GE
Grid Solutions

MiCOM Agile P144

Distribution Feeder Manager with Transient Earth Fault Detection

The P144 is launched with protection features dedicated for Petersen coil (resonant-earthed) compensated networks. GE's P144, high-performance software algorithms are tuned for the fault detection challenge.

Petersen coil neutral compensation is widely used as the method of earthing in distribution power grids. In such systems, single-phase-to-earth faults have minimal effect on the load, but must nevertheless be detected. It is always a challenge to detect the fault with correct selectivity and directionality because the current measured by the relay can be either inductive or capacitive in phase angle. GE uses a robust software method based on 220 Hz interharmonic detection, for dependability and peace of mind.

Shortly after a fault inception, the inductive coil current attempts to compensate the power system's capacitive charging current. In a perfect world the two would summate to zero, in an over-compensated network the vector result would be inductive, and in an-undercompensated network it would be capacitive. This uncertainty in phase angle rules out the use of traditional directional earth fault protection based on fundamental frequency measurements, as it would not be able to discriminate the faulted circuit from the non-faulted circuits. MiCOM P144 Agile incorporates novel transient earth fault detection (TEFD), implemented as a software function block in a multifunction feeder relay, with no need to add unreliable analog hardware relays, nor analog processing boards. This approach achieves the most cost-effective functional integration and protection scheme engineering. Lifetime performance and calibration are assured by means of the fully numerical (digital) implementation in the relay, as opposed to traditional analog detection methods.

Key Benefits

- Highest selectivity and directionality for transient earth faults
- Full complement of distribution protection, reclosing and load-shedding features
- Fully numerical with no reliance on analog techniques
- Graphical programmable logic to customize automation schemes
- Communications include IEC 61850 edition 2, IEC 60870-5-103 and other serial options
- IEC 62439 PRP and HSR communications redundancy available
- IEEE1588 and IRIG-B for accurate time synchronising
- Up to 16 opto inputs and 15 output contacts

Imagination at work

Transient Earth Fault Detection

The TEFD technique works on a special frequency range centred at 220 Hz. Selecting this interharmonic spectrum avoids the 4th and 5th harmonics which are naturally prevalent in such compensated networks. The comparison table below shows how a power-based technique working at 220 Hz is dependable, where an example 50 Hz fundamental technique would not be.

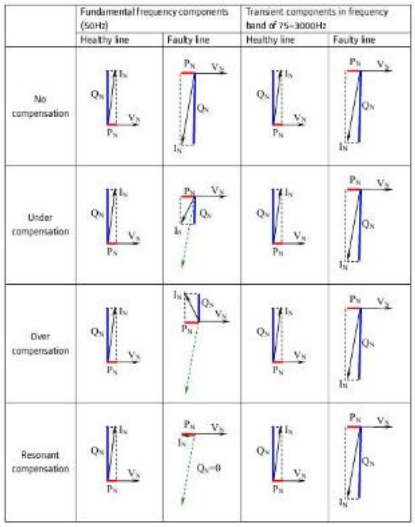

Table 1: Comparison of 50 Hz and 220 Hz centred (75 to 3000 Hz) techniques

It can be seen that in all cases, for the healthy circuits the zero-sequence current (Io) is consistently leading the zero-sequence voltage (Vo) vector. The problem is that in the 50 Hz fundamental case, Io is not in a fixed phase angle sense compared to Vo, so a reliable directional window cannot be found. The right-hand columns show that GE's technique in the P144 overcomes this issue, allowing clear consistency in the vector sense, such as to discriminate between forward (in-zone) and reverse (external) faults in a manner consistent with selective protection relaying.

Figure 1 illustrates the waveform signatures of typical faults on Petersen coil systems, to demonstrate how TEFD is analyzed in the P144 relay to detect the fault.

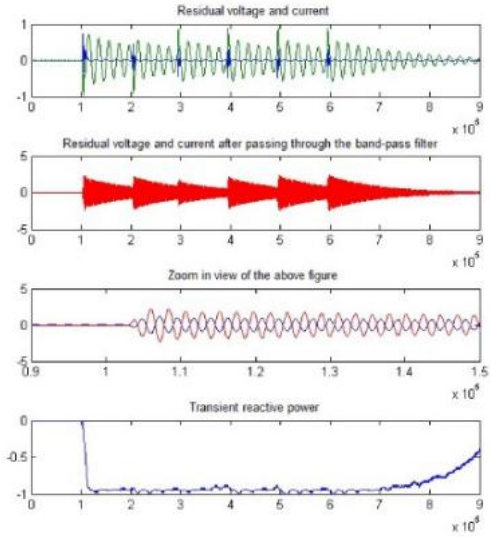

Figure 1: Waveforms during the processing of a reverse fault on a resonant compensated system

Best in Test

GE's innovative TEFD in the P144 is a proven technique to detect the direction of single-phase-to-earth faults on Petersen coil compensated distribution systems. Unlike conventional techniques, such as the first-half-wave method, active power or conductivity method, the P144 TEFD does not require any special hardware with higher sampling rates, nor higher accuracy measurements. Yet, the test results and installed base records from the field show that the P144 achieves significant accuracy improvements for the fault library cases, and improved speed of detection for reverse faults, particularly for better selectivity between feeder relays at the same busbar location.

The performance of the principal protection elements, backup protection, control, measurements, monitoring, recording and communications facilities in GE's P144 make it the perfect choice to protect your distribution network. Non-selective spurious trips with unplanned customer supply outages can be constrained to history.

For more information please contact
GE Power
Grid Solutions

Worldwide Contact Center

Web: www.GEGridSolutions.com/contact
Phone: +44 (0) 1785 250 070

GEGridSolutions.com

IEC is a registered trademark of Commission Electrotechnique Internationale. IEEE is a registered trademark of the Institute of Electrical Electronics Engineers, Inc.

GE and the GE monogram are trademarks of General Electric Company.

GE reserves the right to make changes to specifications of products described at any time without notice and without obligation to notify any person of such changes.

P144-Brochure-EN-2018-10-Grid-GA-0993. © Copyright 2018, General Electric Company. All rights reserved.

Imagination at work