Maximum network reliability

Medium voltage outdoor systems for distribution grid automation

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Outdoor distribution grid automation

1. Distribution grids
   - Market situation
   - Challenges
   - Answer to customer needs
   - Benefits

2. Portfolio
   - Live tank circuit-breaker
   - Dead tank circuit-breaker
   - Smart distribution recloser
   - Compact modular recloser
   - Fusesaver™
   - Disconnect switch
   - Portable switch

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   - Solutions overview
   - Substation automation
   - Spur line automation
   - Feeder automation
   - Smart grid automation
Chapter 1

Distribution grids

- Market situation
- Challenges
- Answer to customer needs

Benefits
- Fast return on investment
- Less operating costs
- Fault and outage management 1
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- Fault and outage management 3
### Market situation

#### Manage complexity in distribution grids

<table>
<thead>
<tr>
<th>Driver</th>
<th>Challenge</th>
<th>Approach</th>
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<tbody>
<tr>
<td><strong>Dynamics in supply and consumption</strong></td>
<td>Increasing demand for supervisory control</td>
<td>Always SCADA link</td>
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<tr>
<td><strong>Big data</strong></td>
<td>Converting big data to smart data in a practical format for further analysis</td>
<td>Customizable data acquisition tools that enable the utility to analyze all system relevant information</td>
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<tr>
<td><strong>Customer behavior</strong></td>
<td>Increasing cost pressure while demand for availability and reliability increases</td>
<td>Lifecycle cost optimized products for every budget</td>
</tr>
<tr>
<td><strong>Decentralization with increasing system complexity</strong></td>
<td>Increasing impact of temporary faults</td>
<td>Unique reclosing device portfolio to deal with temporary faults</td>
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#### Distribution grids

- Portfolio Solutions
- Always SCADA link
- Unique reclosing device portfolio to deal with temporary faults

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#### Solutions

- Manage complexity in distribution grids
- Always SCADA link
- Lifecycle cost optimized products for every budget
- Unique reclosing device portfolio to deal with temporary faults
Challenges

**High operational costs**
Approximately 70 percent of the global medium-voltage power distribution networks are formed by overhead lines, thus prone to faults caused by external influences.

**Categorization of measured faults in MV power distribution networks**

~ 80% are temporary MV faults

~ 20% are permanent MV faults

**Main causes of temporary faults in overhead feeders**

- **Unknown**: ~ 70% of the faults
- **Storm**: ~ 60% of the faults
- **Rain**: ~ 50% of the faults
- **Wind**: ~ 40% of the faults
- **Others**: ~ 30% of the faults

Relative number of faults in %
Shaping reliable power distribution grids for the new electricity age

- Unique portfolio of reclosing devices
- Consulting
- Value-added services
- Complete solutions

**Grid security**
- High degree of operational reliability and safety
- Less operation costs

**CAPEX/OPEX savings**
- Availability improvements with CAPEX/OPEX reduction

**Outage management**
- Automatic restoration and fault isolation in meshed grids

**Outage avoidance**
- Availability improvements under temporary fault conditions
- Fault clearance in less than 300 ms
Benefits

Fast return on investment thanks to an unique portfolio of reclosing devices

- Lower capital cost (CAPEX)
- Lower installation cost (OPEX)
- Easy installation
- No maintenance (due to vacuum technology)

The right balance: Enhancement impact vs. CAPEX/OPEX spending
Less operating costs

- Outage avoidance: Improvement of availability by using reclosing devices
- Unique reclosing devices to deal with temporary faults
Fault and outage management with 3AD-recloser and 7S-controller – short overview

Remote monitoring and control of overhead lines
Fault and outage management with 3AD-recloser and 7S-controller – short overview

Remote monitoring and control of overhead lines
Benefits

Fault and outage management with 3AD-recloser and 7S-controller – short overview

Remote monitoring and control of overhead lines
Benefits

Fault and outage management with 3AD-recloser and 7S-controller – short overview

Remote monitoring and control of overhead lines
Fault and outage management with 3AD-recloser and 7S-controller with master-slave protocol communication

Automated switching for isolation and service restoration
Fault and outage management with 3AD-recloser and 7S-controller with master-slave protocol communication

Automated switching for isolation and service restoration
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Automated switching for isolation and service restoration

Time: Less than 1 minute
Benefits

Fault and outage management with 3AD-recloser and 7S-controller with network protocol communication

Automated switching for isolation and service restoration
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Automated switching for isolation and service restoration

Benefits
Fault and outage management with 3AD-recloser and 7S-controller with network protocol communication

Automated switching for isolation and service restoration

Benefits

Fault isolation

Time: Zero Less than 300 ms

IEC 61850 GOOSE

Portfolio Solutions

Distribution grids

Solutions
Fault and outage management with 3AD-recloser and 7S-controller with network protocol communication

Automated switching for isolation and service restoration

Benefits
Chapter 2

Portfolio

- Portfolio overview
- Live tank circuit-breaker
- Dead tank circuit-breaker
- Smart distribution recloser
- Compact modular recloser
- Fusesaver™
- Disconnect switch
- Portable switch
Outdoor distribution systems
Maximum reliability in medium voltage outdoor networks

All devices are provided ready for smart grids, using state-of-the-art communication protocols to exchange data at lightning speed, quickly reactivating distribution networks in the event of failure.
Reliability in all climatic conditions

The live tank outdoor vacuum circuit-breaker has been especially conceived for breaking short-circuit currents in substations and in overhead-line systems. Its type-tested, safety-oriented and robust design withstands the most adverse climate conditions and guarantees a long electrical and mechanical endurance. The vacuum interrupter is protected against weather influences by means of an insulated enclosure. The live tank circuit-breaker is typically used in distribution grids of power utilities, in industrial applications and in railway power supply systems.

Features
- Reliable and safe vacuum technology
- Compact design
- Available also as 1- or 2-pole breaker for traction applications (3AF04/3AF05)
- IEC 62271-100

Benefits
- Maintenance-free
- Environment-friendly
- Easy transport, erection and commissioning
- High durability against vibrations
- High resistance to the harshest climate conditions
### Arc-resistant outdoor vacuum circuit-breaker for distribution grids

In dead tank circuit-breakers, the vacuum interrupter is installed in an earthed metal enclosure with a very compact design and a small footprint. Optionally, the circuit-breaker features an arc-resistant enclosure. It has been especially conceived for the ANSI market and fulfills the same switching duties as the live tank. It can optionally be equipped with a stored-energy spring mechanism or a magnetic actuator.

Thanks to the circuit-breaker’s robust enclosure and the vacuum switching technology, the maintenance cycles are particularly long, enabling cost-efficient application in transformer substations and distribution grids.

<table>
<thead>
<tr>
<th>Features</th>
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<tbody>
<tr>
<td>Reliable and safe vacuum technology</td>
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<tr>
<td>Very compact design</td>
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<tr>
<td>10,000 operating cycles</td>
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<tr>
<td>ANSI market</td>
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<tr>
<td>Equipped with store-energy spring mechanism or magnetic actuator</td>
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<tr>
<td>Arc-resistant enclosure (optional)</td>
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<table>
<thead>
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<th>Benefits</th>
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<tr>
<td>Low maintenance</td>
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<td>Environment-friendly</td>
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<tr>
<td>Easy transport, erection and commissioning</td>
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<tr>
<td>Cost-efficient</td>
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The allrounder in overhead lines and transformer substations

The smart distribution recloser (SDR) guarantees safe and efficient operation. In case of temporary faults, e.g. due to lightning strikes or falling branches, it avoids permanent interruptions of the distribution lines.

The vacuum smart distribution recloser is used in transformer substations and overhead lines to switch normal and fault currents like a circuit breaker. In the event of a temporary fault, the recloser can trip and reclose up to four times. This ensures that transient faults only result in short and temporary interruptions.

The recloser is available in a single-phase or three-phase design and offers a flexible solution due to its wide range of ratings thanks to the intelligent control also for automated grid systems.

Features

- Two designs covering the whole range (up to 27 kV and up to 38 kV)
- Up to 16 kA short-circuit breaking current and up to 38 kV and rated operating voltage
- Rated normal current of 200, 400, 630 und 800 A
- Same control cubicle look and feel for all applications
- Preventive maintenance features for long lifetime
- Many diagnosis functions with watchdog-alarming to mobile phones and SCADA-System
- More than 30,000 switching operations
- Protection degree IP66
- IEEE C37.60 / IEC 62271-111

Benefits

- Increased reliability
- Smart grid-integration
- Possibility to connect via several protocols (e.g. Modbus, DNP3.0, IEC60870-5-101/103/104, IEC 61850 with GOOSE-messaging)
- Remote access from every place at any time
- Adapted solutions to harsh climatic environment
- Long lifespan for a wide range of applications
The new class of single phase auto-recloser

By eliminating regular maintenance and utilising line voltage as power supply, the new compact modular recloser (CMR) addresses common problems of obsolete hydraulic reclosers. The compact modular recloser is fully rated for voltage systems up to 27 kV. It features a complete insulated housing that covers all live parts. The lightweight device permits easy installation and fast commissioning, plus the ability for wireless firmware and configuration updates.

Features
- Power supply using line voltage
- Rechargeable battery for back-up power
- Integrated protection relay and controller
- Wireless connectivity
- GPS time reference
- SCADA capability (future)
- Voltage and current measurement
- Fault passage indication (FPI)
- Comprehensive event log
- Full range of TCC curves
- Flexible mounting options

Benefits
- Less operating costs
- Improved network reliability
- Reduced number and duration of power outages
- Network infrastructure protection
- Reliable performance
- Long service life with no need for regular maintenance
The world's fastest vacuum circuit-breaker

By virtually eliminating the impacts of temporary faults on lateral lines, Fusesaver™ helps utilities to increase network reliability while minimising operating costs of overhead MV networks.

The ultra-fast circuit breaker has the capability for multi-phase fault clearance for both transient and permanent faults. It can detect, open and clear a fault in as little as one-half cycle (10 ms). The exceptional small footprint and light weight of the, Fusesaver™ enables a quick and easy installation and fast commissioning.

Features
- Smart grid-ready with communications module
- Self-powered from low line current (as little as 0.15 A)
- Wireless connectivity
- Multi-phase protection operation and synchronous manual operation via peer-to-peer communication
- Battery backup auxiliary operation
- Rated for load break and fault make for manual switching
- Delayed operation for manual open/close for load break and load pick-up
- Unique compact design and lightweight (5.5 kg)
- Optional SCADA connection via Remote Control Unit (RCU)
- Different mounting options

Benefits
- Increased network reliability
- Fast and easy line installation (typically in less than 30 min per phase)
- Improved operator safety
- Minimising the risk of bushfire
- Future proof asset
- Fast return on investment
Quick detection of line switching state

The robust, reliable disconnectors have been specially designed for directly splicing onto the line in outdoor applications. As switch-disconnectors, they safely support the conductor while providing the required isolating distance for fast and safe line maintenance.

By the nature of its application, a line tension switch must mechanically support the line and provide high voltage electrical isolation when the switch is in open position.

To achieve this, the latest porcelain and polymer insulators may be chosen. The switches can be used in medium-voltage substations, in the line or on poles. Depending on the intended function, different switch designs can be applied. Switches are available for both manual and motor operation, offering numerous other options, accessories and mounting configurations. All of these features make switches a flexible and low-cost solution that ensures safe and efficient maintenance work on line segments.
Portable switch 27 kV / 400 A

Portable soft ganged switch for temporary isolation

Connect and disconnect the feed to power lines at the push of a button – quickly, safely and without complications. The portable switch provides a fast, safe and cost effective way to create points of temporary isolation on the distribution network. This helps to ensure that outage times and the number of affected customers are kept to a minimum when maintenance work is carried out.

Features

• Light, compact and easy to install using live line practices
• Simple one button operation
• No configuration required
• Self powered from on board battery
• Complete self contained carry case
• 3-phase soft ganging using radio connectivity for synchronous opening and closing switching operations
• Access live data from the line

Benefits

• Improved operator safety
• Reduce demand on scarce live line resources decreasing time spent at site
• Minimize lost customer minutes
• No need to de-load transformers with 400 A load current rating
• Reduced day to day operating cost
• Ferro-resonance is eliminated by synchronous ganged switching
• No external arc drawn during switching operations
• Reduced potential for operator error during switching procedure
Chapter 3

Solutions

- Solutions overview
- Substation automation
- Spur line automation
- Feeder automation
- Smart grid automation
Solutions overview

Substation automation

Transmission (High Voltage)

Feeder automation

Spur line automation

Smart grid automation

IEC 61850

Solutions overview

Distribution grids

Portfolio

Solutions
Solutions – substation automation

Substation automation
• High degree of operational reliability and safety

Transmission (High Voltage)

Live tank circuit-breaker 40.5 kV / 31.5 kA / 2,500 A
Dead tank circuit-breaker 38 kV/40 kA/3,000 A
Smart distribution recloser 38 kV/16 kA/800 A
Disconnect switch 69 kV/2,000 A
Solutions – spur line automation

- Availability improvements with CAPEX/OPEX reduction

Fusesaver™ 27 kV / 6.3 kA / 200 A
Compact modular recloser 3AD7 27 kV / 12.5 kA / 630 A
Disconnect switch 69 kV / 2,000 A

Transmission (High Voltage)

Substation automation
Solutions – feeder automation

Feeder automation
• Availability improvements under temporary fault conditions

Transmission (High Voltage)

Substation automation
Smart grid automation

- Automatic restoration and fault isolation in meshed grids

IEC 61850

Transmission (High Voltage)

Substation automation