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WIDE AREA MEASUREMENT USING PHASOR MEASUREMENT UNIT

SANDIP P. THAWKAR[1], ROHIT G. KANOJIA[2], P. M. DEOGHARE[2]

1. Dept. of Electrical Engg, Y.C.C.E, Nagpur, India.
2. Asst. Professor, Dept. of Electrical Engg, Y.C.C.E, Nagpur, India.

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Corresponding Author

Mr. Sandip P. Thawkar

Abstract

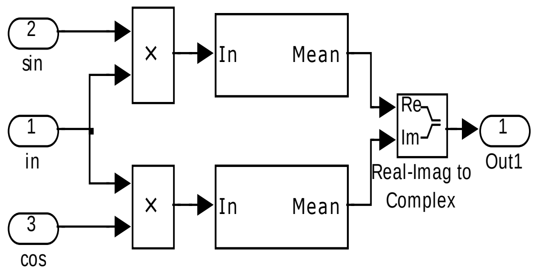
This paper presents a new synchronized phasor measurement unit based measurement scheme for widely spread transmission line network. The principle of the measurement scheme depends on comparing voltage magnitude at each bus during normal condition and fault condition inside a wide area network system to detect the nearest bus to the fault and current magnitudes for each interconnected line between two areas on the network. The new technique depends on synchronizes phasor measuring technology with high speed communication system and time transfer GPS system. The simulation of the interconnected system is applied on 400 KV network in MATLAB simulink.

I. Introduction

System-wide disturbances in power systems are a challenging problem for the utility industry because of the large scale and the complexity of the power system. When a major power system disturbance occurs the protection and control actions are required to stop the power system degradation, restore the system to a normal state, and minimize the impact of the disturbance [1]. The present control actions are not designed for a fast developing disturbance and may be too slow. Further, dynamic simulation software is applicable only for off-line analysis.The recent enlargement and increased complexity of power system configurations has led to adjacent arrangements of short and long distance power transmission lines, both connected to the same busbar in a substation [2].

This causes difficult situations when relay engineers coordinate reach or operate time among distance relays to cope with this, current differential protection which utilizes wide-area current data would be effective for wide-area backup protection although such protection needs system-wide timing synchronism for the simultaneous current sampling at all remote terminals and data exchanges among them.

The proposed technique provide an ideal measurement system for protection, monitor and controlling wide power system networks voltages and currents using phasor measurement unit. It measures positive sequence (negative and zero sequence quantities, if needed) voltage and



currents of a power system in real time with time synchronization, fast communication system and GPS.

II. Phasor Measurement Unit (PMU)

The phasor measurement unit (PMU) provide real time measurement of synchronised sequence components of voltage and current in transmission network. This unit compares accurate measurement over wide area network. For the phasor measurement calculation discrete fourier transform (DFT) used.In proposed technique, a voltage magnitude and the current magnitude is used. Fig. 1 shows the phasor measurement unit

It consist of low pass filter(LPF), an analog-to- digital converter for analog to digital (A/D)conversion, Discrete fourier transform(DFT) and Sequence analyzer, GPS, time synchroniser.

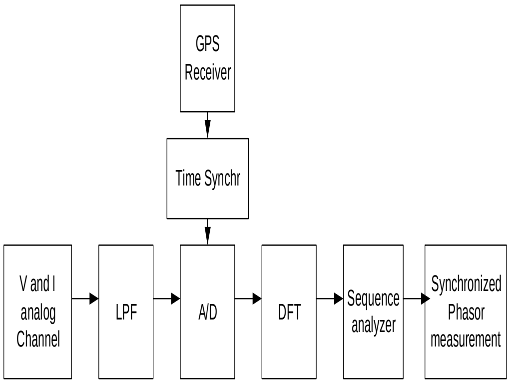


Fig.1. Phasor measurement unit block diagram

The phasor measurement unit represented by discrete phase sequence analyser block which convert three phase signal of voltage or current to a positive negative and zero sequence component magnitude and angle, if needed.

Fig. 2. Discrete fourier transform (DFT)

Fig. 2 shows the analog power signal that converted into digital data by the analog to digital converter. For example, if the voltage is needed to be measured, the samples are taken for each cycle of the waveform and then the fundamental frequency component is calculated using (DFT). The figure also shows a simple block diagram explaining the procedure of measured voltage or current analog signal.

The relay decision is based on collected and shared data through communication network. The suggested technique satisfies high degree of reliability and stability while it is based on shared decision.

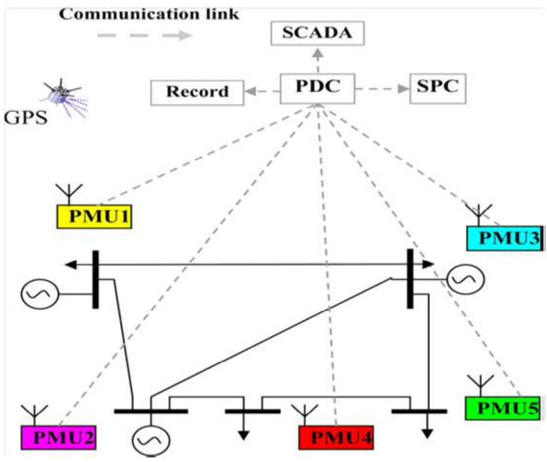


Fig. 3. PMU arrangement at five bus system

Phasor measurement system have been implemented as real time system .withthese system phasor measurement units (PMU) installed at substation send data in real time over dedicated communication channels to a data concentrator at a utility control centre . This approach allow the data to be used in system protection scheme as well as being recorded for system analysis and monitored in SCADA system. PMUs measure the bus voltage(s) and all the significant line currents. These measurements are sent to a Phasor Data Concentrator (PDC) at the control center. The PDC correlates the data by time tag to create a system-wide measurement. The PDC exports these measurements as a data stream as soon as they have been received and correlated. System protection center (SPC) receive Data stream and make a wide area protection depending on wide area view. This principal of operation is used in this paper.

Studied Network

Three generators are interconnected to each other, bus 1, bus 2 and bus 3 is of 400 KV simulation studied on same transmission line. PMU are installed at all bus's. It measure and compare real time voltage magnitude at each bus and current magnitude at each interconnected line component data from PMU's in central unit, with fast communication , (GPS) system and precise time synchronization. In differential protection fibre optics cable are used now recently replaced that is into PMU's. For the measurement of currents at both ends of the system by using fibre optic cables. The main drawback of that system is measurement very difficult for very long distance. The application of the fibre optics is limited.

Transmission line protection is the most challenging function in power system protection. Two - third of faults in power system occurs on the transmission line network. Disturbances in power system are changing problem for the utility industry because of the large scale and complexity of power system. Earlier in the differential protection pilot wire are used now we replace that is into PMU. The solution is more advanced protection to achieve the required balanced in transmission line network.

Simulation Result :

Fig. Voltages magnitudes at different bus's

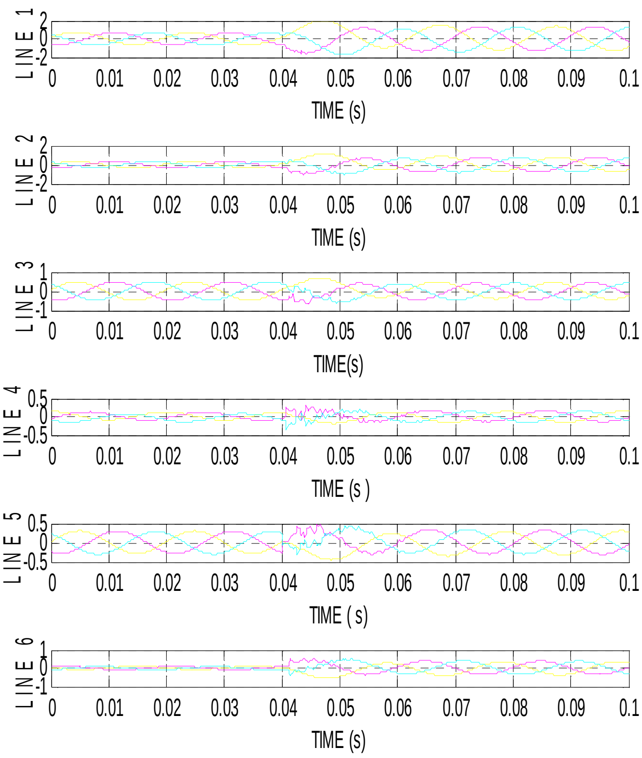


Fig. Currents magnitude in line's

Conclusion

The paper presents a new protection technique for transmission grids using phasor synchronized measuring technique in a wide area system. The protection scheme has successfully identified the faulted line all over the interconnect system. The relay descried in this paper represents a new state-of-art in the field of interconnected grid protection for many reasons. The relay is based on sharing data from all areas. One relay is used instead of many stand alone relays with different complexity coordination. The relay has the feature of unit protection in identifying the faulted zone. One and only one trip decision is issued from the protection center. The relay has a very fast detection time estimated by 5 msec for all fault cases. In the near future and with a very fast communication links the relay can be considered as a main relay on the interconnected grids.

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