Lars Frisk, Global product manager, ABB Substation Automation Products, 2013-12-09

IEDs / Combiflex Relays
Latest trends
Agenda

• Relion® protection and control
  ▪ The six series for protection and control
  ▪ Relion product family highlights
  ▪ Relion for various application areas

▪ History
  ▪ Relion 650 and 670 series
  ▪ COMBIFLEX® and COMBITEST

▪ Cyber security
▪ Process bus solutions
▪ Tools for the complete lifecycle
▪ Roadmap ahead
Agenda

- **Relion® protection and control**
  - The six series for protection and control
  - Relion product family highlights
  - Relion for various application areas
- **History**
  - Relion 650 and 670 series
- **COMBIFLEX® and COMBITEST**
- **Cyber security**
- **Process bus solutions**
- **Tools for the complete lifecycle**
- **Roadmap ahead**
The Relion® product family offers widest range of products for protection, control, measurement and supervision for power systems. To ensure interoperable and future-proof solutions, Relion products have been designed to implement the core values of the IEC 61850 standard. With ABB’s leading-edge technology, global application knowledge and experienced support network, you can be completely confident that your system performs reliably - in any situation.
Committed to protect
The ABB knowledge and experience

- Ultimate grid reliability, dependability and selectivity based on ABB’s extensive experience
- Rigid testing at every stage of the development and manufacturing
- Relion products incorporate our proven knowledge and proven algorithms to a new level
Relion® - from generation and interconnected transmission grids to secondary distribution kiosks

- **670/650 series**
  Flexibility, performance and ease of use from ready-to-use solutions for generation, transmission and sub-transmission applications

- **630 series**
  Flexibility and performance for demanding utility distribution and industrial applications

- **615 series**
  Compact and powerful solution for utility distribution and industrial applications

- **610 series**
  Dedicated protection for utility distribution and industrial applications

- **605 series**
  Simplicity for secondary distribution applications
Agenda

• Relion® protection and control
  ▪ The six series for protection and control
  ▪ Relion product family highlights
  ▪ Relion for various application areas

• History
  ▪ Relion 650 and 670 series
  ▪ COMBIFLEX® and COMBITEST
  ▪ Cyber security
  ▪ Process bus solutions
  ▪ Tools for the complete lifecycle
  ▪ Roadmap ahead
### Release history

#### Relion 650 and 670 series

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Covers all applications, from generation and interconnected transmission grids to secondary distribution kiosks

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<thead>
<tr>
<th>Application</th>
<th>Type</th>
<th>670 series</th>
<th>650 series</th>
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<tr>
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### Relion® Product Family
#### Actual portfolio per application

- Covers all applications, from generation and interconnected transmission grids to secondary distribution kiosks

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<thead>
<tr>
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# Busbar protection

## Positioning

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<tr>
<th>Product</th>
<th>REB500</th>
<th>REB670 1Ph</th>
<th>REB670 3Ph</th>
<th>REB650</th>
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<tr>
<td>low impedance</td>
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<td>●</td>
<td>-</td>
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<tr>
<td>high impedance</td>
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<td>zone</td>
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<td>2</td>
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<td>check zone</td>
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<td>●</td>
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<td>●</td>
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<tr>
<td>bay</td>
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<td>24</td>
<td>8</td>
<td>-</td>
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<td>CT's</td>
<td>180</td>
<td>24</td>
<td>24</td>
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<td>1995</td>
<td>2006</td>
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Busbar protection
Portfolio positioning

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<tr>
<th>1BB.</th>
<th>2BB.</th>
<th>3BB.</th>
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<tbody>
<tr>
<td>REB650</td>
<td>REB670</td>
<td>REB500</td>
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- **High Impedance**
- **Low Impedance**

- **Centralized**
- **Distributed**

- **Busbar Protection**
- **Station Protection**
## Bay control and breaker Positioning

<table>
<thead>
<tr>
<th>Product</th>
<th>REC670</th>
<th>REC650</th>
<th>REQ650</th>
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<tr>
<td>Segment</td>
<td>Transmission Subtransmission</td>
<td>Subtransmission</td>
<td>Transmission Subtransmission</td>
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<tr>
<td>Controllable objects, max</td>
<td>30</td>
<td>8</td>
<td>8</td>
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<tr>
<td>Controllable bays, max</td>
<td>6</td>
<td>1</td>
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<tr>
<td>Automatic voltage control of parallel transformers</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Reservation between bays</td>
<td>Basic + Advanced</td>
<td>Basic</td>
<td>Basic</td>
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<tr>
<td>Tripping type</td>
<td>1Ph and 3Ph</td>
<td>3Ph</td>
<td>1Ph and 3Ph</td>
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Generator protection

Positioning

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<th>Class (MVA rating)</th>
<th>Hydro</th>
<th>Turbo</th>
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<td>pico</td>
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<tr>
<td>micro</td>
<td>&lt; 2</td>
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<td>small</td>
<td>1 to 15</td>
<td>&lt; 30</td>
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<tr>
<td>medium</td>
<td>10 to 60</td>
<td>20 to 200</td>
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<td>large</td>
<td>40 to 300</td>
<td>180 to 650</td>
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<td>extra large</td>
<td>&gt; 300</td>
<td>&gt; 650</td>
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### Product

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<tr>
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<th>REG670</th>
<th>REG650</th>
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<tbody>
<tr>
<td>Segment, Machine rating</td>
<td>Medium &amp; upwards</td>
<td>Medium &amp; below</td>
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</tbody>
</table>

### Applications

- Nuclear, hydro, fossil, steam, gas, diesel, co-gen, waste-energy, desalination
- Hydro, fossil, steam, gas, diesel, co-gen, waste-energy, desalination, wind

### Generator differential

- ●

### Generator + Transformer unit protection

- ●

### Multiple PDIF zones of protection

- ●

### Sensitive reverse power protection

- ●

### Stator Injection

- ● (with REX060)

### Rotor Injection

- ● (with REX060+REX061)
  - (50Hz/60Hz with RXTTE4 only)
Transformer protection Positioning

<table>
<thead>
<tr>
<th>Product</th>
<th>RET670</th>
<th>RET650</th>
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<tr>
<td>Segment, Transformer rating</td>
<td>Large and medium</td>
<td>Medium</td>
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<td>2-3 winding transformers</td>
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<td>●</td>
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<tr>
<td>Multiple main protections (TWPDIF)</td>
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<tr>
<td>Special transformers (phase shifting, HVDC converter trafo) + auto transformers (all sizes) + SVCs and FACTS devices</td>
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<tr>
<td>Tripping time (restrained/unrestrained)</td>
<td>25 ms / 12 ms</td>
<td>25 ms / 20 ms</td>
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<tr>
<td>Automatic voltage control of parallel transformers (max in IED)</td>
<td>4</td>
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<tr>
<td>Apparatus control (APC)</td>
<td>30 (6 CB)</td>
<td>8 (1 CB)</td>
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<tr>
<td>Dual CT input per winding (for multi breaker arrangements)</td>
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## Line protection

Positioning

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<th>RED670</th>
<th>REL670</th>
<th>REL650</th>
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<tbody>
<tr>
<td>Segment</td>
<td>Transmission Subtransmission</td>
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<td>Line distance protection</td>
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<td>Line differential protection</td>
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</tr>
<tr>
<td>Tripping type</td>
<td>1Ph and 3Ph</td>
<td>1Ph and 3Ph</td>
<td>1Ph and 3Ph</td>
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<tr>
<td>Tripping time</td>
<td>1 cycle</td>
<td>1 cycle</td>
<td>1.5 cycles</td>
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<td>Series compensated line protection</td>
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<td>Apparatus control (APC)</td>
<td>15 (2 CB)</td>
<td>15 (2 CB)</td>
<td>8 (1 CB)</td>
</tr>
</tbody>
</table>
Agenda

- Relion® protection and control
  - The six series for protection and control
  - Relion product family highlights
  - Relion for various application areas
- History
  - Relion 650 and 670 series
- COMBIFLEX® and COMBITEST
- Cyber security
- Process bus solutions
- Tools for the complete lifecycle
- Roadmap ahead
COMBIFLEX®
Auxiliary relays

- Tripping
  - Ultra High Speed Tripping
  - Trip Lock-out
  - VT Selection
  - CT-Switching
  - Lock-out
  - Output relays in Protection relay
  - AC-supply monitoring
  - Contact Multiplication
  - Interposing relays in control equipment

- Bi-Stable
- General Purpose

Medium duty
- RXMA1/2
- RXMM1
- RXMB1/2, RXMC1 high speed
- RXMD1/2
- RXME1/18
- RXMH2

Heavy duty
- RXMT1 Ultra high speed
- RXMS1 High speed
- RXMVB2/4

Light duty

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COMBIFLEX®
Supervision, signaling and time relays

- Signalling & Supervision
  - Supervision
  - Signal Flag

- Time
  - Range: 0.1 - 320 s
  - Range: 20 ms - 99 h

- RXEM1
  - Trip circuit supervision
- RXSF1
  - Transformer trouble indications
  - Signalling applications
- RXKA1
  - Pick-up or drop-out delay
- RXKL1
  - Pick-up delay
- RXKM2H
  - Pick-up or drop-out delay
COMBIFLEX®
Measuring Relays

- **RXBA4**
  - Single, two or three phase fuse failures
  - Alarm and block protection equipment

- **RXETB1**
  - Single or two phase fuse failures
  - Alarm only

- **RXEDA1**
  - Overvoltage protection
  - Undervoltage protection
  - DC Voltage Protection
  - Neutral point voltage protection
COMBITEST Portfolio

- Test Switches
  - RTXP 8
  - RTXP 18
  - RTXP 24

- Test-plug Handles
  - RTXH 8
  - RTXH 18
  - RTXH 24

- Trip-block plug
  - RTXB

- Ammeter Test Plug
  - RTXM

- Block-plug handle
  - RTXF
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Cyber security for substation automation

Why is cyber security an issue?

- Cyber security has become an issue by introducing **Ethernet (TCP/IP) based communication protocols** to industrial automation and control systems.

- **Connections to and from external networks** to industrial automation and control systems have opened systems and can be misused for cyber attacks.

- **Cyber attacks on industrial automation and control systems are real and increasing**, leading to large financial losses.

- **Utilities need to avoid liability** due to non-compliance with regulatory directives or industry best practices;
Cyber security for substation automation
Standards and their scope

- Energy
- Industrial Automation
- IT

Design Details

- IEC 62351
- IEEE P 1686
- ISO 27K
- NIST 800-53
- NERC CIP
- IEC62443

Details of Operations

- Technical aspects
- Relevance for Manufacturers

Operator

Completeness

Manufacturer

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Cyber security for substation automation
Systematic approach to ensure cyber security

- ABB has identified cyber security as a key requirement and is committed to providing our customers with products, systems and services that clearly address this issue.

- ABB takes a systematic approach to cyber security through its operations on a global level. For instance, ABB has established the power systems security council to:
  - keep track of the global needs and requirements concerning cyber security
  - to drive proactive R&D effort to support future trends, and ensure fast and efficient security improvements
ABB’s cyber security initiatives
Product and System Hardening

- **ABB’s Solution**
  - Centralized security testing center guarantees a common and best practice robustness testing of all products
  - Regular regression tests on ABB products and systems ensure a high level of robustness against cyber security attacks
REB500 supports the following functionality:

- User account management
- Role based access control
- Password policy enforcement
- Local and remote logging of security events

REB500 has been hardened, unused services have been closed.

Deployment guideline available

Supports NERC-CIP and IEEE 1686 standard
Relion® 670/650 series
Cyber security capabilities

- The Relion 670/650 Series supports the following functionality:
  - User Account Management
  - Role based access control
  - Local and remote logging of security events
  - Secure communication from PCM600
  - Denial of service protection (protects primary IED functionality)

- 670/650 Series has been hardened, unused services have been closed
- Deployment guideline for 650 Series available
AFS / AFF/ AFR family
Cyber security capabilities

- AFS / AFF / AFR familily
  - User accounts and access levels
  - SSH for secure CLI access
  - Secure web access using SNMPv3 (encrypted)
  - Unsecure services can be deactivated (e.g. telnet)
  - Restricted management access
  - Port security (MAC or IP based)

- AFR - router
  - Access control list (ACL)

- AFF - firewall
  - Integrated VPN
  - Statefull firewall
  - Network address translation
Agenda

• Relion® protection and control
  ▪ The six series for protection and control
  ▪ Relion product family highlights
  ▪ Relion for various application areas

▪ History
  ▪ Relion 650 and 670 series
  ▪ COMBIFLEX® and COMBITEST

▪ Cyber security

▪ **Process bus solutions**
  ▪ Tools for the complete lifecycle
  ▪ Roadmap ahead
SAS configuration
SAS with Network Redundancy on Station/Process Bus

- **Station Level**
  - HMI/GW with PRP
  - PRP network redundancy
  - RSTP been used in the independent station bus networks
  - 2 independent master clocks with 1588

- **Bay Level**
  - PRP to Station bus
  - HSR to process bus
  - Transparent clock / ordinary clock

- **Process Level**
  - MU with HSR and 1588
  - Individual 9-2 stream for each MU

- **Business Motivation**
  - Redundancy on station and process bus
  - Large station level network not limited by 100Mbit -> PRP
  - Cost optimized network redundancy on process bus
SAS configuration
SAS with Network Redundancy on Station/Process Bus

- **Station Level**
  - HMI/GW with PRP
  - PRP network redundancy with RSTP been used in the independent station bus networks
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- **Bay Level**
  - PRP to Station bus
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- **Process Level**
  - MU with HSR and 1588

- **Business Motivation**
  - Redundancy on station and process bus
  - HSR interbay bus to share 9-2 sample values/GOOSE between bay with additional 2 port in Bay level IED
  - Cost optimized network redundancy on process bus and interbay process bus
Agenda

- Relion® protection and control
  - The six series for protection and control
  - Relion product family highlights
  - Relion for various application areas
- History
  - Relion 650 and 670 series
- COMBIFLEX® and COMBITEST
- Cyber security
- Process bus solutions
- **Tools for the complete lifecycle**
- Roadmap ahead
## PCM600 2.5

Simplified variant concept, no license, free of charge

### Functionality PCM600 variants / versions

<table>
<thead>
<tr>
<th>Functionality</th>
<th>PCMv2.4 (base)</th>
<th>PCMv2.4 (Eng)</th>
<th>PCMv2.4 (Eng Pro)</th>
<th>PCMv2.5</th>
<th>IET600</th>
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<td>Graphical Application (ACT) Viewing</td>
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<td>Graphical Application (ACT) Config</td>
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<td>PCM User Management</td>
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<tr>
<td>Disturbance Handling</td>
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<tr>
<td>Signal Monitoring</td>
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<tr>
<td>Event Viewer</td>
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<tr>
<td>Communication Mgt for DNP, Modbus, SPA &amp; LON, IEC 103</td>
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<tr>
<td>IEC 61850 engineering for any System, Vendor</td>
<td>●</td>
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<tr>
<td>IEC 61850 engineering for Relion IEDs</td>
<td>●</td>
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</tbody>
</table>

- IET600 taken out of the PCM600 EP package (v.2.5 and further) → separate product
PCM600 2.5

- Simplification of PCM600 variant concept
  - One variant only, free of charge download
- Installation of multiple PCM600 versions on same computer
  - v.2.5 is the first version that can be installed in parallel to any former or future PCM600
- Significant performance improvements
  - standard user operations
    - “Opening PCM600” or “Opening Project” (up to 7 -10 times faster compared to 2.4)
    - Write/Read performance to/from IEDs of improved in general
    - Import & Export project with good performance improvements
  - Increased supported system size (# of IEDs) per project
PCM600 2.5

- IEC 61850 engineering embedded in PCM600
  - closing basic gaps in IEC61850 IED engineering
  - additionally introduces dedicated system integration capabilities for systems with ABB only IEDs.

- Supported use cases:
  a) “as is” engineering process with IET600 with new possibility to see actual IEC 61850 configuration in the PCM600 user interface
  b) Integration of loose Relion IEDs into ABB & 3rd party systems (dataset and report control block engineering on ABB IEDs)
  c) GOOSE configuration between Relion IEDs in one project
PCM600 2.5

- Graphical representation of distance protection function
  - Dynamic chart that provides visual feedback of distance protection parameter settings when changing them
    - Understand meaning of the different parameters
    - Helps to eliminate wrong settings

- New compare functions for
  - PCM600 configurations
    - Online comparison - PCM600 configuration with configuration in IED
    - Offline comparison - Two IED configurations, within same project or in different projects
  - IEC 61850 SCD file import preview on changes
Rule based visualization of parameter settings (RBPS)
- Hides unnecessary parameters based on value of other parameter

For effective reduction of visible parameters in Parameter Setting Tool

Benefit
- Allows customers to focus on the relevant parameters

New with PCM600 2.5, already supported by 670 ConnPack ver 2.1.6
- ConnPack of other Relion IED series will follow
New Release “PCM600 2.5”

Selected Feature Highlights

- Enables utilities to customize appearance of IED context menus according to their roles.
- Customer specific tools with Customized Menus.
- To simplify user interface, show only needed tools, used by e.g. maintenance and operation engineers.
IET600 - Integrated Engineering Tool

- New product offering in Substation Automation Products:
  - **IET600 - Integrated Engineering Tool**
    - Configure IEC 61850 communication between ABB and 3rd party protection and control IEDs (including GOOSE)
    - Maintain and modify station-level signals for ABB’s SYS600 station computers and gateways
  - IET600 is a stand-alone product serving:
    - Product sales - IEDs, HMI and gateways
    - New Version 5.2 released in 12/2012
## IET600 v.5.2 - Introduction

### Changes in Product Packages and Functionality

<table>
<thead>
<tr>
<th>Functions</th>
<th>IET600 v.5.1</th>
<th>IET600 v.5.2</th>
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<tbody>
<tr>
<td>Substation specification (graphical editor for SLD)</td>
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<tr>
<td>IED data exchange (import/export ICD, IID, CID)</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Communication specification</td>
<td>●</td>
<td>●</td>
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<tr>
<td>IEC 61850 Data flow engineering</td>
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<tr>
<td>MMS+GOOSE / Sampled Values</td>
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<tr>
<td>Import / export IEC 61850 SCD file</td>
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<tr>
<td>Merge and Compare function</td>
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<tr>
<td>Export IEC 61850 Dataflow Signallist</td>
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<tr>
<td>SAS6xx (SYS600 / SYS600C) Maintenance Engineering</td>
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<tr>
<td>SAS6xx (SYS600 / SYS600C) Export Signal List</td>
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<tr>
<td>HW key license for external sales</td>
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<td>External (included in PCM600 Eng Pro 2.4)</td>
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</tbody>
</table>

**Sales**

- External
- New 2877 Product
### Available functionality

<table>
<thead>
<tr>
<th>Functionality</th>
<th>V.1.7 SP2</th>
<th>V.1.8</th>
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<tbody>
<tr>
<td>IEC61850 Client</td>
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<tr>
<td>- support for Setting Groups</td>
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<tr>
<td>- support for Dynamic Datasets</td>
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<tr>
<td>- Event list for IED testing</td>
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<tr>
<td>Ethernet Packet Analyzer decoding support</td>
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<tr>
<td>- IEC61850-8-1 / 9-2</td>
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<tr>
<td>- RSTP, SNTP, SNMP</td>
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<td>- IEC104 / DNP / SPA-TCP / Modbus-TCP / PRP</td>
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<td>Goose – Oscilloscope</td>
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<td>Online/offline comparison of IEC 61850 models</td>
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<td>Localisation possible</td>
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<td>Windows 7</td>
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<td>HW key license for external sales</td>
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<tr>
<td>Explore SV (process bus)</td>
<td>Phase out with v.1.8</td>
<td>Release 2012-12</td>
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</table>

**Status:**
- **Release 2012-12**
- **Phase out with v.1.8**
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