

Power swing blocking (PSB) function for distance relay using prediction technique

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Abstract Power swing leads to mis-operation of distance relays due to variations in system current (I) and voltage (V) magnitudes. PSB function is crucial to distinguish power swing and fault properly and prevent relay pickup during power swings to avoid unintended outage of the transmission lines. Moreover, the relay should initiate trip command in case of fault during power swing. This paper introduces a prediction based PSB function to block the relay operation during power swing and also to unblock it in case of occurrence of a fault during power swing. This method predicts current and voltage samples during power swing using auto-regression technique and subsequently calculates the predicted impedance observed by the distance relay (V/I). Blocking is invoked if predicted impedance is inside the distance relay protection zones. The differential components computed using actual and predicted values are used to detect fault in the transmission system. The proposed method is tested for two-area four-machine power system and compared with available methods.

Keywords Balanced faults · Distance relaying · Prediction technique · Power swing

1 Introduction

Power swing may be experienced by a system following a disturbance such as a fault, generator disconnection or switching on/off large load. Due to significant changes in system current (I) and voltage (V) magnitudes, the impedance trajectory observed by a distance relay may enter into the protective zones and can cause unintended trip during a power swing (Tziouvaras 2006; IEEE Power System Relaying Committee of the IEEE Power and Energy Society 2005). The impedance trajectory of a distance relay during stable and unstable power swings cases is shown in Fig. 1.

The stable and unstable power swings causes unwanted initiation of tripping of distance relay. This may further leads to cascade outage of transmission lines and power system blackout. To ensure high security in protection decision, PSB function is integrated with the protective relay (Tziouvaras 2006; IEEE Power System Relaying Committee of the IEEE Power and Energy Society 2005; Mooney and Fischer 2006). Traditional methods initiate the blocking function, without observing the impedance trajectory with reference to relay operating characteristics, resulting in unwanted blocking of PSB function. If the blocking can be achieved much before the impedance trajectory encroaches to the zone-1 characteristics, it can avert unintended outages. In addition, whenever a fault appears in the transmission system during power swing, the distance relay must be able to identify the fault and trip the required circuit breaker immediately. Due to significant oscillations in pre-fault voltage and current magnitudes, the conventional fault detection algorithms good at steady state condition may not qualify to judge the fault during power swing. Conventional fault detection techniques may fail to

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