

Abstract

Maloperation of distance relay and lack of real-time visualization have been the primary reason of many power system blackouts. Modern power systems are highly interconnected for economics and reliability concerns, which has made them more vulnerable to stressed conditions. Stressed conditions in power systems often lead to these cascading outages. Identification of such stressed conditions by enhancing situational awareness has emerged as a research challenge. Invention of synchrophasor technology has facilitated precise monitoring of power system in real-time. In the recent years, the transmission sector is witnessing a boom in the installation of Phasor Measurement Units (PMU) which has led to an exponential growth in the amount of data available for use at the control centers or Phasor Data Concentrators (PDC). This thesis focuses on extraction of essential features from the data obtained from Wide Area Measurements (WAMS) and dynamic assessment of health of the system in order to enable the system operator to initiate remedial action schemes for preventing events capable of endangering the integrity of the system. In order to achieve these objective, schemes employing PMUs have been proposed for enhancing Wide Area Protection (WAP), Situational Awareness (SA) and suggesting appropriate System Integrity Protection Schemes (SIPS) for retaining system stability. The schemes are as follows:

- 1) A new intelligent philosophy based wide area protection (WABP) scheme is suggested for power transmission system. It uses PMU information for stress assessment in power system and accordingly enhances the security aspect. It also includes out of step protection.
- 2) Qualitative assessment on the impact of Thyristor controlled series capacitor (TCSC) on power swing and distance relay is studied. A new index is derived for secured operation of distance relay during power swings in TCSC compensated lines.
- 3) Enhancement of wide area SA in power transmission systems by using PMU measurements for devising indices in order to identify events by visualizing the underlying dynamics in power systems through Dynamic State Estimation (DSE).
- 4) Two different algorithms are reported as SIPS for enhancing transient stability and preventing voltage instability using WAMS information.

Keywords: Blackouts, Distance relays, Stress assessment, Power swing, Voltage instability, Wide Area Measurement Systems, Wide Area Protection, Wide Area Situational Awareness, Zone-3 supervision.