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Fault Analysis and Phasor Differential Protection of Line Current

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Abstract

Any interrupt in the power system ought to be identified by the relay placed in the network effectively. Primarily, the fault detection is the major complication in the power network, and if any fault happens during the power swing the perception of fault is more complicated. Phase comparison of line current technique is a special form of current differential protection. Here the phase angle of each phase current plays an important role to decide the most significant change in the power network like fault, whether it is an internal or external fault. This technique is also used to obtain the stable and unstable power swing by using MATLAB software in the 2-bus system. At the fault point, by measuring the various percentage of transmission line distance, the fault occurred during power swing can be analyzed. This method is faster and efficient. This technique is also tested in 9-bus 3-machine WSCC power system model.

Keywords: Fault Analysis, differential protection, phase angle control, relays.

1. Introduction

In most of the power system, fault detection in a power network was the very critical part. Nowadays, fast mode of detection of the fault in the power system is very efficient for the power system fastness to maintain dependable of the network. There are several methods designed for the detection of the internal and external faults, stable power swings and unstable power swings. Mostly, the stable power swings goes down after sometimes and unstable power swings exists in further separation of the rotor angle of the two area system. For the identification of the fault and unstable power swing, transmission line distance relay is widely used. The programmable parameter in a distance relay is obviously impedance. When the impedance touched the zone protection then the time start and the difference between the end time and start time indicates the working of the relay; i.e., if time rises the predefined time, the relay trip. Another standard technique of fault detection during power swing is rate of change of load impedance several technique like decreased impedance method, phasor evaluation, current differential protection phasor measurement unit with system integrated protection scheme, fault detection and diagnosis using artificial intelligence are used to determine the fault in the power network successfully. The important problem of the modern power system is to estimate the stable and unstable power swing. Here the ultimate aim is to control the relay, when the stable power swing happens, the relay should not function; and unstable power swing happens the relay function is very accurate. For this trouble a power swing blocking (PSB) function is used to estimate the power swing in the power system network and the fault happens while this power oscillation. Here the power system blocking function is the phase differential of the phase current in each phase A,B,C respectively are assumed as the fault detection factor of the technology present in the power swing function. There are two types of faults that may take place on any transmission lines , where the balanced faults is known to be as symmetrical and unbalanced faults to be as asymmetrical faults . Mostly the asymmetrical three phase faults occur on power system where the symmetrical faults are scarce. In addition, faults can be classified into 3 classifications such as t shunt faults, series faults and simultaneous faults. In the analysis of power system under fault conditions, it is essential to distinguish the types of fault to provide the best possible results in analysis. Anyway, shunt faults are only to be analyzed. Series Faults Series faults indicates open conductor and take place whenever the unbalanced series impedance condition of the lines are present. Two common samples of series faults are when the system holds one or more broken lines, or impedance lodged in one or two lines. Series faults are identified by increase of voltage and frequency and fall in current in the faulted phases. The shunt faults are the faults occurring often in the field. They include power conductors or conductor-to-ground or short circuit middle of the conductors. The most important aspects of shunt faults is that includes increment of the current suffers, fall in of voltage and frequency .Shunt faults can be categorized into four classifications. Line - to - ground fault this type of fault happens, only when one phase of any transmission lines sets up a connection with the ground, due to ice, wind, falling tree on the transmission line or any other incident. 70% of fault occurs under this category.

Line -to -line fault High blowing wind results in a phase to get contacted with another phase thus line -to -line fault takes place. 15% of faults are line -to -line faults. A line-to-line fault may occurs either overhanging and or below surface transmission line and happens when two conductors are break. Double line-to-ground when a tree falls on a system containing multiple phases, where two phases become in contact with the ground could lead to this type of fault. 10% of all transmission faults are assumed to be double line -to -ground faults. Three phase fault The causes includes falling tower ,failure of equipment or even a line breaking and making contact with the remaining phases can lead to three phase faults . In phenomenon of existence this fault does not occur often that can offer its share of 5% of all transmission line faults.

2. Proposed Scheme

Proposed scheme consider the difference in the phase angle of the same series line to increase the speed of relay in the system of detection power factor fault and the power swing without leaving the security. Estimation of the scheme is on stable and unstable power oscillations. Simulated results include symmetrical faults with change in fault location and the fault occurrence time. This power system is used in 2-bus system to get quick and appropriate result. This technique is justified through MATLAB software. In sequence to analyze any unequal power system, C. L. Fortes cue designed a technique called symmetrical parameters in 1918 to evaluate that technique using a uniform description. This technique determines the base of all conventional fault analysis way of evaluating unequal power systems. The data proposes that any unequal system may be described by a cycles of equilibrium system proportional to the cycles of its phasor. The equilibrium systems descriptions are known as symmetrical parameters. In three phase technique, there are three batches of equilibrium parameters may be captured; the positive, negative and zero order parameters. The positive sequence contains a number of phasor with which has the identical actual system progression. The second batch of phasor has a different progress which is known as the negative progression. The zero progress has three parameters in phase with each other. The symmetrical parameters data will be consider into more information in this technique. The basic complication is high situation which produces fault in function and it may collapse. As fault estimation technique became significant needs of the electric power system to became fast and error-free system. To ignore such conditions we defined easy and inexpensive components which will give a result to the above determined complications. Types of fault may be based on the environmental equipment and its property
Since symmetrical components method involves much matrix function, computer can be utilized to do fault analysis in well-defined, effective, quicker and logical means. MATLAB is the best technique language for data processing. It combines arithmetic, display and compile in a fast and accurate manner which the complication and results are determined in popular arithmetic notations. The classical uses involve Application development, including Graphical User Interface building.

Fault-1 Data:- Time = 0.5 second
Fault resistance=0.01ohm Fault duration =1 second Transmission length =300km

Fault-2 Data:-
Time = 1 second
Fault resistance=0.01ohm Fault duration =1 second Transmission length =300km

Fault-3 Data:-
Time = 1.5 second
Fault resistance=0.01ohm

Fault duration =1 second Transmission length =300km

Technique used here as Power Swing Blocking is to detect the positive sequence component of sending end and receiving end current

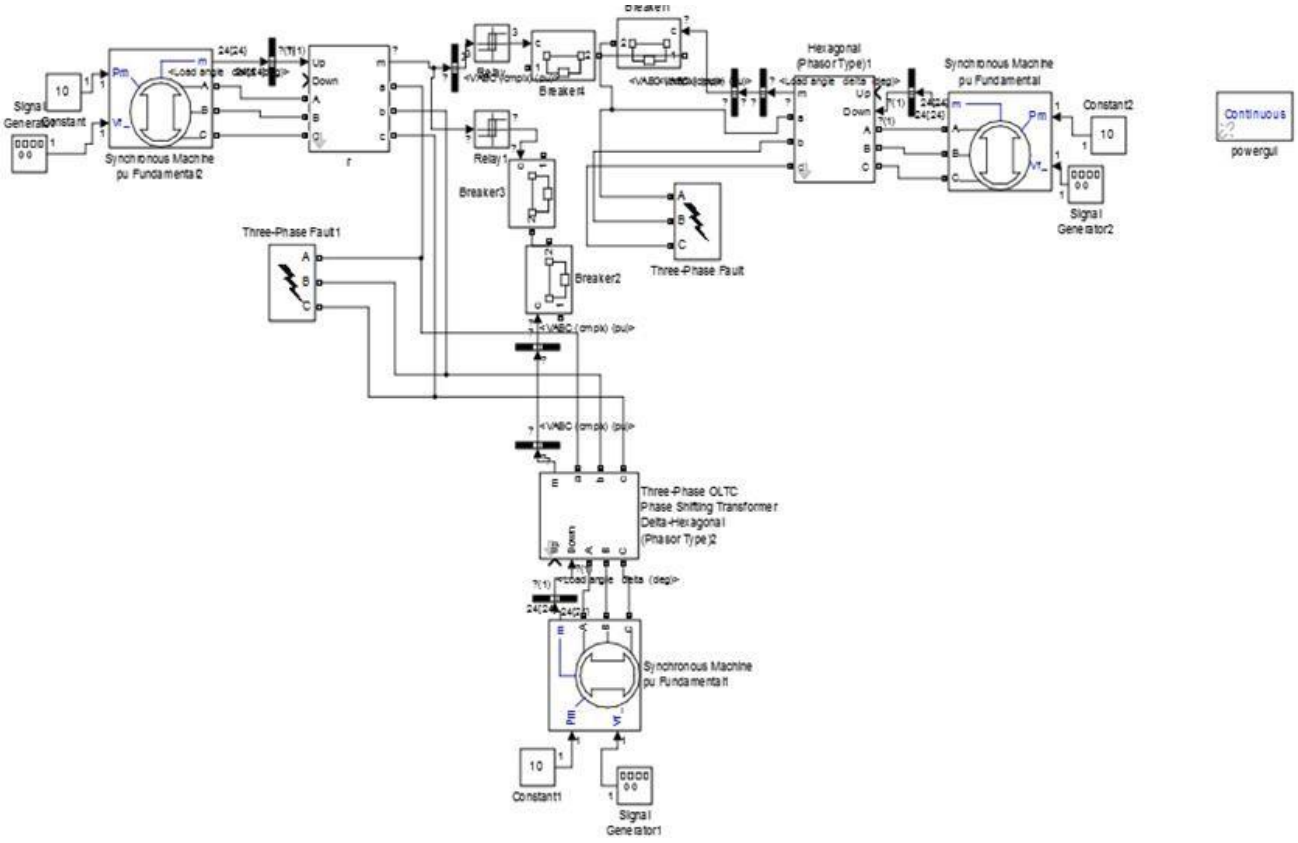

Fig. 1 The proposed 9 bus system with three faults In 9-bus model the as shown in Fig. 1 fault data is given below:

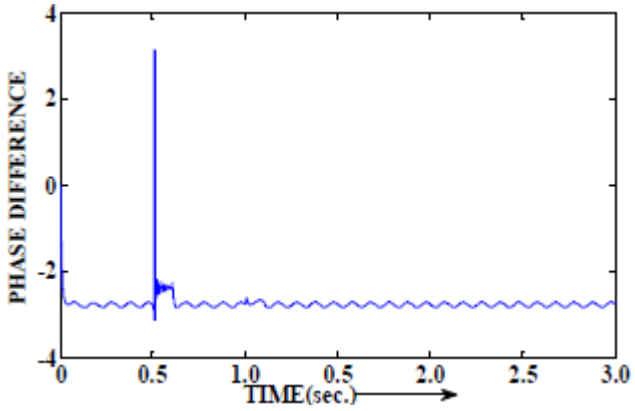

Fig 2. Current at the time of first fault occurrence

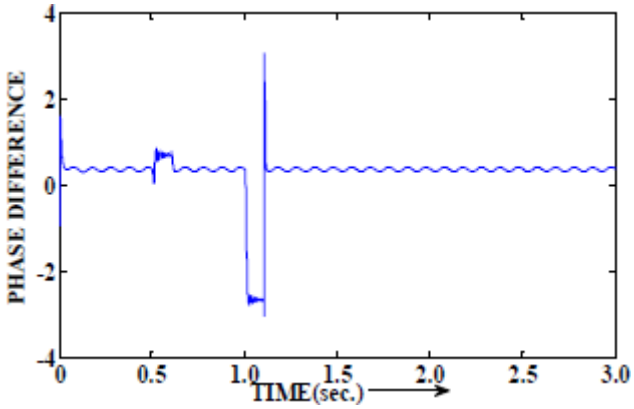

Fig 3. Current at the time of second fault occurrence

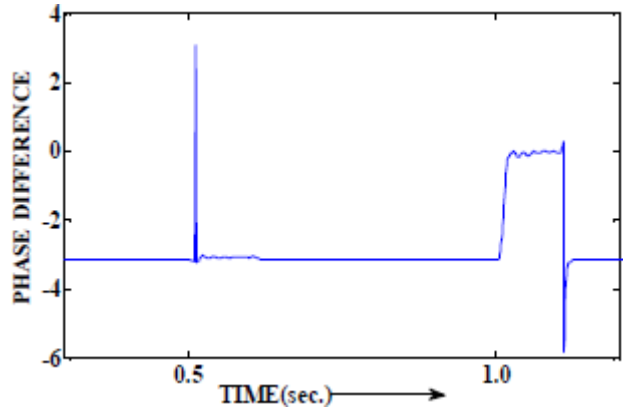

Fig 4. Current at the time of third fault occurrence

3. Conclusion

A new approach for the protection of transmission line by using distance relay is presented in this paper. The discrimination of fault during power swing is very important to avoid the mal-operation of the digital relay in the network. It is found that, the current component of both ends on transmission line is used to differentiate the fault from power oscillation. The Scheme of phase difference in each phase states that, it helps to detect the internal fault, external fault, unbalanced power swing at different percentage of transmission line length. The simulations are done in MATLAB software and the fault detection during power oscillation is verified.

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