Protection & Control Relay (IED)
Protection relay evolution

**Electromechanical relay:**
- Induction disc type
- Electromagnetic force causes mechanical operation of relay
- Fixed operating characteristic

**Static relay:**
- Doesn’t have moving parts
- Trip output is of attracted armature type
- Operating qty is generated by discrete analog (generally) electronic components
- Selectable operating characteristic

**Numeric relay, IED:**
- Analog input is sampled and converted to digital format.
- The digital quantity is managed further by microprocessor with mathematical algorithm to generate the operating quantities and implement the protection functions.
- Operating characteristic is adjustable.
- Having sophisticated communication features.
Protection function

Detect faults  Isolate faults selectively and quickly from the network  To limit consequences, i.e. damaged equipment or loss of production

Protection requirement

LV  MV  70kV…150kV  275kV…500kV

Fuse, MCB  Overcurrent relays  - Main prot - Backup prot  - Main 1 - Main 2

Shorter operating time  Higher CT requirement

Protection application

System topology and characteristic  Protection zones, Fault detection, Suitable protection scheme and algorithm  Protection relay selection & settings
Fault clearing time

Fault clearing time according to Aturan Jaringan PLN (Grid Code) :

1. For main protection
   - 500 kV system \( \leq 90 \text{ ms} \)
   - 275kV system \( \leq 100 \text{ ms} \)
   - 150kV system \( \leq 120 \text{ ms} \)
   - 70 kV system \( \leq 150 \text{ ms} \)

2. For backup protection \( \pm 500 \text{ ms} \)

3. Fault clearing time consists of :
   - Relay operating time
   - Circuit breaker break time
   - Teleprotection transfer time
   - CT performance
Example 1: Unit protection zones

- Line protection:
  - Distance
  - Line diff.

- Transformer protection:
  - Diff.
  - REF

- Busbar protection:
  - Busbar Diff.

Bus1

Bus2
Example 2: Unit protection zones

Line protection:
- Distance
- Line diff.

Busbar prot.:
- Busbar Diff.

Transformer prot.:
- Diff.
- REF
Example 3: Unit protection zones

- Line protection:
  - Distance, or
  - Line diff.

- Busbar protection:
  - Busbar Diff.

- Tee zone protection:
  - Circulating current

- Transformer protection:
  - Diff.
  - REF
Fault detection:

Ground fault current too small... practically not feasible

Make use of open delta VT to detect ground fault for:
- Neutral displacement protection relay
Challenging areas:

- CT accuracy class
- CT saturation
- Transformer inrush
- Zero-sequence block by delta winding or ungrounded wye
- Power swing
- Communication scheme for line protection
- Short zone/dead zone
- High impedance differential protection
- Asynchronous closing of capacitor or transformer
CT classes:

- Metering: 0.2S, 0.2, 0.5, 1
- Protection: Class P, Class PX, TPX, TPY, TPZ
Power swing:

Communication scheme for protection:

(a) Stepped time/distance characteristics

(b) Trip logic
Short zone/dead zone:

A = two CTs are available one on each side of the feeder circuit breaker
B = one CT is available on the line side of the feeder circuit breaker
C = one CT is available on the bus side of the feeder circuit breaker
1 = End fault region
High impedance differential protection:
Capacitor bank energization:

- High frequency inrush current → protection failure
- Overvoltage → flashover
Transformer energization:

- $V = L \cdot \frac{di}{dt}$ → asymmetrical inrush current for closing at zero crossing
- Voltage drop
# The Relion® product family

Relion for various application areas

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Relion® 670 series
Optimized for transmission applications

- 670 series IEDs are available as:
  - Pre-configured
  - Customized

- 670 series IEDs are equipped with:
  - Functionality required specifically in transmission applications
    - Series compensation
    - 1- and 3-phase tripping
    - Voltage control for up to eight parallel transformers
    - Extended disturbance recorder
    - Binary and analog data transfer between IEDs
    - Powerful and flexible hardware
  - Multi-object capability

The 670 series protection and control IEDs provide versatile functionality, and maximum flexibility and performance
Relion® 650 series
Off-the-shelf, ready to use solutions

- The 650 series IEDs include:
  - Pre-defined functionality
  - Complete application configuration ready-made at the factory
  - Support for user-defined names in the local language
  - Minimized parameter setting based on default values and ABB’s new global base value concept
  - Extended HMI functionality
    - 15 dynamic three colour-indication LEDs per page
    - Configurable push-button shortcuts
    - Programmable LED text-based labels
  - Settable 1A/5A -rated current inputs

The 650 series IEDs provide ‘off-the-shelf’, ready-to-use solutions for line, transformer, busbar and generator protection as well as bay control applications
Relion® 630 series
Flexibility and performance

- The 630 series IEDs:
  - Pre-configured and flexible. Easily tailored to meet the specific requirements.
  - Full freedom to build application configurations
  - Minimized parameter setting, new global base value concept.
  - Control capability of several objects, CB's or disconnectors.
  - Bay control logic and interlocking.
  - High performance GOOSE messaging.
  - Large detachable and user-friendly HMI.
  - Connectors for easy service with integrated CT short-circuit.

Pre-configured for feeder, transformer and motor protection & control.
For utility power distribution and industrial applications
Relion® 615 series
Compact and powerful

- The 615 series IEDs:
  - After setting the application-specific parameters, IEDs are ready to be commissioned.
  - Control of one circuit-breaker via the IED’s HMI or remote.
  - Patented plug-in design speeds up installation, maintenance and testing.
  - Compact design, excellent for new and retrofit installations.
  - High performance GOOSE messaging.
  - Advanced earth fault protection, including transient protection.
  - Three-channel arc-fault protection to increase personal safety, reduce material damage and minimize system down-time.

Standard configurations for feeder, transformer, line differential and motor protection & control.
For utility power distribution and industrial applications
Relion® protection and control
Highlights in the family

- One common tool for all Relion® products, Protection and Control IED Manager PCM600
- The IEDs utilize ABB’s unique connectivity package concept
- Covers all applications, from interconnected transmission grids to secondary distribution kiosks
- The performance of protection and control IEDs meet the comprehensive IEC 61850 communication tasks, for example, GOOSE messaging IEC61850-8-1 for horizontal communication (Bay Level)
- Also continual development for vertical communication IEC61850-9-2 to the Process Bus
- The Relion product family provides configured, pre-configured or fully customized IEDs
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