Interconnection Protection REG615 std configuration A
Numerical interconnection protection in medium-voltage networks

The relay is intended for protection, control, measurement and supervision of interconnection points of distributed generation units in utility and industrial power distribution systems.

Mechanical and construction details

- The relay shall have compact dimensions not exceeding 4U in height. The depth of the relay shall, without any additional raising frame, not exceed 160 mm when flush mounted so as not to foul with other equipment mounted inside the cabinet.
- The weight of the relay must not exceed 5 kgs to permit use of optimized sheet metal thickness in construction of panels.
- The relay shall support flush, semi-flush, rack and wall mounting options.
- As flush mounted, the relay shall meet the IP54 ingress protect ion requirements on the front side and IP20 on the rear side and connection terminals.
- To facilitate quick unit replacement, the relay design shall be of draw-out type with secure current transformer (CT) shorting . It shall be possible to quickly replace a faulty unit with a less than 30 minutes.
- To prevent unauthorized detachment of the relay plug-in unit, the relay shall be provided with an integrated seal.
- The relay shall have a graphical display with at least 7 rows of characters and up to 20 characters per row.

Protection functions
Distributed Power Generation Units (DPGU):

- In distributed power generation applications where the power generation units (PGU) are connected to the grid, the PGUs are required to comply with grid connection requirements (grid codes) including system stability, reactive power support, transient recovery and voltage-frequency regulations. The grid codes require the distributed PGUs to remain connected even during network disturbances to ensure grid stability and reliability

and thus avoiding a grid collapse. To enable the connection of distributed power generation units to the grid the relay shall include the following protection functions:

- To determine whether and when to disconnect a distributed generation unit from the grid during network disturbances, the relay shall have three-stage low-voltage ride-through protection 27RT) with a user-definable Low-Voltage Ride-Through (LVRT) curve, to comply with local or national grid cod e requirements.
- To ensure power system stability, the relay shall have directional reactive power and undervoltage protection (32Q,27) and monitor the reactive power flow to prevent a power system voltage collapse in the event of a network fault.
- To detect islanding or loss-of-mains conditions of distributed generation units, the relay shall have vector shift protection (78V). The function shall continuously measure the voltage cycle shift in terms of the phase angle, which shall be settable between 2 and 30 degrees with 1 degree resolution.
- The relay shall support the combined and parallel use of multiple protection functions to detect loss-of-mains conditions. The relay shall to minimize the non-detectable zone , support the combination of vector shift protection (78V) and frequency rate-of-change protection (81R), or other user-definable combinations of passive detecting techniques such as overvoltage, undervoltage, overfrequency, underfrequency, rate-of-change of frequency and voltage unbalance.
- The relay must have three-stage frequency protection, including at least overfrequency (81O), underfrequency (81U) and frequency rate-of-change (81R) protection with rate-of-rise or rate-of-fall freely selectable for each stage.

Other protection functions:

- The relay shall have non-directional overcurrent (50) and earth -fault (50N) protection.
- The relay shall have three-stage directional overcurrent and earth-fault protection (67/67N) with voltage memory and positive and negative-sequence voltage polarization. I_0 and U_0 shall be derived either from the phase voltages and currents or from the measured neutral current and residual voltage.
- In compensated, unearthed and high-resistance earthed networks, the relay shall be able to detect transient, intermittent and continuous earth faults.
- The relay shall have two-stage negative-sequence overcurrent protection (46) settable between 0.01 and 5 times I_n, definite time (DT) and inverse definite minimum time (IDMT) characteristics, supporting both IEC and ANSI/IEEE operating curves.
- The relay shall have comprehensive voltage protection functionality, including at least overvoltage (59), undervoltage (27), positive-sequence undervoltage (47U+), negative-sequence overvoltage(47O-) and residual overvoltage (59G) protection with multiple stages.
- The relay shall have three-phase thermal overload protection (49F).
- The relay shall have a three-phase inrush detector (68) to avoid tripping during magnetizing inrush conditions. It shall be possible to selectively block the overcurrent and earth-fault protection stages when the ratio of the 2nd harmonic component to the fundamental component exceeds the set value.
- To protect the generator and turbine from the harmful effect of excessive power/motoring, the relay shall have two stage reverse power/ directional overpower protection (32R/32O). It shall be possible to use positive-sequence components for calculating power, which makes the determination of power insensitive to the possible asymmetry in currents or voltages and corresponds to the real load of the generator's prime mover . The protection function shall have a settable power angle between -90 to +90 degrees and an adjustable power setting range of 1 % to 200 %.
- The relay shall have circuit breaker failure protection (51BF/5 1NBF) including independent timers for repeated tripping of the same breaker and backup tripping of the upstream breaker. The function shall allow higher selectivity by avoiding tripping of the upstream breaker if the repeated tripping of the breaker closest to the fault is successful.

- The relay shall have arc protection based on simultaneous detection of current and light. During maintenance work at the substation, it shall be possible to change the operation criteria to light only via a binary input.

Inputs and outputs

- The relay shall have 12 binary inputs and 9 binary outputs and all of them freely configurable. Optionally, it must be possible to add 4 more binary inputs and 1 more binary output.
- To enable direct tripping of the circuit breaker, the relay must have 2 double-pole power output relays with integrated trip-circuit supervision (TCS). The two power output relays shall be rated to make and carry 30 A for 0.5 s with a breaking capacity of $\geq$1 A (L/R<40 ms).
- To enable fast direct tripping of the circuit breaker, the relay must have 3 optional high-speed binary outputs with an operate time of $\leq$ 1 ms. The binary output contacts shall be rated to make and carry 30 A for 0.5 s with a breaking capacity of $\geq$1 A (L/R<40 ms).
- The threshold voltage of the relay's binary inputs shall be set table to 16...176 V DC.
- The relay shall be equipped with inputs for detecting temperature using resistance temperature detector (RTD) sensors. At least 2 inputs shall be required. It shall be possible to include the ambient temperature measured from an external temperature sensor in thermal modeling of the three-phase thermal protection for feeders.
- The relay shall support the commonly used sensor types Pt100, Pt250 ,Ni100, Ni120, Ni250 and Cu10 with 2-wire or 3-wire connection with common ground.
- The phase current inputs and the residual current input of the relay shall be rated 1/5 A. The selection of 1 A or 5 A shall be software based.
- For applications requiring sensitive earth fault protection the relay shall offer an optional 0.2/1 A residual current input. The selection of 0.2 A or 1 A shall be software based.

Measurements, alarms and reporting

- The relay shall have three-phase current and voltage measurement (fundamental or RMS-based as selectable options) with an accuracy of ±0.5% and zero, negative and positive-sequence current and voltage measurement functionality with an accuracy of ±1% within the range of ±2Hz of the nominal frequency.
- To collect sequence-of-events (SoE) information, the relay must include a non-volatile memory with a capacity of storing at least 1024 event codes with associated time stamps.
- The relay must support the storage of at least 128 fault records in the relay's non-volatile memory.
- The fault record values must at least include phase currents, phase voltages, zero, negative and positive-sequence currents and voltages, and the active setting group.
- The relay shall have a disturbance recorder supporting a sampling frequency of 32 samples per cycle and featuring up to 12 analog and 64 binary signal channels.
- The relay's disturbance recorder shall support not less than 6 three-second recordings at 32 samples per cycle for 12 analog channels and 64 binary channels.
- The relay shall support up to 100 disturbance recordings.
- The relay must have a load profile recorder for phase currents and voltages supporting up to 12 selectable load quantities and more than 1 year of recording length. The load profile recorder output shall be in COMTRADE format.
- The relay shall include a motor runtime counter for calculating and presenting the accumulated operation time of a machine. The function shall alert the operator via a warning and an alarm when the accumulated operation time exceeds the set limit.

Communication

- The relay must support IEC 61850 Edition 1 and Edition 2.
- The relay must support, besides IEC 61850, simultaneous communication using one of the following communication protocols: Modbus® (RTU-ASCII/TCP), IEC 60870-5-103 or DNP3 (serial/TCP).
- The relay must have an Ethernet port (RJ45) on the front for local parametrization and data retrieval.
- The relay shall support up to five IEC 61850 (MMS) clients simultaneously.
- The relay must have two fiber-optic Ethernet ports with HSR and PRP-1.
- The relay shall have a third Ethernet port for providing connectivity of any other Ethernet device to an IEC 61850 station bus inside a switchgear bay.
- The relay must support IEC 61850 GOOSE messaging and meet the performance requirements for tripping applications (<10 ms) as defined by the IEC 61850 standard.
- The relay shall have support for sharing analog values like temperature, resistance, tap positions using IEC 61850 GOOSE messaging.
- The relay must support IEEE 1588 v2 for high-accuracy time synchronization (< 4 µs) in Ethernet-based applications. The relay shall also support the SNTP (Simple Network Time Protocol) and IRIG-B (Inter-Range Instrumentation Group - Time Code Format B) time synchronization methods.
- The relay must support IEC 61850-9-2LE with IEEE 1588 v2 for accurate time synchronization.

Engineering and configurability

- The relay must have 6 independent settings groups for the relevant protection settings (start value, operate time). It must be possible to change protection setting values from one setting group to another in less than 20 ms from the binary input activation.
- The relay must have a web browser-based human-machine interface (WHMI) with secured communication (TLS) and shall provide the following functions:
  - Programmable LEDs and event lists
  - System supervision
  - Parameter settings
  - Measurement display
  - Disturbance records
  - Phasor diagram
  - Single-line diagram (SLD)
  - Importing and exporting of parameters
- When a protection function is disabled or removed from the configuration, neither the relay nor the programming tool shall show the function-related settings.
- The relay HMI and engineering tool shall have multilingual support.
- The relay HMI and engineering tool shall support IEC and ANSI protection function codes.
- The relay shall have at least 11 freely configurable and programmable two-color LEDs.
- The relay must have at least 10 user-configurable local HMI views including measurements and SLDs.
- The relay shall have a graphical configuration tool for the complete relay application including multi-level logic programming support, timers and flip-flops.
- The relay configuration tool must include online visualization of the relay application state.
- It must be possible to keep the relay configuration tool up-to-date using an online update functionality.
- The relay configuration tool shall support viewing of relay events, fault records and visualization of disturbance recordings.

- The relay configuration tool must include the complete relay documentation including operation and technical details.
- The relay configuration tool must include functionality for comparing the archived configuration to the configuration in the relay.
- The relay configuration tool must allow configuration of IEC 61850 vertical and horizontal communication including GOOSE and sampled values.
- The relay configuration tool must support importing and exporting of valid IEC 61850 files (ICD, CID, SCD, IID).
- The relay configuration tool must be compatible with earlier relay versions.

Type tests and other compliance requirements

- The relay shall have an operational temperature range of -25 … +55°C and transport/storage temperature range of -40...+85°C.
- The relay must fulfill the mechanical test requirements according to IEC 60255-21-1, -2 and -3, Class 2 for vibration, shock, bump and seismic compliance.
- The relay's maximum DC auxiliary power consumption shall be less than 20 W (all inputs activated and over the full supply range).
- The relay must have an IEC 61850 Edition 2 certificate from an accredited Level A testing laboratory.
- The relay must fulfill the electromagnetic compatibility (EMC) test requirements according to IEC 60255-26.
- The relay must be tested according to the requirements of the IEC or an equivalent standard.

Additional information

For more information, please contact your local ABB representative or visit our website at:
www.abb.com/substationautomation
www.abb.com/mediumvoltage