Grid automation in distribution
Society having higher demands on Power Distribution

Benefits of Grid Automation

- Grid Automation increases distribution network reliability by providing fast fault location, isolation and restoration.
- Grid Automation enables integration of distributed energy resources.
- Grid Automation provides accurate information for outage management and thus enables better services for end customers.
Introduction
Types of faults – Overhead lines

Temporary faults
Permanent faults

80%
20%
Introduction
Types of faults – Overhead lines

Some faults are temporary:
- Conductors clashing in the wind
- Tree branches falling on overhead conductors
- Animals or birds getting curious
- Lightning strikes

An “auto-reclose” cycle should clear the fault

Some faults are permanent:
- Careless motor vehicle drivers
- Operating errors: leaving earths connected etc.

“lock-out” of the section to repair it
Grid Automation
Benefits of Grid Automation - Improved KPI

Reduce outage times
- Grid automation
- Fault location
- Fault isolation

Reduce the risk of outages
- Network topology
- Grid automation
- DMS
- Condition monitoring

Preferred area

SAIFI

SAIDI (Minutes )
ABB’s Grid Automation products and solutions
Optimal solutions for entire value chain
Smart Secondary Substations
Four functional classes (levels) for indoor and outdoor solutions

Level 1
- Monitoring
  - MV Monitoring
  - LV Measurement
- Situational awareness

Level 2
- Control
  - MV Switches
    - (LV Switches)
- Monitoring
  - MV Monitoring
  - LV Measurement

Level 3
- Control
  - MV Switches
    - (LV Switches)
- Monitoring
  - MV Monitoring
  - LV Measurement

Level 4
- Protection
  - CBs with remote control for in-/outgoing lines
- Measurement
  - Accurate MV Measurements
- Automation solution and primary equipment (greenfield)

Retrofit of automation (brownfield)

© ABB Group
# Smart Secondary Switchgear

Four functional classes (levels) for indoor and outdoor solutions

<table>
<thead>
<tr>
<th>Functional Level</th>
<th>Customer benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 4</strong></td>
<td></td>
</tr>
<tr>
<td>Protection</td>
<td>Selective protection</td>
</tr>
<tr>
<td>Line Circuit Breakers</td>
<td>Integration of DG</td>
</tr>
<tr>
<td><strong>Level 3</strong></td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td>Real time power flow data</td>
</tr>
<tr>
<td>Accurate MV Measurements</td>
<td>Safe network reconfiguration</td>
</tr>
<tr>
<td><strong>Level 2</strong></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>Fast fault isolation and power restoration</td>
</tr>
<tr>
<td>MV Switch operation</td>
<td></td>
</tr>
<tr>
<td><strong>Level 1</strong></td>
<td></td>
</tr>
<tr>
<td>Monitoring</td>
<td>Faster fault localization</td>
</tr>
<tr>
<td>MV Fault and switch indication</td>
<td>Reliable Switching status information</td>
</tr>
<tr>
<td>LV Measurement</td>
<td></td>
</tr>
</tbody>
</table>
Communication according to customer preferences
Packet Switched Networking fits all medias
Distribution Grid Automation products
From products to solutions

• COM600
  • Grid Automation controller

• REC615 / RER615
  • From remote control to protection

• RIO600
  • Extendable I/O including FPI functionality and sensor inputs

• RTU540
  • Modular I/O scalability

• Arctic Wireless Controller and Gateways
  • GPRS/3G/LTE
  • VPN and Firewall
# Arctic family
## Products in the family

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARG600 Wireless Gateway</td>
<td>- GPRS/3G/LTE</td>
</tr>
<tr>
<td>ARP600 Wireless Protocol Gateway</td>
<td>- GPRS/3G/LTE, Protocol converter</td>
</tr>
<tr>
<td>ARR600 Wireless I/O Gateway</td>
<td>- GPRS/3G/LTE, Protocol converter, Serial over TCP/IP, VPN and firewall</td>
</tr>
<tr>
<td>ARC600 Wireless Controller</td>
<td>- Control and indication of three switching devices</td>
</tr>
<tr>
<td>ARM600 M2M Gateway</td>
<td>- Control and indication of three earthing switches, Protocol converter</td>
</tr>
</tbody>
</table>

- Central communication server
- VPN concentrator
- Firewall and routing
- Arctic Patrol condition monitoring
- Static IP addressing
L2 Solution example
SafeRing with integrated intelligence

- GPRS, 3G, 4G ... fiber, private wireless
- Battery back-up
- IEC 104
- VPN
- I/O's

Level 2

- Control
  - MV Switch operation
- Monitoring
  - MV Fault and switch indication
  - LV Measurement
L4 Solution example
UniSec with integrated intelligence

Level 4
- Protection
  - Line Circuit Breakers
- Measurement
  - Accurate MV Measurements
- Control
  - MV Switch operation
- Monitoring
  - MV Fault and switch indication
  - LV Measurement

GPRS, 3G, 4G... fiber, private wireless

IEC 104

Extended I/O’s Sensor Modules

IEC 61850

Battery back-up

VPN

I/O’s

Sensors
Control Cabinets

- One standardized plug-in solution for outdoor apparatus, secondary switchgears based on ABB IEDs
- Monitoring, Automation, Protection and Communication functions over Public and Private networks
- Easily installed, independent from the primary parts
- Suitable for both Greenfield and Brownfield
# Grid Automation Control Cabinets

<table>
<thead>
<tr>
<th>Application</th>
<th>Model</th>
<th>Functionalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over-head line</td>
<td>GAO2</td>
<td>1–3 outdoor disconnector switch controller</td>
</tr>
<tr>
<td></td>
<td>GAO3</td>
<td>Switch-disconnector controller with MV voltage and current measurements</td>
</tr>
<tr>
<td></td>
<td>GAO4</td>
<td>Recloser controller including MV measurements and protection</td>
</tr>
<tr>
<td>Cable networks</td>
<td>GAI2</td>
<td>RMU controller for load-break switches</td>
</tr>
<tr>
<td></td>
<td>GAI3</td>
<td>RMU controller for load-break switches including MV voltage and current measurements</td>
</tr>
<tr>
<td></td>
<td>GAI4</td>
<td>RMU controller with circuit breaker and several load-break switches including MV measurements and protection</td>
</tr>
</tbody>
</table>
Outdoor Apparatus

NPS Disconnector + GAO2 Control Cabinet

Sectos LBS + GAO3 Control Cabinet

OVR3 Recloser + GAO4 Control Cabinet
Case Fortum, Finland
Introducing the concept of self healing

- Masala area has 20 remote controlled disconnector zones (red areas)
- Masala area has two remote controlled re-closer protected zones (blue areas)
Case Fortum, Finland
Introducing the concept of self healing

[0 s] A fault occurs
Case Fortum, Finland
Introducing the concept of self healing

- [0 s] A fault occurs
- [1 s] Remote re-closer operates
Case Fortum, Finland
Introducing the concept of self healing

- [0 s] A fault occurs
- [1 s] remote re-closer operates
- [10 s] The system analyses and localizes the fault
Case Fortum, Finland
Introducing the concept of self healing

[0 s] A fault occurs
[1 s] remote re-closer operates
[10 s] The system analyses and localizes the fault
[1 min] remote controlled disconnectors isolate the end of the feeder
Case Fortum, Finland
Introducing the concept of self healing

- [0 s] A fault occurs
- [1 s] remote re-closer operates
- [10 s] The system analyses and localizes the fault
- [1 min] remote controlled disconnectors isolate the end of the feeder
- [2 min] remote controlled disconnector restores the power from another feeder
Case Fortum, Finland
Introducing the concept of self healing

- [0 s] A fault occurs
- [1 s] remote re-closer operates
- [10 s] The system analyses and localizes the fault
- [1 min] remote controlled disconnectors isolate the end of the feeder
- [2 min] remote controlled disconnectors restore the power from another feeder
- [~100 min] the service crew fixes the fault
Case Fortum, Finland
Introducing the concept of self healing

3 zones suffered an outage of <2min

1 zone suffered an outage of ~100 min

Without the advanced system, the fault would have been located with time consuming trial & error method ‡ total outage ~200 min
Take Away from this Session

- Consumers realize **quantifiable benefits** from reduced outages and improved power quality.

- Many Utilities now in **analysis, justification or deployment** of Distribution Grid Modernization and Secondary Distribution Automation Programs.

- Benefits have been documented through **pilots and deployment projects**.

- **Products and solutions in place** to support safety, reliability and efficiency programs and capable of supporting future requirements.
Power and productivity for a better world™