A self healing power system for the accurate fault location and zone concept

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A self-healing power system

Introduction

- Why self-healing?
- Needs to improvements
  - Reliability of the supply
  - Quality of the power
  - Operational efficiency
- Accurate fault location, including also earth faults, is crucial for fast fault isolation
- Fast fault isolation enables fast power restoration → SAIDI improvement
- Local automation confines the impact of a network fault to the limited area → SAIFI improvement
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The Zone concept

- Divide the network into zones based on protection zones and control zones
- Limit the effects of disturbances to smaller areas brings less consumers affected and revenue lost
- Get improved voltage quality (light substations and shorter lines)
- Get improved use of the distribution network investments heals higher degree of utilization, less stress on the network and improved asset management
- Adapts to changes in the operational environment which can be implemented step by step and grows with the requirement
A self-healing power system
Intelligent Zone concept components
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Intelligent Zone concept components

Bay level
- Protection algorithms for short circuits and earth fault
- Disturbance data recording, COMTRADE
- Enable prediction of non-permanent earth faults
- Fully automated fault localization
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Protection Zone level
- Reclosers enable automatic isolation
- Indicators transmit the fault status
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Communication
- Secure end-to-end communication utilising M2M VPN technology and built-in firewall
- Precise, real-time data acquisition from your distribution network with standardized protocols
- IEC 60870-5-104 (GPRS)
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Multiple levels of security

A secure connection pipe

- M2M gateway physically separates external and internal IP networks
- Integrated firewall blocks unauthorized access
- Secure VPN: strong authentication and encryption
- Private IP address on equipment level: not visible to public, only through M2M gateway
- GPRS radio signals are encrypted with multiple algorithms
- Equipment has in-built firewalls: accepts traffic only from M2M gateway
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**Substation level**
- Grid Automation Controller
- Generates the fault report to DMS

**Diagram**
- Recloser OVR
- Switch disconnector including fault indicator

**Distribution Management System**
- COM600
- Substation level
- Generates the fault report to DMS
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Advanced fault reporting

- Advanced fault report functions on substation level, contributed by advanced IEDs is of essential significance.
- Advanced station level fault reporting reduces the amount of non-processed data sent to operators – control center can focus on overall coordination tasks.
- The grid automation controller generates a fault report including the distance estimation information and sends it to the DMS.
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MicroSCADA Pro
DMS 600

Distribution Management level
- DMS analyzes the fault report
- Locates the fault on geographical map
- Network reconfiguration
- Generates restoration sequence
- Possibility to run the sequence automatically through SCADA
- Fault reporting even for non-permanent faults (enable predictive maintenance)

Control Center

Recloser OVR

Switch disconnector including fault indicator

Substation

GPRS Communication

Switch disconnector

Recloser OVR

Switch disconnector including fault indicator
Pilot Case
Fortum Oy, Masala

Where to start

- SAIDI > 200min
- Fault location and isolation based on "trial and error"-method - increase also SAIFI, specially at the end of feeders
- Only 15% of fault could be located, overcurrent faults

Target

- Improve the reliability - reduce SAIDI by 50%
- Verify the functionality of the concept
Zone Concept
- 2 feeders
- 4 protection zones
- 20 remote zones

The pilot scope
- Disconnectors with fault indication 4 pcs
  - ABB RER601
  - KOHU + REC523
- Overhead reclosers 2
Pilot Case
The results and the conclusion

- Improved network reliability
- Enhanced power quality
- The data quality is improved and quantity decreased, which is transferred to the control centre
- Advanced station level reporting reduces the amount of non-processed data sent to operators – control center can focus on overall coordination tasks.
- The accuracy of the fault location of the DMS 600 fault management function is enhanced by adding information from all system levels of the distribution network.
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