Arcteq Innovation: Broad range multi-criteria earth-fault protection

The problem

The increase of medium voltage cabling, connection of distributed generation and compensated networks (Petersen coil) along with distributed compensation has led to new challenges in earth-fault protection of distribution feeders. Challenging combinations of short cable feeders, long overhead feeders and mixed cable and overhead network is increasing significantly among distribution system operators. Relaying on conventional protection methods may lead to either nuisance trips of healthy feeders or undetected faults in faulty feeders. When protecting compensated long-distance cables and overhead lines it is in some cases difficult to distinguish between healthy- and faulty feeder when protection is based on merely measuring the angle and magnitude of residual voltage and currents.

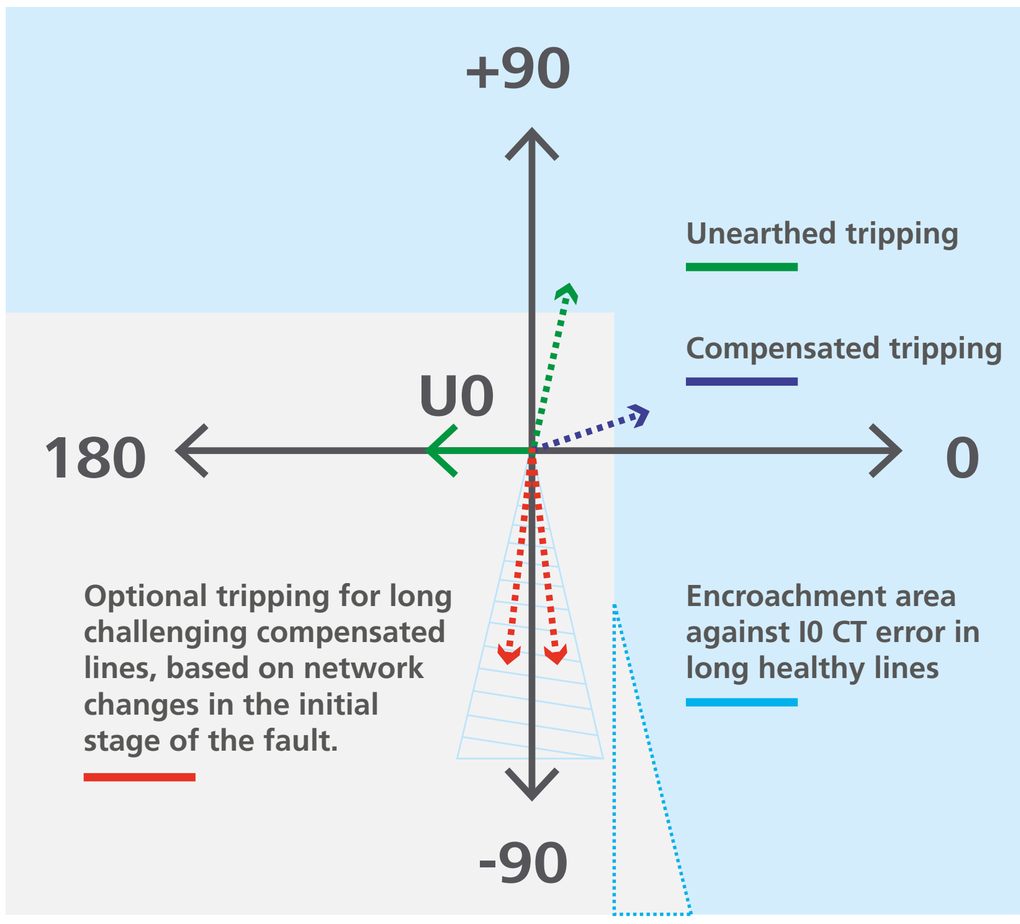
Earth fault protection often requires information on network status (ungrounded or compensated). When changing between these two statuses setting group must be changed and especially in case of distributed compensation the change may be difficult or impossible to arrange.

The Solution: New broad range mode with multi-criteria detection

New broad range mode available in AQ-200 series protection and control IEDs can protect against earth-fault in both ungrounded and compensated networks without setting changes. The algorithm reliability is further increased using a new multi-criteria detection. This optional additional tripping condition for compensated networks uses Arcteq's patented, high-resolution intermittent earth-fault algorithm with added symmetrical component calculation of phase currents and voltages. If this mode is activated the tripping criteria comprises of a measured residual current in the third or fourth quadrant and the symmetrical components of voltages and currents detecting a fault. No extra parameterization is required compared to traditional method.

Multi-criteria algorithm can be tested with Comtrade files supplied by Arcteq. Function requires connection of 3-phase currents, residual current and zero sequence voltage to operate correctly. To avoid unnecessary trips due to CT errors, encroachment area in compensated long healthy feeders can be added.

New broad range mode



Operation of new broad range mode covers both ungrounded and compensated networks and is equipped with optional additional multi-criteria detection for compensated networks to increase the protection reliability.

For a complete coverage of feeder earth-faults in compensated networks, the intermittent / transient type of earth-faults are to be protected by Arcteq's patented intermittent earth-fault protection stage available in the AQ 200 series feeder protection IEDs.