

Abstract

Disturbances in power system may cause oscillations in machine rotor angles and can result in severe power flow swings. Distance relay is widely used for protection of transmission lines, which finds limitation during power swing and can cause unintended line tripping. Maloperation of such a relay may lead to cascaded outage of transmission lines. This thesis investigates the effect of power swing on distance relaying schemes and proposes innovative schemes for improved protection performance during power swing.

Unwanted tripping of distance relay can be avoided by using a power swing blocking (PSB) function embedded in a distance relaying algorithm. In this thesis, a new PSB algorithm is developed using moving window average of three-phase current signals. The proposed algorithm is capable of discriminating slow and fast power swings from faults accurately.

The voltage and current waveforms deviate from normal sinusoid and are modulated with a low frequency component during power swing condition. The challenges of phasor estimation during power swing and related issue on sequence component based relaying principles are discussed in this thesis. Using least squares technique an accurate phasor estimation technique during power swing is proposed and applied for unbalanced fault detection during power swing.

Fault detection during power swing is a challenge to protection schemes because of large variations in voltage and current even before the fault. Due to the symmetric nature of signals during power swing, symmetrical faults are difficult to be detected. A differential power based fault detection technique is proposed to identify symmetrical faults during power swing. The technique is able to identify balanced faults during the power swing at a power angle near 180° when small increase in fault current results.

Zone 2 pickup signals of adjacent line relays are unified using simple logic gates and the information is transferred to supervise remote backup protection; the zone 3 for maintaining the security of power system during stressed system condition. An impedance trajectory prediction method is proposed using synchrophasors to supervise distance relay during power swing. The prediction approach overcomes the latency of synchrophasor data to initiate the blocking decision for distance relay.