo 220/110 kV Substation
OEK (Russia)

Digitalization of existing SAS

- High-speed auto-reclosing blocking scheme in the cable section of 13 lines and associated disturbance recorder function
- Multi-vendor DSAS with proved interoperability
- Integration with 3rd party non-conventional optical CTs
- TPU 500 series IEDs with synchronized sampled values subscription at process-bus interface and conventional hardwired analogue inputs



Lucero 66 kV Substation
SAESA (Chile)

Digital line protection blocking scheme

- Monitoring of a remote tap located at the middle of a line through the acquisition of sampled values
- TPU 500 and BCU 500 with process bus interface
- MCU 500 merging unit



Monte da Pedra 150 kV Switching Station
REN/R&D Nester (Portugal)

Digital substation pilot-project

- Process bus compliant IED multi-vendor installation
- TPU 500 with process bus interface
- MCU 500 merging unit
- Line differential protection using sampled values over IP/MPLS channel



Montemor 60 kV Substation
E-redes (Portugal)

Digital substation DSGrid pilot-project

- Process bus compliant IED installation with full Efacec solution
- MCU 500 merging units
- TPU 500 with process bus interface for HV line protection and control

Co-funded by:



RAC Pilot-project
E-redes (Portugal)

Automatic centralized data collection

- Integration of System Point at 6 substations
- Use of several technologies from different generations and vendors
- Automatic collection of power system data (disturbance records, event logs), operational events, system status, protection settings

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mod. CS4882110A1