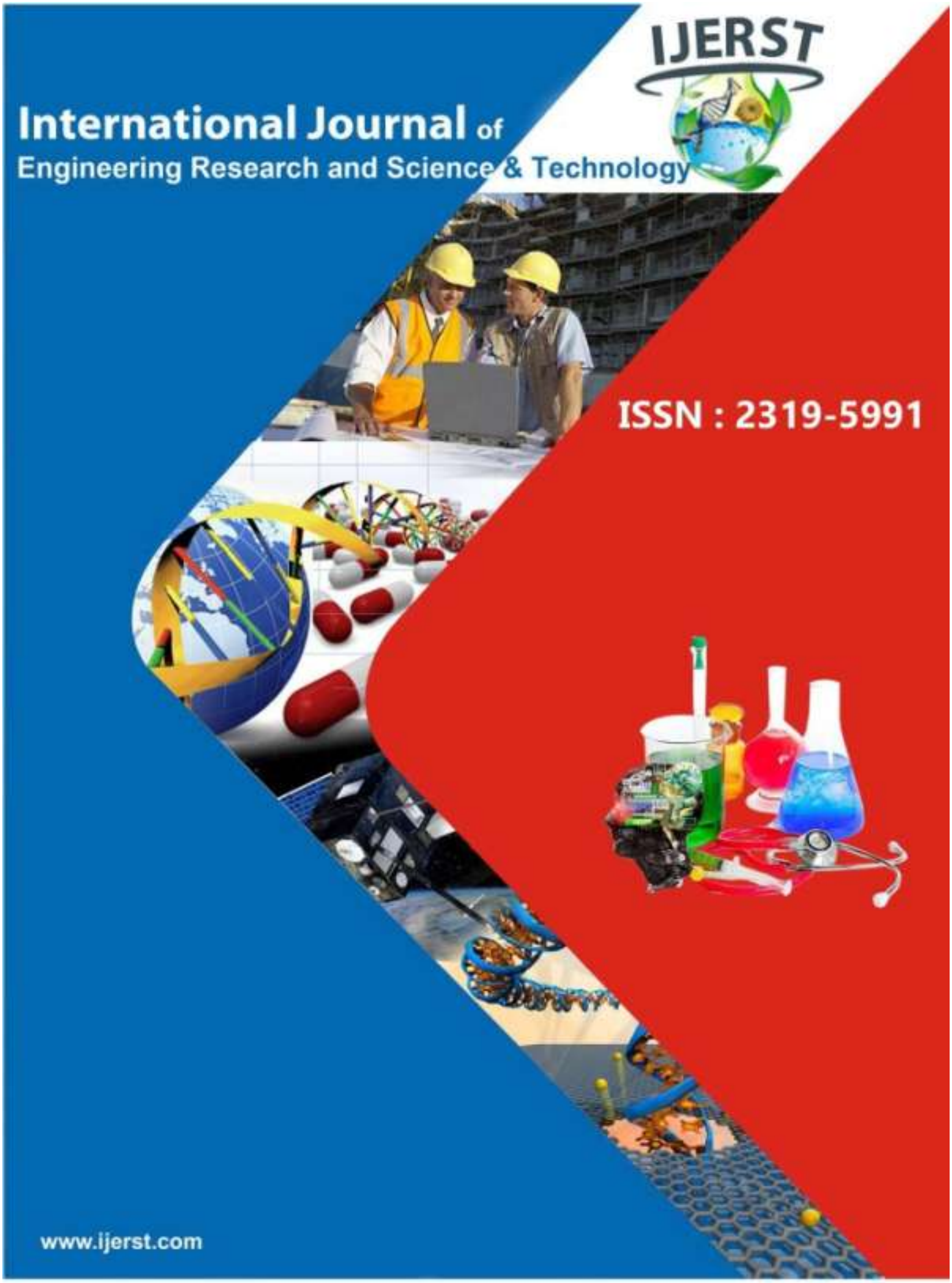

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SMART-GRID BACKUP PROTECTION BY PMU IN POWER SYSTEM

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Abstract— Power transmission lines are protected by a wide-area backup system in this article. PMU-based broad area backup protection for transmission lines is discussed in this study, which uses PMUs to locate the damaged line. The faulty backup protection zone may be identified by measuring the increase in zero and positive sequence currents entering the zone when a fault occurs in the transmission network. Using WAMS broad area data, an optimization model is created to help solve these issues and pinpoint the faulty line. By using linear least squares approach, a faulty line and its position may be determined with few measurement sites in the Backup Protection Zone (BPZ) using voltage and current phasors. MATLAB/Simulink is used to implement the new approach on the IEEE-5 bus system.

Keywords— Backup Protection Zone (BPZ), PhasorMeasurement units (PMUs),Wide Area Measurement System (WAMS), IEEE 5-bus system

1.INTRODUCTION

The current SCADA systems generate erroneous estimates of system status due to a lack of synchronisation. Furthermore, their scan rate of roughly 2 to 10 seconds renders them ineffective at capturing extremely small grid perturbations of the scale of a few hundredths of a second. The phasor measuring systems, which use GPS receivers to properly time-stamp each measurement, potentially solve these problems. PMUs have the capacity to measure between 25 and 60.

Because of their high sample rate, they are well-suited for system analysis in dynamic environments. Direct measurements of all system states would be made possible by placing PMUs on each bus. PMUs, with their greater installation costs and more restricted communication capabilities, make this both uneconomical and impossible. As a result, PMUs must be strategically placed across the electrical system. In order for a distance relay to work, there must be a defect somewhere between the relay and theall faults outside of this area or zone stay stable at the designated reach point

The fault impedance is not detected by the relay because of the resistance of the fault arc, which places it outside of the relay's tripping characteristic. It may also be picked up exclusively by zones 2 or 3, resulting in unacceptable delays in the tripping process. While each of the three distance relays functions separately, they all share a same decision-making process. One of the primary causes of

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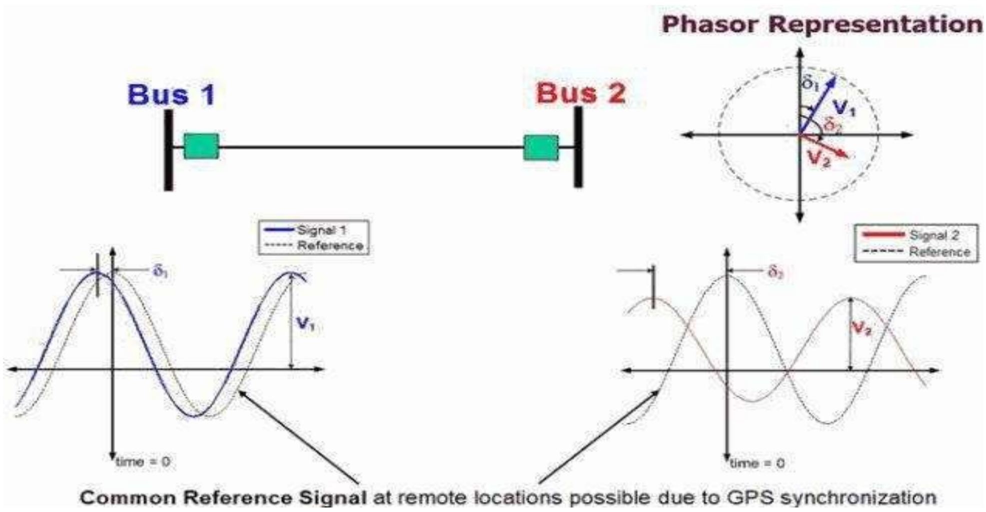
large power system disruptions is the malfunction or failure to trigger of protective devices. Unwanted trips account for the great majority of relay misoperations, which have been demonstrated to spread significant disruptions. When the main protection fails or is temporarily out of service, backup safeguards are called upon to step in and take over. It is increasingly difficult to coordinate the timing and location of relay operations due to the increasing complexity and size of power networks. There are two major tendencies in the automation of power systems and substations: centralization and decentralisation, respectively. The dynamic roles of local and regional governance are increasingly shifting.toward national or central control centres. Furthermore, the communication needs must be addressed in order to guarantee that such a system is capable of quickly taking action in response to unexpected occurrences. Two methods are used to develop the suggested system. As a first step, implement an intelligent processing system at the substation to handle some of the more traditional backup protection tasks. Next, create a regional processing unit to handle all of the backup protection functions in a given area. Optic-fiber networks transport data between the devices. The relay decision is based on data that has been gathered and communicated through the network. To provide high dependability and stability, the proposed method relies on shared decision-making rather than a single decision-maker. An optimization model is proposed in this research to reduce the number of PMUs necessary for this strategy. Problems of data storage, the limitations and needs of significant communication facilities and infrastructures may be solved by this method. The transmission lines may be treated as a unit of protection in the proposed method. The fundamental goal of these systems is to enhance the monitoring and system for detecting disturbances.event tracing They have been placed at key locations to monitor huge power plants, major transmission lines, and important control points. All important state measurements, including voltage magnitude, voltage phase angle, and frequency, may be obtained via synchronised phasor measurements.

Units for phasor measurement

This technology, which was initially presented in the early '80's, has matured and now has several applications in various stages of development all over the globe. Wide Area Measurement Networks (WAMS) using PMUs and Phasor Data Concentrators (PDCs) in a hierarchical framework are finding fresh traction in the wake of widespread blackouts in major power systems throughout the globe. Analysis of the blackouts may be done using PMU data, which is very precise and allows system analysts understand exactly what caused the blackout and what defects may have been responsible for causing the power system to collapse catastrophically. WAMS has a wide range of applications, and it is only a matter of time until phasor measurements are put to use in other ways. Considerable



literature, to name only a few examples:exists which deals with application of phasor measurements to system monitoring, protection, and control. A pure sinusoidal waveform can be represented by a unique complex number known as a phasor. The phasor representation are illustrated in Fig. 1

Fig.1 Phasor representation.

2. WIDE AREA MEASUREMENT SYSTEM

Electricity markets have been rebuilt and re-decentralized during the last two decades to boost efficiency and lower operating costs while freeing customers from their choice of suppliers. There are a number of unique issues that arise as a consequence of these developments for emerging competitive power sectors as compared to old power systems.

planning. Due to these difficulties, new intelligent power systems must be developed and implemented in order to deal with them. In the late 1980s, the term Wide Area Measurement Systems (WAMS) was introduced to the literature on power systems. They have recently become commercially accessible in power systems for monitoring, operation, and control.

WAMS integrates metering operations (both new and old) with communication system capabilities in order to monitor, operate, and regulate power systems across a vast geographic region. Data from the whole system may be gathered at once and in the same area, the control centre, thanks to this unique combination. Data from the whole system may be utilised efficiently by several WAMS functions. These statistics show that WAMS has been a tremendous chance to tackle power system difficulties connected to the restructuring, deregulation, and decentralisation of the power system in the current climate.

3.1 WAMS's Communication System

data resources to the control centres and back is the responsibility of the WAMS communication systemThe system's command and control center(s). In fact, WAMS's communication system resembles the human brain in many ways. Due to neural network failure or mal-functioning, the breakdown of communication network may create major issues in system operation and control, notably in the operation of WAMS. Because communication infrastructure is as critical as electrical infrastructure, particular attention should be given to it. Because the electrical and communication infrastructures are now so intertwined, if one fails, the other may go down with it as well.

Using the Open System Interconnection (OSI) concept, new communication systems are being developed and implemented in the field. Assuming that all of the bottom levels are functioning properly, the top layers of this design simply pass along data. As a matter of fact, this model serves as an excellent framework for the design and implementation of communications networks. There are seven levels in the OSI reference model: physical (data connection), network (transport), session (presentation), and application.

If you're looking for an explanation of what OSI stands for and what each layer stands for, you'll find it here: The media's qualities will have a significant impact on the characteristics of communication systems. Because of this, it can be stated that the features of the transmission medium play an essential part in WAMS' communication architecture. Cost, bandwidth, propagation latency, security, and dependability are some of the most important features of a media.

There are two types of transmission media: guided and unguided, as will be explained in the next paragraphs. Waves are guided through a solid medium in guided media. Examples of guided media include twisted pair, coaxial cable, power transmission/distribution line, and optical fibre. When it comes to guided media, the medium itself plays the most significant role in defining the transmission constraints.

There are two types of transmission media: guided and unguided. Waves are guided through a solid medium in guided media. An optical transmission/distribution line and an electricity transmission/distribution Guided media include, for example, line fibres. When it comes to guided media, the medium itself plays the most significant role in defining the transmission constraints.

Protective Zone No. 3

The basic goal of backup protection is to allow a cleared fault on the system to affect all sources of generation. These functional criteria must be met in order for a back-up system to fulfil this goal:

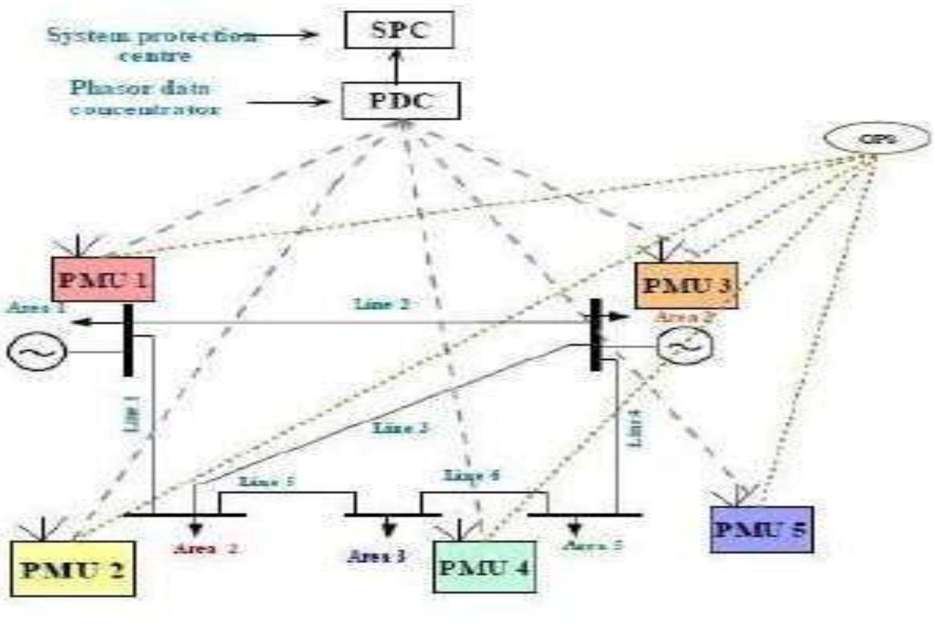
First and foremost, it must identify the presence of any flaws that occur in its designated area of protection.

When primary protection fails to clear the problem as expected, the secondary protection must be alerted.In order to remove the error from the system, the circuit breakers must be tripped a minimum of three times. Operate quickly enough (in accordance with coordination criteria) to preserve system stability, avoid excessive equipment damage, and maintain a certain level of service continuity..Afterwards, a local back-up system is described that achieves all of the aforementioned parameters and comes near to optimal back-up relaying. No one will be affected by this suggested plan.

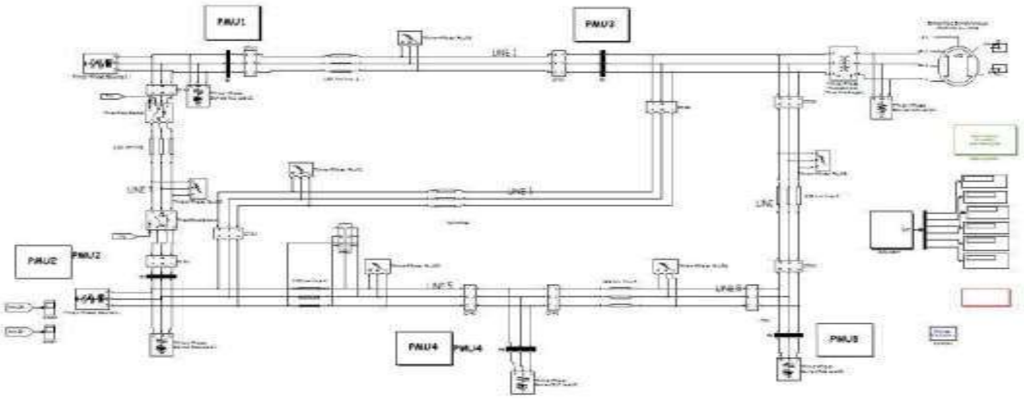
5. If any of the ac, relay, or dc control and trip circuits (excluding the station batteries) fail, the whole system is rendered useless. When it comes to the proposed local back-up system, there are two distinct back-up functions: it offers relay backup with a completely independent set of relays from that used for front-line protection, and it provides breaker backup with the appropriate time delay and auxiliary relay components. Regardless of the bus configuration, the core concept of the proposed system is the same regardless of the breaker location. Different bus configurations only alter the specifics of the breaker backup protection. PMU placement and network architecture are used to create BPZs. There are PMU-equipped buses all over each BPZ, which is made up of the lines and buses that make up that zone.]

6. **SIMULATION RESULTS**

It is used to illustrate the adaptive wide-area backup protection scheme's efficacy. There are three generators and loads in the IEEE-5 bus system. Figure 2 depicts an IEEE-5 bus system's single-line diagram with



5 Bus power system network shown in figure 2.
It shows the Simulink diagram for IEEE-5 bus system employing PMU with three sources and three loads, as shown



in the figure 3. The voltage and current are measured when this PMU is connected to bus 4. This PMU's voltage and current are measured through bus4.

Fig.3. Simulink Model of 5 bus 220kv system

7. CONCLUSION

In a large area system, this research provides a novel transmission grid protection approach based on phasor measurement units. The idea of a transmission line backup protection system that covers a large region has been floated. Wide Area Measurement System data is used. Comparatively, there are fewer PMUs in this protection plan than in other PMU-based protection schemes. Furthermore, this backup protection strategy adapts to the power system's circumstances. Using the IEEE 5-bus test system power network, the suggested backup protection mechanism has been tested. Different fault sites, changing fault types, high impedance faults, and measurement mistakes have been shown to be resistant to the suggested technique. Aside from that, it has been shown that the suggested approach works well and promptly pinpoints the location of a faulty line even when there are no PMUs present. The suggested approach may be implemented in smart transmission grids via the establishment of communication infrastructures and wide area measuring systems (WAMS).

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An analogous linear formulation for an exhaustive search may be used to find the best location for a PMU, as shown by the work of Azizi, Dobakhshari and Sarmadi, as well as Ranjbar.

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