ABB’s protection, control and monitoring solutions

What’s new in the latest Relion® 670 series update?

October 2018
Introduction

Presenters

Joseph Menezes
Global Product Manager
Relion 670 series
P: +46 21 321 719
E: joseph.menezes@se.abb.com

Marko Kovacic
Technical Marketing Manager
Grid Automation
P: +46 21 340 098
E: marko.kovacic@se.abb.com

Krister Hagman
Global Product Manager
Relion 650 series
P: +46 21 321 462
krister.hagman@se.abb.com
1. Evolution of electrical infrastructure
2. Protection, control and grid automation
3. What's new?
4. Enabling ABB Ability™
5. Life cycle and migration path
6. Product information and documentation
Evolution of electrical infrastructure
Substation and grid
Electrical infrastructure

Grid evolution

Traditional Grid

Modern Day Grid

©ABB
Oct-18
Slide 5
Electrical infrastructure

Substation evolution

Evolution continues

- The main objectives of the utilities are to provide **affordable electric power** of **good quality, continuously** and preferably for a **profit**\(^1\)

- Reliability of the power system protection, as well monitoring, control and asset management have significantly improved from the early days of electromechanical relays to modern IEDs → leading to higher availability

- New challenges are arising for the customers, and it is the manufacturer’s task to facilitate usability of the equipment, in order to leverage the maximum out of all assets in the power system

Digital Substation is the way forward

---

\(^1\) P.G. Smit “Digital Substation... Dream or nightmare”, 2017 Southern African Power System Protection & Automation Conference
Electrical infrastructure

ABB wins $150 million order to grid-connect world’s largest offshore wind farm

Key technologies and ABB Ability™ solutions will integrate wind energy from Hornsea Project Two to the UK grid, powering more than 1.3 million homes.

ABB has won orders worth over $250 million from Danish energy company Ørsted (previously Dong Energy), to supply a range of technologies that will help integrate and transmit renewable wind energy from Hornsea Project Two, slated to be the world’s largest offshore wind farm. The orders were booked in the second quarter of 2018 and are the first tranche of a global five year framework agreement for the supply of electrical and automation equipment for offshore and onshore wind power connection and integration to the grid.

Hornsea Two is a 1,400 megawatt (MW) project to develop wind resources in the North Sea about 100 kilometers off the Yorkshire coast. Upon completion, it will be able to deliver enough clean electrical power to meet the needs of more than 1.3 million homes annually. The additional power supply will support economic growth in the UK’s Humberside region, and help the UK meet its target of generating 15 percent of energy needs from renewable sources by 2020.

ABB will supply its state-of-the-art Static Var Compensation (SVC) Light technology, with advanced ABB Ability™MACH control systems, high voltage gas-insulated switchgear (GIS), transformers, reactors and harmonic filters. ABB will also be responsible for the engineering, supply, project management and commissioning of the digital control and protection systems for the onshore substation, and the two offshore platform substations.

“We are delighted to partner with Ørsted for this strategic long term technology alliance and work towards our common goal of integrating more renewables into the grid and promoting sustainable energy solutions”, said Claudio Facchin, President of ABB’s Power Grids division. “Advanced technologies and ABB Ability™-based digital solutions will play a key role in enhancing capacity and improving quality and reliability of electricity supplies to millions of people. This project reinforces ABB’s position as a partner of choice for enabling a stronger, smarter and greener grid.”

The electrical power flow from Hornsea Two farm will be protected and controlled by the largest Static Compensator (STATCOM) system ever built for an offshore wind application. STATCOMs help offshore wind generating turbines to increase power transfer capability, improve power quality and enhance grid stability, delivering energy efficient and reliable power supply. The brain of the STATCOM is the ABB Ability™MACH control, protection and monitoring system, managing this sophisticated technology by overseeing thousands of operations in real time to ensure power reliability and efficiency.

As part of the project scope, the ABB Ability™ enabled MicroSCADA system will be used for monitoring of the electricity network and gather data from Hartek® Intelligent Electronic Devices (IEDs) and Remote Terminal Units (RTUs) to ensure safe and reliable grid integration system operations. Advanced mission critical technology will also be used for communication between the offshore platforms and the onshore substation.
ABB’s solution
The solution to stay abreast with the trends and on top of challenges
## ABB’s solution

**What do we offer?**

### Relion 670 series – value proposition

<table>
<thead>
<tr>
<th>ABB’s technological proficiency</th>
<th>Digital substation</th>
<th>Sustainable lifecycle promise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing end-to-end protection, control and monitoring solutions for all HV electrical infrastructure</td>
<td>• Enabling digital installations</td>
<td>• All functionalities part of core 670 and 650 platform ➔ Lifecycle longevity</td>
</tr>
<tr>
<td>ABB’s thought leadership through world class industrial advancements</td>
<td>• Remote end communication</td>
<td>• ABB’s promise towards customer needs (tech support, training and upgrades)</td>
</tr>
<tr>
<td>Create ➔ Complete ➔ Cultivate</td>
<td>• Reduced cabling</td>
<td>• Sure ➔ Sustainable ➔ Surging</td>
</tr>
<tr>
<td>• Scalable to future needs</td>
<td>• Cost effectiveness</td>
<td></td>
</tr>
<tr>
<td>• Agnostic functionalities - single solution for varied applications</td>
<td><a href="http://www.abb.com/digitalsubstations">http://www.abb.com/digitalsubstations</a></td>
<td></td>
</tr>
<tr>
<td>• Customizable HW and SW functionalities</td>
<td>• Ideate ➔ Innovate ➔ Inspire</td>
<td></td>
</tr>
</tbody>
</table>

**The power of one solution**
Relion 670 series
Evolution

670 series 1.0
New generation IEDs
- Several advanced functionality on platform & products
  - IEC 61850-8-1
  - Std configs + customized
- 4/5 products

2005-2006
Limited

670 series 1.1
Growth with increased offering
- Portfolio increased covering more applications
- Generator protection REG670 introduced
- Connectivity with DNP protocol
- Std configs + customized
- 6 products

2007
Limited

670 series 1.2
Major product, system functionality increased offering
- Parallel Redundancy Protocol PRP
- Process bus conn. IEC 61850-9-2LE
- Introduced injection based 100% Stator, Rotor EF protection
- Introduced PMU RES670
- Std configs + customized
- 7 products

2010-2012
Active

670 series 2.0
P&C - advanced & secure platform
- IEC 61850-8-1 Ed2
- New LHMI
- EMC improvements
- High speed distance protection
- Improved cyber security
- Improvements to IEC 60870-5-103 protocol
- Several new features with benefits
- Improved RES670 with IEEE 37.118
- Std configs + customized
- 7 products

2014-2015
Active

670 series 2.1
Impr distance prot enhanced security & flexibility
- Central Account Management
- Combined Quad/Mho
- Flexible Product Naming
- IEC 61850 settings
- Supporting 64bit OS PCM600
- Railway applications
- Std configs + customized
- 8 products

2015
Active

670 series 2.2
Enabling digital substations, improved line protection, cost savings
- Upto 6 Ethernet ports
- Higher IP class
- Conformal coated mod
- HSR redundancy
- PTP time sync IEC/IEEE 61850-9-3 [1588]
- Sub-cycle line differential protection
- 2Mbps comm speed
- 6 zone BBP
- Catenary protection
- Trafo cond monitoring
- Cost savings
- Std configs + customized
- 8 products

2017- ...
Active
Protection, control and grid automation
Recap – highlights from 670 series version 2.2

Digital substation solutions
- Support different system topologies
- Number of Ethernet ports increased
- Improved communication/redundancy possibilities, routing
- HSR redundancy now available, ports can be single/PRP/HSR
- All ports can be configured GOOSE publish/subscribe
- Conditional blocking of applications when using SV
- Complete flexibility with 8-1/GOOSE/SV on any port
- Precision Time Protocol (PTP) IEC/IEEE 61850-9-3 profile (IEEE 1588)

Protection, control and monitoring
- Centralized **busbar protection** covering more zones
  - REB670 supporting up to 6 zones, 24 bays, conventional & IEC/UCA 61850-9-2LE
- **Railway** applications to cover larger market
  - RER670 supporting 16.7/50/60Hz, conventional & IEC/UCA 61850-9-2LE
- High-speed **line differential** protection, faster fault clearance
  - Sub-cycle operation of line differential protection with 2Mbps communication
- Integrated **PMU** functionality in P&C IEDs
  - PMU functionality now in addition to standalone RES670, also supported in REC670, RED670, REL670, RET670, REG670
- **Condition monitoring** functionality
  - Condition monitoring of transformer, insulation loss-of-life
## Relion 670 series
Evolution with the 670 version 2.2 with continuous updates

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enabling digital substations, improved line protection, cost savings</strong></td>
<td><strong>Enhancement</strong></td>
<td><strong>Enhancement</strong></td>
</tr>
<tr>
<td>• Up to 6 Ethernet ports configurable</td>
<td>• 6 Ethernet ports selectable as optical or galvanic</td>
<td>• Complete offering for railway protection, control and monitoring</td>
</tr>
<tr>
<td>• Higher IP class</td>
<td>• Faster fault analysis through the capture of settings in disturbance recorder</td>
<td>• Transformer through fault monitoring</td>
</tr>
<tr>
<td>• Conformal coated modules</td>
<td></td>
<td>• Line differential via X.21 communication</td>
</tr>
<tr>
<td>• HSR redundancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• PTP time sync IEC/IEEE 61850-9-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Sub-cycle line differential protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 2Mbps communication speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 6 zone BBP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Transformer condition monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cost savings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Standard configs + customized</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 8 products</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

©ABB
Oct-18
What’s new?
Relion 670 series - July 2018 release
Release notes

The evolution of Relion® 670 series continues with this update.

We are pleased to announce an update of the Relion® 670 series version 2.2, our flagship protection & control IEDs. With this update, we bring several new features and enhancements.

The update covers customized and pre-configured IEDs covering all application areas with the products REB/REC/RED/REG/REL/RER/RES and RET670. The Relion® 670 series covers a complete set of applications from generator protection, transformer protection and control to busbar protection, line protection, phasor monitoring and bay control. With the introduction of version 2.2 of the 670 series, we further expand the application areas especially for digital substations, enhancing the system functionality and flexibility.

Key system features such as support for a large number of Ethernet communication ports, HSR redundancy method, and precision time synchronization following the IEC/IEEE 61850-9-3 profile are introduced in this release. Process bus sampled values via IEC/ULCA 61850-9-2LE are now supported in all products of the Relion® 670 series family.

New features and benefits

The following new features and their benefits are included in this update:

- RER670 is now extended to support protection, control and monitoring for one or two railway catenary lines with a single IED. In addition to previously supporting applications for 2-phase transformers and 2-phase lines, the release now includes 1-phase and 2-phase distance protection for catenary lines.

- RER670 now includes extended monitoring functionality of delta quantities based on current/voltage/real numbers. Harmonic supervision (up to 5th order) of current and voltages helps to monitor the distortion in the power system.

- Improved fault locator accuracy for catenary lines in 2-phase AT system.

- Monitoring of transformer through faults and reporting functionality. This advanced monitoring functionality brings a key benefit to monitor mechanical stresses caused by through faults and thereby help take appropriate actions on maintenance of power transformers.

- LDCM galvanic X.21 module is now introduced in 670 series version 2.2 for remote communication for C37.94 protocol.
Relion 670 series (enhancements in this latest update!)
What's new in the July 2018 release?

Catenary protection
- Complete railway solution with the RER670
- Possibility to cover the whole power system ➔ railway corridor with one protection and control platform

Line differential-X.21
- Line differential communication interface
- Possibility to ensure backwards compatibility with the existing communication systems.

Through fault monitoring
- Possibility to monitor closely the power transformers
  - ensuring rapid response maintenance actions if needed
  - though prolonging the life of a valuable asset
Relion 670 series (enhancements in this latest update!)

What's new in the July 2018 release?

**Catenary protection**
- Complete railway solution with the RER670
- Possibility to cover the whole power system → railway corridor with one protection and control platform

**Line differential-X.21**
- Line differential communication interface
- Possibility to ensure backwards compatibility with the existing communication systems.

**Through fault monitoring**
- Possibility to monitor closely the power transformers
  - ensuring rapid response maintenance actions if needed
  - though prolonging the life of a valuable asset
Relion railway solutions with 670 series
Railway protection and control solutions with RER670
Relion transportation solutions with 670 series
The power of one solution for railways

RER670 – complete solution for rail assets - line, transformer, catenary and control packaged in one

Line protection
- Line distance protection
- Delta I & U protection
- Fault location
- Scheme communication
- Back-up protection

Catenary protection
- Catenary distance protection for 2 catenaries
- Delta I & U protection for reliable start
- Fault location
- Scheme communication
- Back-up protection

Transformer protection
- Transformer differential protection
- Transformer impedance protection
- Restricted earth fault protection
- Transformer tank overcurrent protection
- Transformer energization control (16.7 Hz)
- Back-up protection
- Delta I & U protection

Control and monitoring
- Control for up to 15 apparatuses
- Synchrocheck and auto-reclose
- Tap changer control and supervision
- Transformer energization control (16.7 Hz)
- Circuit breaker monitoring
- Harmonic monitoring
Catenary traction substation

There are 3 types of substations

- Traction substations (TSS) with traction (power) transformers
- Sectioning and Paralleling Post (SP) with autotransformers
- Sub-Sectioning and Paralleling Post (SSP) with autotransformers
2-Ph Transmission (2x110 kV)

- 16.7Hz Transmission network
- Longer Lines than usual HV Network

BT Catenary (1x15 kV/16 kV/25 kV)

- Booster Transformer based catenary system
  - Metro rail networks
  - Small networks
  - Local networks

AT Catenary (2x16kV/2x25 kV)

- Auto Transformer based catenary system
  - Long rail networks
  - Radial power fed via many SPs and SSPs
Relion railway solutions with 670 series

Transformer protection

Transformer differential protection

1-phase / 2-phase transformer differential protection with high security and dependability.

Possible transformer configurations:
– 2 phase to 2 phase transformers
– 2 phase to 1 phase transformers

• Automatic current magnitude compensation
• Possibility to remove zero-sequence current internally
• Possibility to invert the measured current on the W2 side internally

Application guidelines for special traction transformers
Transformer under-impedance protection

- Non-directional characteristic
  - quadrilateral
  - offset mho
  - three separate zones, with single loop measurements.
- Few setting parameters for easy handling.
- If required, directional lines can be obtained using the separate directional overcurrent function, which also includes voltage memory.
Relion railway solutions with 670 series

Transformer protection

- Very fast instantaneous over current function.
- Operate time of less than 10 ms, for 16.7 Hz, for fault at 90 deg and fault current greater than 2 times I>.
- Can be used as high speed single phase OC for catenary lines.
### Relion railway solutions with 670 series

Back-up protection (for line, transformer, catenary and control)

<table>
<thead>
<tr>
<th>Current</th>
<th>Voltage</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Instantaneous phase overcurrent protection</td>
<td>• Undervoltage protection</td>
<td>• Underfrequency protection</td>
</tr>
<tr>
<td>• Instantaneous residual overcurrent protection</td>
<td>• Overvoltage protection</td>
<td>• Vector shift supervision</td>
</tr>
<tr>
<td>• Directional phase overcurrent protection</td>
<td>• Residual overvoltage protection</td>
<td></td>
</tr>
<tr>
<td>• Directional residual overcurrent protection</td>
<td>• Voltage delta supervision</td>
<td></td>
</tr>
<tr>
<td>• Current delta supervision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Sensitive directional residual over current and power protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Thermal overload protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Breaker failure protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Line distance protection [2 phase system]

The distance protection is **applicable for all earthing types in 2-phase power networks**. The SystemEarthing setting is provided in order to have the distance protection function suitable for a specific type of earthing system.

The function is characterized by:

- 6 Zones Quadrilateral characteristic with 3 parallel loops (L1E, L2E, L1L2)
- Residual current start / Impedance based starting with circular characteristic
- Internal Load encroachment cut-out and phase selection logic
- End zone timer based tripping logic for long un-cleared faults
- Separate stub line protection for compensated systems
- The function can be used in 16.7 Hz, (50 Hz and 60 Hz) systems
Relion 670 series
Railway solutions with the RER670

Catenary distance protection [page 1]

- Simplified high speed distance protection for catenary feeders, which supply power to the moving locomotive through a pantograph and contact wire.
- Function is applicable for both single-phase booster transformer (BT) and Auto transformer (AT) based railway supply systems.
- Function has five independent zones with Quadrilateral characteristics, inbuilt Load Encroachment and Direction characteristics.
- Individual settings in forward and reverse directions provided in zone settings for flexibility to design the characteristics according to network needs.
- Delta I / Delta U / 2\textsuperscript{nd} harmonic blocking can be arranged for higher zones as starting conditions, distinguish between fault & load conditions.
Relion 670 series

Railway solutions with the RER670

**Catenary distance protection [page 2]**

- Function can be programmed for special conditions in traction network like wrong phase coupling logics, external start signals from delta based detections etc.
- Used in 16.7 Hz, 50 Hz and 60 Hz railway supply systems
- The IED allows up to six independent setting groups in order to cover different operating condition of the traction feeder such as normal arrangement, alternate feeding, bypass, etc. The setting group can be changed remotely via communication link or via binary inputs.
Relion railway solutions with 670 series

Line protection

Line fault location

- Two different fault locator algorithm for different types of railway networks:
  - 2 Phase System: Used for 2 phase transmission system / BT based traction system. Up to 10 line sections can be covered.
  - Traction AT: Special algorithm to cover all the individual currents. Separate RER is required at each SSP/SP/TSS for accurate fault location.
- Separate R, X settings for each section
- Fault section, fault impedance in R and X, distance to fault in units and fault loop (in 2-Ph system) as outputs
- Accuracy of +/- 5% for 16.7Hz systems X/R ratio less than 1
- Accuracy of +/- 2% for 50/60Hz systems X/R ratio less than 1
Relion railway solutions with 670 series

Line protection

Apparatus control

Control up to 15 apparatuses with one RER670. Choose direct operate, select before operate (SBO) or SBO with enhanced security.

A single line diagram corresponding to your switchgear arrangement offers a quick overview of the status of the bay

- Position indications
- Dynamic measurements
- Up to six SLD pages

Control and supervise a tap-changer

Protocols supported in RER670:

- IEC 61850 (Ed2 only), others same as in all other 670 series
Relion railway solutions with 670 series

Line protection

**Delta supervision**

Current or voltage based delta supervision is needed as a release criteria for distance protection in catenary network. The delta function has the following features:

- Instantaneous sample based delta detection (U, I)
- RMS value based delta detection (U, I)
- DFT magnitude based delta detection (U, I)
- Vector shift protection (U)
- 2nd harmonic blocking of delta function (I)
- 3rd harmonic based adaption of starting value (I)
- General real value delta detection

**Harmonic monitoring**

For current and voltage:

- Total harmonic distortion (THD), per phase
- Total demand distortion (TDD), per phase
- Crest factor, per phase
- Individual harmonic distortion (2nd, 3rd, 4th, 5th harmonic)
- Harmonic RMS value, per phase
- Frequency
# Railway solutions with Relion RER670

## Application features to order

<table>
<thead>
<tr>
<th>Software options</th>
<th>A50</th>
<th>B60</th>
<th>B70</th>
<th>C61</th>
<th>H37/H38</th>
<th>H52</th>
<th>H51</th>
<th>H55</th>
<th>H53/H54</th>
<th>M25/M26</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transformer protection</strong></td>
<td>⬤</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>⬤</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Line protection</strong></td>
<td></td>
<td></td>
<td>⬤</td>
<td></td>
<td></td>
<td>⬤</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Catenary protection</strong></td>
<td></td>
<td>⬤</td>
<td></td>
<td></td>
<td>⬤</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Back-up protection</strong></td>
<td></td>
<td></td>
<td>⬤</td>
<td></td>
<td></td>
<td></td>
<td>⬤</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Apparatus control</strong></td>
<td></td>
<td></td>
<td></td>
<td>⬤</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Autoreclose</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Optional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Synchrocheck</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Transformer energization control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tap changer control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>⬤</td>
<td></td>
</tr>
<tr>
<td><strong>Harmonic monitoring</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>⬤</td>
</tr>
<tr>
<td><strong>I/U vector shift supervision</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>⬤</td>
</tr>
</tbody>
</table>

### Applications

- **Transformer protection**
  - Optional
- **Line protection**
  - Optional
- **Catenary protection**
  - Optional

### Application Packages

- **Powerful offering with easy to choose packaged features**

©ABB
Oct-18 | Slide 31
Relion 670 series (enhancements in this latest update!)

What's new in the July 2018 release?

Catenary protection
- Complete railway solution with the RER670
- Possibility to cover the whole power system ➔ railway corridor with one protection and control platform

Line differential-X.21
- Line differential communication interface
- Possibility to ensure backwards compatibility with the existing communication systems.

Through fault monitoring
- Possibility to monitor closely the power transformers
  - ensuring rapid response maintenance actions if needed
  - though prolonging the life of a valuable asset
Relion 670 series
Transmission solutions

Line differential communication - X.21 interface
Line differential communication using X.21 protocol is now supported in 670 series version 2.2 with 64kbps

- Protection communication
- Remote end data communication modules
- Duplicated channel capability for redundancy

Application
- To interface with legacy communication equipment supporting X.21 interface up to 10m distance
- Supporting backward compatibility using X.21 protocol

Products
- 670 series: All customized products except RES670
- 650 series: None
Relion 670 series (enhancements in this latest update!)

What's new in the July 2018 release?

Catenary protection
- Complete railway solution with the RER670
- Possibility to cover the whole power system ➔ railway corridor with one protection and control platform

Line differential-X.21
- Line differential communication interface
- Possibility to ensure backwards compatibility with the existing communication systems.

Through fault monitoring
- Possibility to monitor closely the power transformers
  - ensuring rapid response maintenance actions if needed
  - prolong the life of a valuable asset
Relion 670 series
Transmission solutions - Transformer through-fault monitoring

Transformer through-fault monitoring [What is it? Why?]

- Transformer is one of the most expensive primary equipment in electrical system. Through-faults create mechanical stresses in the transformer. Eventually leading to damages, and expensive maintenance.
- Through faults are external faults outside the transformer zone which causes large currents flowing through the transformer windings. This causes:
  - Conductor displacement
  - Mechanical stresses
  - Insulation damage
  - Weakness to the windings
  - Collapses the physical structure
- Early indication of the state transformer is a key benefit to prevent outage, damage or expensive repairs.
Transformer through-fault monitoring [Principles]

- Integrate the winding current when above a set level over time $I^2t$ to indicate the mechanical stresses brought about by external faults.
- Inhibit the through fault calculation during transformer energization [external 2nd harmonic blocking], internal fault conditions [differential protections] to the INHIBIT input.
- Alarms/Warnings from the function can be used to prevent energization of the transformer until the relaxation time.
- Every through-fault captured generates a reports which is stored in the IED. Easy retrieval of these reports through PCM600 via communication.
- These can also be retrieved from the IED using MMS or FTP.
- This feature is primarily designed for transformer through-faults. However, can also be used for line applications where the IED reports primary quantities based on external triggering conditions.

Function block in Application Configuration

- I3PW1: ALARM
- I3PW2: W1L1ALT
- I3PW3: W1L2ALT
- U3P: W1L3ALT
- BLOCK: W2L1ALT
- ACCFREEZE: W2L2ALT
- EXTRIG: W2L3ALT
- INHIBIT: W3L1ALT
- RSTTFCNT: W3L2ALT
- RSTCML2T: W3L3ALT
- TAPOLT1: MTWRN
- TAPOLT2: I2TALT
- CML2TALT: REPMADE

Transmission solutions – Transformer through-fault monitoring
Relion 670 series
Through fault records as visualized on PCM600

Transformer through-fault monitoring [Report]

- Reports stored in the IED are listed per instance / fault number and the occurrence of the fault
- Reports retrieved [read] from PCM600. The through fault monitoring tool works with the IED in online mode
- Clear indication of through faults in PCM600
- Details of the selected fault record are visually displayed showing the fault duration and fault values.
Transformer through-fault monitoring [Capabilities]

- Through-fault monitoring function supports any type of power transformer – two or three winding
- The function can be set following guidelines according to IEEE C57.12.00-1993 standard
- 2 instances can be chosen for monitoring 2 transformers
- Each of the above instance can record up to 100 through-faults
- Provides instantaneous energy per through fault and cumulative values since last reset
- From PCM600 the user can also export through-fault reports
- MMS & FTP transfer. Reach IED folder \frep
- This is an optional feature in REC/RED/REG/REL/RET
Enabling ABB Ability™
Relion enabling digitalization through a complete suite of future proof solutions
Digital Transformation Journey
Technology from the field to the boardroom

ABB Ability enables the digital transformation
Mission-critical communications connect the unconnected

<table>
<thead>
<tr>
<th>Field</th>
<th>Control Room</th>
<th>Operations Center</th>
<th>Board Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid Automation Systems &amp; Products</td>
<td>ABB Ability Network Manager</td>
<td>ABB Ability CALM</td>
<td>Energy Portfolio Management</td>
</tr>
<tr>
<td>Asset Visibility</td>
<td>Operational Confidence</td>
<td>Business processes</td>
<td></td>
</tr>
<tr>
<td>Business processes</td>
<td>Grid</td>
<td>Performance Orchestration</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Milliseconds | Seconds | Minutes | Hours | Days | Weeks | Months | Years

©ABB
Oct-18
| Slide 40
ABB Grid Automation
End-to-end offering

Energizing the digital grid

- ABB has the most complete digital portfolio in the industry. Offering end-to-end solutions from primary sensors to Station Level (OT) through to Enterprise Asset Health Center (IT).

- We combine our products with our exceptional expertise which makes us unique for our customers on their journey to the digital grid

- Our deep understanding of our customers’ needs across the whole value chain is the enabler for innovative solutions

Distributed energy resources and loads that can be operated in a controlled, coordinated way either connected to the main power grid or in “islanded” mode.
Migration path
Our sustainable lifecycle promise
### Migration path and life-cycle status

**How does the user get here?**

#### Upgrades and migration

- Hardware upgrade from previous versions of 670 series to version 2.2 is not supported. A new IED box will be needed.

- If you already have version 2.2, then it can be upgraded to get the benefits of these enhancements in this release. Order process will be same as through BOL.

  - Within version 2.2, each update has a further version 2.2.0/2.2.1/2.2.2 and upgrades are supported

- Application migration in PCM600 is supported through all versions. In general, the closer one is to the final version, the application migration is better

  - Migrating a configuration of 2.1 → 2.2 will result in less loss of data compared to a migration from 1.1 → 2.2.

- PCM600 version 2.8 or 2.9 is required for 670 series version 2.2

#### Life-cycle status

<table>
<thead>
<tr>
<th></th>
<th>1.0</th>
<th>1.1</th>
<th>1.2</th>
<th>2.0</th>
<th>2.1</th>
<th>2.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How does the user get here?
Product information and documentation
Relion 670 series 2.2
Application areas

Brochures

The four key application areas comprehensively cover the industrial protection, control and monitoring requirements.

- Railway solutions
- Substation solutions
- Power generation and renewables
- Line protection application
# Product documentation

Protection and control portfolio - Relion 670 series

<table>
<thead>
<tr>
<th><strong>Product guides</strong></th>
<th><strong>Tech spec sheets</strong></th>
<th><strong>Technical manuals</strong></th>
<th><strong>Application manuals</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Railway application, RER670</td>
<td>Railway application, RER670</td>
<td>Railway application, RER670</td>
<td>Railway application, RER670</td>
</tr>
<tr>
<td>Bay control, REC670</td>
<td>Bay control, REC670</td>
<td>Bay control, REC670</td>
<td>Bay control, REC670</td>
</tr>
<tr>
<td>Busbar protection, REB670</td>
<td>Busbar protection, REB670</td>
<td>Busbar protection, REB670</td>
<td>Busbar protection, REB670</td>
</tr>
<tr>
<td>Generator protection, REG670</td>
<td>Generator protection, REG670</td>
<td>Generator protection, REG670</td>
<td>Generator protection, REG670</td>
</tr>
<tr>
<td>Line distance protection, REL670</td>
<td>Line distance protection, REL670</td>
<td>Line distance protection, REL670</td>
<td>Line distance protection, REL670</td>
</tr>
<tr>
<td>Phasor measurement, RES670</td>
<td>Phasor measurement, RES670</td>
<td>Phasor measurement, RES670</td>
<td>Phasor measurement, RES670</td>
</tr>
<tr>
<td>Transformer protection, RET670</td>
<td>Transformer protection, RET670</td>
<td>Transformer protection, RET670</td>
<td>Transformer protection, RET670</td>
</tr>
</tbody>
</table>

Links to more information on our protection, control and monitoring devices
Point of contact

Joseph Menezes
Global Product Manager
Relion 670 series
joseph.menezes@se.abb.com

Krister Hagman
Global Product Manager
Relion 650 series
krister.hagman@se.abb.com

Marko Kovacic
Technical Marketing Manager
Grid Automation
marko.kovacic@se.abb.com

Anukool Korde
Product Marketing
IEDs and tools
anukool.korde@se.abb.com

Product and marketing queries