Adaptive Phasor Measurement Technique for Finding Exact Fault Location in Transmission Systems

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Abstract— A major stride forward to enhance power system checking and execution, proceeded with burden development without a corresponding increment in transmission assets has brought about diminished operational edges for some force frameworks worldwide and has prompted operation of force frameworks nearer to their security constrains and to power trade in new patterns. Wide-zone checking, protection, and control require imparting the particular hub data to a remote station yet all data ought to be time synchronized so that to kill the time contrast between data. It gives a complete concurrent depiction of the forced outages. The ordinary framework is not ready to fulfill the time-synchronized prerequisite of force framework. Phasor Measurement Unit (PMU) is empowering agent of time-synchronized estimation, it convey the synchronized neighborhood data to remote station. The most common protection apparatus are relays which are responsible for protecting power systems from upcoming faults. In order to employ a productive and proper protection these relays must be well-coordinated with each other to clear the faults at the system in the earliest possible time. Mat lab/Simulink has been used simulation software has been used to obtain the results from the studies.

Key words: Phasor Measurement Unit (PMU), Backup Protection System, Overcurrent Relay, Coordination of Overcurrent relay, Power System Protection

I. INTRODUCTION

Power outages are most brought on amid stumbling disappointment or operational disappointment of relays which bring about unsettling influences in force framework. This paper proposes another versatile phasor estimation unit (PMU) based protection plan for wide territory interconnected transmission lines system. This technique utilizes positive succession voltage and current phasors at both finishes of a transmission line to decide the blamed region on the transmission line. The ever progressively air contamination rate and the impediment of fossil fuel sources have prompted far reaching execution of renewable energies particularly wind vitality.

The electrical framework is not a basic thing it's a perplexing man-made framework so it has numerous issues where as on the flip side, it ought to dependable and supply electrical vitality consistently with no intrusion. There ought to be no power outage and blackout. The power outages and particularly occasional blackouts is a blend of arrangement of interrelated occasions. These arrangements of occasions are difficult to account even with cutting edge effective frameworks and can never again be contained to the little parcel of the framework. In some cases these little occasions or unsettling influences can be enhanced to a framework wide impact. Along these lines for this reason numerous methods have been produced to survive the force framework amid unsettling influences and to proceed with its operation. One late created technique which is utilized is WAMPAC with time synchronized estimation.

By utilizing protective relays as an insurance framework and applying a precise coordination in the system, not just if there should be an occurrence of shortcoming, the force segments are shielded from harms from unreasonable streams additionally nonstop power stream is nourished to the matrix and brilliant force quality is given by wind power plants.

The biggest force blackout in history happened in the north eastern part of America along some parts of America and Canada. The primary reports were of software issues in the system. The immediate affect was on New York Power Grid which supplied around 3500MW of power.

Parts of Ohio, New York, Michigan, and New Jersey: Cleveland, Akron, Toledo, New York City, Westchester, Orange and Rockland counties, Baltimore, Rochester, Syracuse, Binghamton, Albany, Detroit, and parts of New Jersey, including the city of Newark in these cities outages were reported in next 30 minutes.
The reason for outages were

1) System was not operated under proper voltage criteria
2) Failed to understand deteriorating conditions of the system
3) Failed to have proper diagnostic support

In consideration of global security of power system, the action algorithm of conventional backup protection cannot be considered as best choices because of the operation of the individual relays are hardly coordinated each other. For system wide disturbances, wide area measurement will result very reliable and efficient. The proposed technique exploits extent and additionally stage edge of phasors as opposed to strategies just utilizing the measure of voltage plunge or the heading of fault current.

Section 2 of this paper tells about Overcurrent relays, their function, how they are set and coordinated to provide proper protection. Section 3 discusses about mal-operation or failure of tripping of relays which may lead to disturbances in the power system. Section 4 discusses about wide area protection of transmission line using phasor measurement unit. Conclusion is provided at the end of this paper.

II. MODELLING OF OVERCURRENT RELAYS

Short circuit in the system causes change in current levels and direction of power flow. This may cause significant impact on the protection system such as protection-devices mis-coordination and asynchronous reclosing. Protection system uses simple protection devices such as over current

relays, recloser's and fuses, where the coordination between these devices has to be well established.

The inverse time relays are commonly used because of their faster operation and has inverse time characteristics. The inverse time relays are sensitive to current and time and instantaneously eliminate the high magnitude of currents and reduce the damage to power system.

Coordination of OCRs basically implies that the nearest relay to the fault location. One of the disadvantages of this method is its capability for tripping decreases in the number of cases when coordination is lost is lost between the relays.

This coordination is extraordinarily crucial and is conducted so as to decrease the swollen power loss and avert power quality compromise. The mis-coordination problem can be easily solved without replacing the existing protective devices by making use of proper techniques.

The coordination development is shown in Fig one. In this figure, OCR1 as primary protection should trip to the fault. Just in case of any malfunction, OCR2 as backup protection ought to trip. Additionally if OCR2 doesn't operate, OCR3 because the second backup protection should trip and disconnect the feeder.

The generation plant modelled during this paper, consists of three generating sources that every of them manufacture a pair of 2.5 MW power. Their voltage and frequency are 575V and 60Hz respectively. Transformers for each and every turbine have voltage magnitude relation of 575V/25KV in star delta configuration wherever the star faced is earthed. The last electrical device such as the grid has the voltage magnitude relation of 25KV/110KV and delta star configuration wherever star is earthed. The transmission lines have 20km lengths each which are interconnected. The wind generation plant model is illustrated in Figure. Since the protection space is that the main scope of this paper, the breakers are highlighted named by CB1, CB2 … CB eight and also the corresponding relays to every breakers, area unit highlighted shown by R1, R2 … R8.

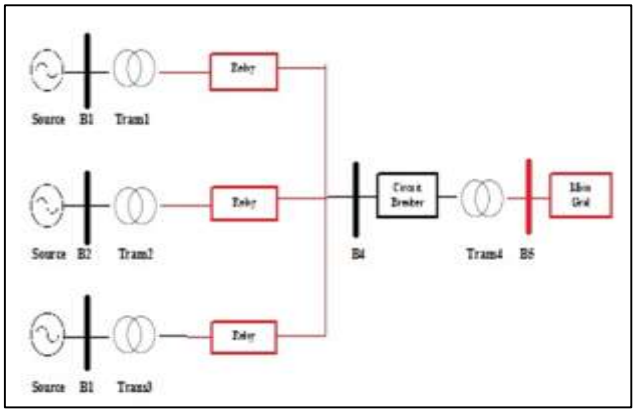

Fig. 1: Simplified Block Diagram of the System to Illustrate Proposed Idea

As we realize that, force framework is the unpredictable systems. Different shortcomings happen on the transmission line due which the framework breakdown. There are diverse conditions like burden infringement, basic blames, islanding and control swings as a result of this framework get influenced generally. At the point when straight forward deficiency happens on the framework it is considered as introductory phase of the flaw.

Keeping in mind the end goal to set the relays and arrange them legitimately, the precise estimation of present and short out current coursing through each CB ought to be inferred. Portrays the normal flow of current in Ampere unit at each CB some time recently amid and after faults. In this reproduction, the aggregate recreation time is 60s. A three stage issue has been forced to every breaker at time 30 going on for 5s.

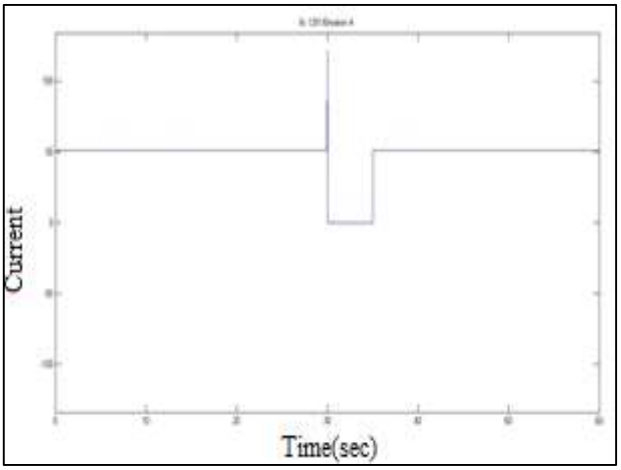

Fig. 2: Current through CB1 during Fault

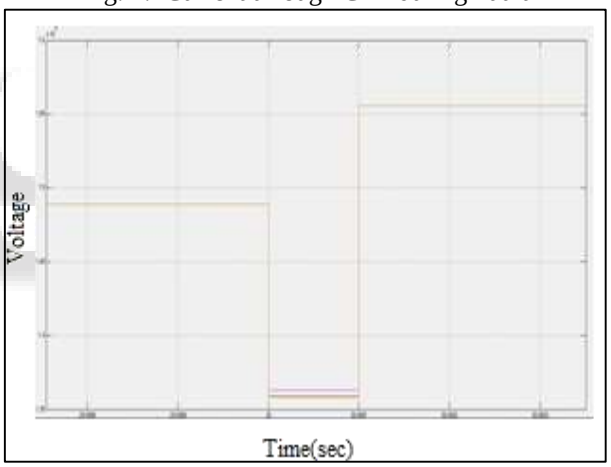

Fig. 3: Voltage in the line during fault

III. PROBLEM MODELLING

Relays can be effectively utilized for power systems and has turned out to be compelling, precise just on the off chance that they don't neglect to work precisely and if no misoperations happen. In the past strategy transfers should be composed and defer in the flaw time increment in the event that one hand-off neglects to work. In the current framework the method is to arrange the OCRs fundamentally implies that the nearest hand-off to the issue area, which is alluded to as the essential hand-off, must first excursion the CB, and in the event that the hand-off does not trek or glitches, the other transfer nearest to the essential hand-off, which is known as the reinforcement hand-off, must outing. This coordination is to a great degree urgent.

If there should be an occurrence of concealed disappointments framework may include fractional or complete power outages as seen in black outs seen in Northern part of America during 2003.Where hand-off neglected to work legitimately. There was deficiency

brought about because of force swings and hand-off neglected to work legitimately and transmission line was not analyzed precisely and which prompted dark out for two back to back days in Northern part of India.

In proposed system, the fault protection is based on relays. If the current passing through the line is high, the relay will sense it and send signals to circuit breaker to open. For better fault detection we need accurate current value of transmission line. So the positive and negative sequences of current magnitudes are to be considered for fault detection.

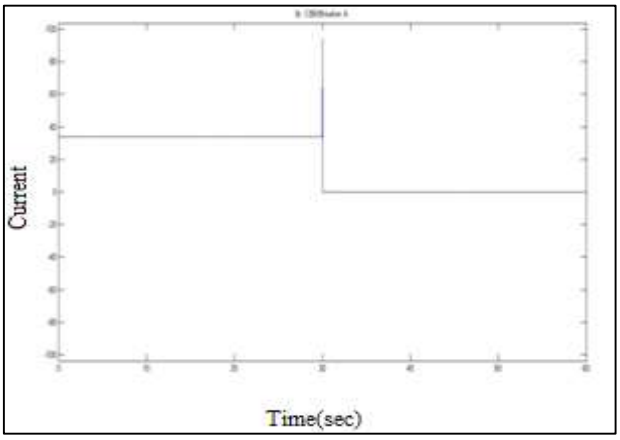

Fig. 4: Current through CB 1

IV. NECESSITY OF FASTER REAL TIME MONITORING OF SYSTEM

Transmission line security is the most intricate and testing capacity in power system assurance. Around 70% of flaws in power systems happen on the transmission line system. The proposed method can see the entire power system region and can manage the transmission lines as unit assurance. The essential reason for these frameworks is to enhance aggravation observing and framework occasion examination. These estimations have been sited to screen vast producing destinations, real transmission ways, and critical control focuses. Continuous transmission observing framework is required to give early cautioning of crumbling framework conditions, so administrators can take restorative activities; restrict the falling impact of unsettling influences (by giving wide-zone framework perceivability); and enhance transmission unwavering quality arranging and consider quick post-aggravation examination and perception using documented checking framework information. Take into consideration the more successful utilization of programmed controls for self-adjustment, for example, programmed exchanging or controlling the stream of force; and enhance PC models of the force framework.

Other specialized elements of a continuous transmission observing framework require that uniform information and basic information stockpiling be utilized over the framework so that all framework administrators can impart and utilize each other's information to ease; and the framework should have basic perception highlights so that all clients will see the constant data in a comparative manner. The failure of operators to observe the loss of transmission lines, to acknowledge or perceive the deteriorating condition of the system, and to acknowledge the necessity for action because of short information; the failure of operators to assess and perceive the inadequacies of the system, significantly in relevance voltage stability; and therefore the failure of the interconnected grid's dependableness organizations to supply effective period of time diagnostic support.

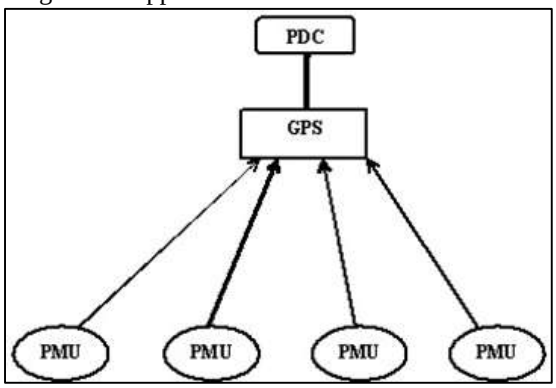

Fig. 2: Scheme for measurements

Long separation high voltage electrical cables are imperative in power conveyance since force stations are typically worked far from force loads. Amid the transmission process, parity must be always kept up to coordinate the force supply and request. Parameter changes affect our current electrical transmission line execution. The electric current streaming in the lines ought to be measured to maintain a strategic distance from over-burdens, stage unbalance and change. Line positions ought to be observed to monitor the hanging and running circumstances. Listing can bring down the conductor to utilization tallness over the earth. The motions can bring about genuine transmission issues, for example, flashover because of encroached line to line leeway, danger of mechanical disappointment of transmission tower, and exorbitant stacking stress. Conductors between two transmission towers frequently endure listing and jogging marvel. Listing can bring down the conductor to a hazardous tallness over the earth. It can be brought about by motions which can come about into genuine transmission issues, for example, flashover because of encroached line – to - line faults, danger of mechanical disappointment of transmission tower, and unnecessary stacking stress. Endeavors have been improved to comprehend this wonder and create method for ensuring the transmission line against this issue and get quick results and ensure best way of monitoring the system.

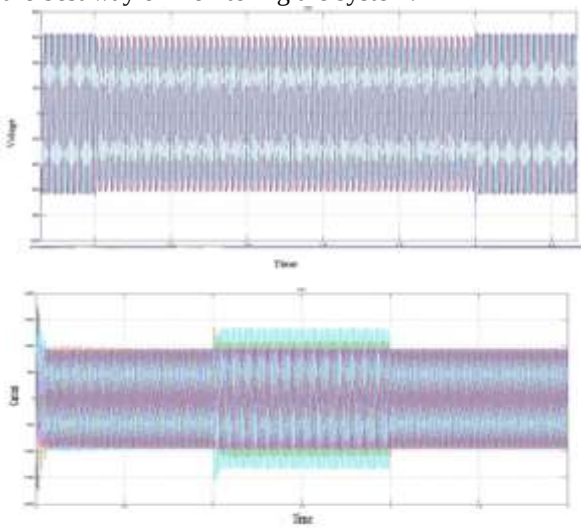

Fig. 7: Voltage and current waveform during LG fault

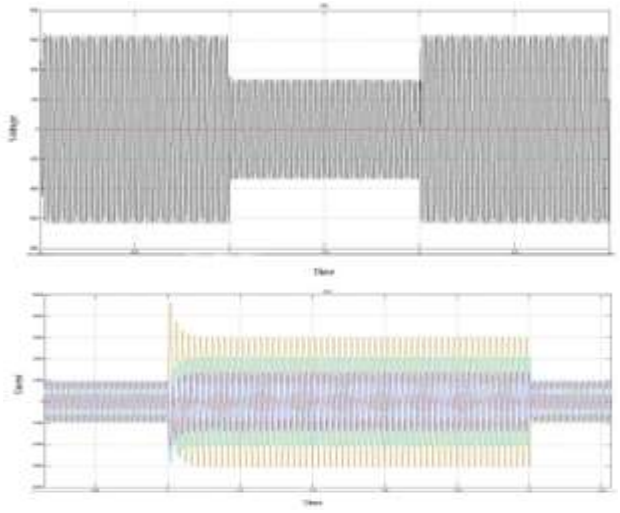

Fig. 8: Voltage and current waveform during LL-G fault

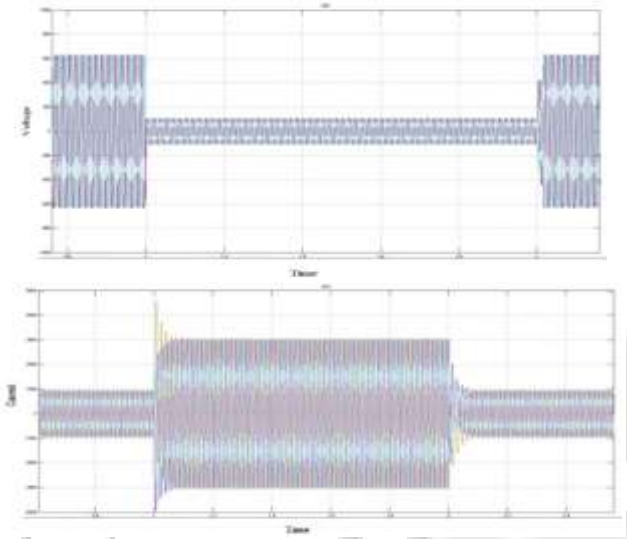

Fig. 9: Voltage and current waveform during LLL-G fault

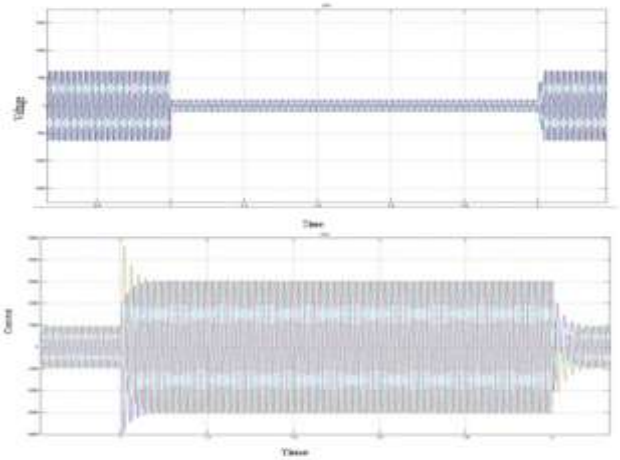

Fig. 10: Voltage and current waveform during LLL fault

Fig 7 shows the output waveforms for voltage and currents during line to ground fault. Fig 8 shows voltage and current waveforms during double line to ground fault. In figure 9 the waveforms during LLLG fault and the figure 10 shows the waveform during three phase faults. Analysis of faults during different conditions is carried out. Through PMU we can also derive positive sequence voltage magnitude and locate nearest fault location

V. CONCLUSION

In this paper another productive technique for issue area on overhead transmission lines is exhibited. The calculation depends on synchronized measured voltages and streams, examined at both line terminals, and the utilization of quick correspondence channels between two estimation units introduced at the line terminals. It doesn't require line parameters to decide the faulted area. In the paper, the answer for the different fault types, is displayed and completely tried.

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