Abstract

The current scenario of restructured and market driven power system has obligated protection schemes to perform better. Inclusion of series capacitors and power electronics devices in the network is another concern for any protection scheme. Power networks are operating frequently under aberrant system conditions like power swing and single-pole tripping when the relaying algorithms are constrained. This thesis investigates on directional relaying for different power networks and system conditions and proposes innovative solutions based on sequence components and integration approaches.

Directional relaying is an integral element in many protection schemes for transmission network. With numerical relaying, there are significant developments in the area of directional relaying for networks where most of them use different sequence components of voltage and current. Such algorithms are constrained with the inclusion of series compensation in a line due to the presence of subsynchronous frequency component in the fault signals and voltage and current inversion conditions. A solution to this problem is developed using phase change in positive sequence current and change in magnitude of positive sequence voltage during fault. Such a technique is advantageous for close-in fault, voltage inversion and other conditions. Double circuit line has inherent problems in protection specifically for cross-country, far-end and high resistance faults. An integrated solution strategy is proposed for double circuit line using multi-criteria fuzzy decision approach which provides improved performance during cross-country fault and other network conditions. Thyristor controlled series compensation (TCSC) introduces variable reactance to the network and imposes challenges to directional relaying based on phasors. This issue is solved by integrating the decisions from three direction-classifiers and its performance is found to be accurate.

Phasors are being modulated during power swing condition which is observed in networks following disturbances. Using fuzzy decision based integration and with three features a directional relaying algorithm is proposed for power swing situation and its performance is found to be accurate at numerous fault conditions. Single pole tripping operation is an unusual situation when negative and zero sequence phasor components become substantial before the fault and creates problems to many relaying algorithms. A phase change in negative sequence current based technique is proposed which provides accurate results for different fault conditions.

This thesis proposes innovative solutions to directional relaying issues related to series compensated line, double circuit line and system conditions like power swing and single-pole tripping (SPT) using information derived from sequence components of phasors and different integration techniques.