Grid Solutions

MiCOM AGILE P54A/B/C/E

Simplifying the Integration of Renewables

Grid Modernization Challenge – Protect Lines with up to 6 Terminals

For more than 100 years, electric power plants have mainly been large, utility-owned facilities, feeding distributed load based on unidirectional power flow. Over the past 20 years, smaller, independent power generation plants have been developed and distributed within electrical networks. The increasing number of Distributed Generation (DG) sites, and their increasing power ratings from kW to hundreds of MW, create new challenges for network planning and operation.

DG Tee Infeeds to Existing Transmission Lines

Circuits near the coast may be candidates for tee infeeds to evacuate renewable energy from onshore and offshore wind generation. A tee infeed to a nearby transmission line can be a more cost effective solution to connect the generation to the grid than building a new substation. This economy enables more DG connections to penetrate the network helping to meet green energy connection targets and reduce greenhouse gas emissions.

Multi-Ended Circuit Differential

Previously, transmission and distribution circuits would have two or three ends only. However, five or more ends are becoming common because large DG sites such as onshore or offshore windfarms and solar farms are being connected to the grid. As the power networks evolve to transport power in ever more complex ring and meshed networks, line/cable differential protection becomes increasingly attractive, with its inherent ability to address grading/selectivity challenges and is scalable for multi-terminal circuits able to accommodate many connections of distributed generation along the line. Grid Solutions at GE Vernova' multi-ended current differential protection is now ready for any protection topology from two to six terminals, whether those multi-terminals exist now, or are provisioned for connection in the future.

Protection and Control

- Maximises connection of renewables, up to 6 lines or cable ends
- Subcycle tripping time up to 4-ended topology (<1.25 cycle for 5 or 6 ends)
- Assists with grading/selectivity challenges such as ride-through, arcing limitation and ground potential rise
- Full support of SONET/SDH channel switching
- Suitable for direct fibre and multiplexed (IEEE C37.94) networks, including MPLS systems

Application Flexibility

- Expandability – connect two or three ends now and grow the scheme as each new tee is added
- Ability to take an end off-line for maintenance improving system availability
- Extensive binary signalling capability between ends for intertripping, breaker fail, interlocking and control/observation of remote 3rd party substations

Advanced Communications

- Advanced IEC 61850 Edition 2 implementation with device settings via SCL files
- Redundant communications with zero downtime using optional PRP/HSR protocols
- Wide range of supported protocols: Courier/K-Bus, IEC 60870-5-103, DNP 3.0 (EAI-485 or Ethernet) and IEC 61850
- NERC CIP cybersecurity including role-based access control (RBAC), RADIUS and SysLog

GE VERNOVA

MiCOM Agile P54x Models

Current differential protection has been used for many years to protect transmission lines and distribution feeders. Currently, GE Vernova's existing relay portfolio of P541-6 line current differential protection relays offers protection for 2 or 3 ended schemes. With this release, GE Vernova introduces a new multi-ended line differential protection to the P40 Agile range. The protection can not only protect a line or cable up to a maximum of six terminals, but the operating time of the protection has been accelerated to sub-cycle for 2-4 ended schemes and 1.25 cycles for 5 or 6 ended schemes.

- P54A compact (40TE), economical line differential protection without VT inputs, offering non-directional backup protection
- P54B compact (40TE), economical line differential protection with directionalised back-up protection and inbuilt reclosing and check synchronism
- P54C transmission-class 1/3-pole tripping line differential protection with backup protection and inbuilt reclosing and check synchronism (built from today's P543 hardware)
- P54E transmission-class 1/3-pole tripping line differential protection with back-up protection and inbuilt reclosing and check synchronism with a large number of binary I/O for traditional hardwired schemes (built from P545 hardware)

Network Extension

GE Vernova's multi-ended current differential protection is now ready for any protection topology from two to six terminals, whether those multi-terminals exist now, or are provisioned for connection in the future. The P54x multi-ended line differential compensates for line CT ratio mismatches, even for 1 A and 5 A differences between line ends to facilitate easier retrofitting.
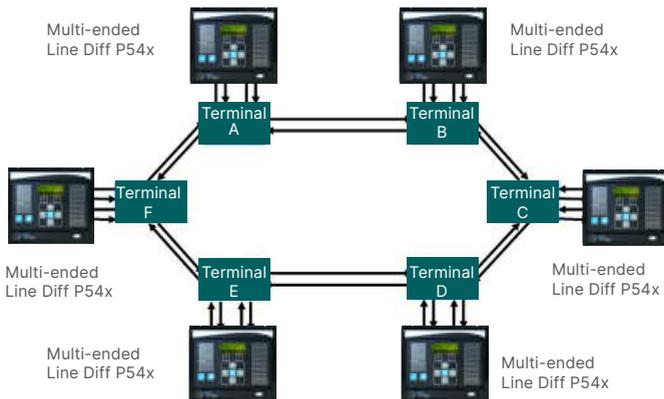
Multi-ended Line Diff P54x connection

Programmable Scheme Logic

Powerful graphical logic allows the user to customise the protection and control functions. The logic includes 32 timers, gates (OR, AND, MAJORITY) and set/reset latch functions, with the ability to invert the inputs and outputs and provide feedback.

This logic has the ability to condition any of the eight binary logic states that can be sent between any pair of relays in the scheme. This has particular value to avoid the need to overlay separate breaker fail or intertripping schemes, or where a remote substation(s) are inaccessible by SCADA. In the latter case, binary data for control and supervision can be connected by "proxy" via an end that is accessible.

Communication Interfaces for System Integration

To ensure compatibility with standard communications equipment, the MiCOM P54x Agile multi-ended line differential series is designed to work with IEEE C37.94™. A direct fiber optic connection to a multiplexer is possible if the MUX is IEEE C37.94™ compliant.

In direct fibre optic applications, 1300 nm and 1550 nm channel options are available. The transmitters are designed with an "optical budget" to support up to 120 km.

Post-Fault Analysis

Event Records

Up to 1024 time-tagged event records can be stored in battery backed memory. An optional modulated or demodulated IRIG-B port is available for accurate time synchronisation.

Fault Records

The last 15 fault records are stored.

High-Resolution Disturbance Records

The oscillography has 16 analogue channels, 64 digital and 1 time channel, all at a resolution of 48 samples/ cycle.

Fault Location (P54B, P54C, P54E)

A fault location algorithm provides distance to fault in miles, kilometres, ohms or percentage of the line length. The proven algorithm employed tolerates pre-fault loading and fault arc resistance.

For more information, visit
gevernova.com/grid-solutions

GE VERNOVA