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Real-time Visualization, Monitoring and Controlling of Electrical Distribution System using MATLAB

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ABSTRACT:An electric energy is an essential ingredient for the industrial and all around development of any country. An electrical power system consists of generators, transformers, transmission lines distribution lines etc. Short circuits and other abnormal conditions often occur on power system. The heavy current associated with short circuits is likely to cause damage to equipment, if suitable protective relays and circuit breakers are not provided for the protection of each section of power system. The aim of this paper is to design a real time visualization, monitoring and controlling of electrical distribution system using MATLAB. All the equipment must be visible, all the parameters must be measured and if any fault or abnormal condition occurs in distributed feeders then it should be discriminate from healthy part of power system. It increase reliability of power system. The goal of this paper is to provide a better understanding of the design challenges of electric distribution line monitoring system and identify important research in this increasing important field.

KEYWORDS: Electrical distribution, Short circuit current, Protective relay, Circuit breaker, MATLAB.

I.INTRODUCTION

Economic development of a country depends on the energy availability and its consumption. Electric energy is the back bone of any developed country. Power system has three major parts: (1) Electric power generation, (2) Electrical transmission system and (3) Electrical Distribution system. Initially electric power is generated from the conventional power plants such as thermal power plant, nuclear power plants, hydro power plant and solar power plant etc. This voltage is step up before transmitting for the long distance. It decrease the value of current. Hence lower the I^2R losses in the transmission lines.The controlling and monitoring part of a substation in any country is handled by three major subsystem: collection subsystem, relay subsystem and monitoring subsystem. The collection substation collects required different parameters using power apparatus. The relay subsystem is responsible for delivering the signal to the monitoring subsystem. The monitoring subsystem monitors real time parameters of the system [1]. A power system consists of components such as power generators, transmission lines, transformers, loads, switches, circuit breakers and bus bar etc. [2]. A distribution system provides an ultimate link between high voltage transmission systems and consumer services. In other words, the power is distributed to different customers from the distribution system through feeders, distributors and service mains. A substation is used to distribute this power at lower voltage 11 KV and 33 KV in distribution system by using power transformers [3]. Faults or abnormal conditions often occurred in the power system. The parameters are changed at time of fault and it is dangerous for the equipment associated with power system. Hence these faults must be cleared as soon as possible [4].

II.RELATED WORKS

V. Thiyagargan and T. G. Palanivel created a substation using microcontroller to monitor the parameters. This system has a lot of disadvantages such as power consumption, inaccurate results, and effect of temperature on the system [5]. Overbye and Weber have given a brief idea on various techniques are (1) Contouring, (2) Animation, (3) Data Aggregation and (4) virtual environments. The problems associated with these visualization techniques are the impact of solitary proposed power transfer but of a great number of such transactions [6]. P. Daponte have discussed the design and implementation of Transient meter, a monitoring system for the detection, classification and measurement

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of disturbances on electrical power systems. CORBA architecture is utilized as communication interface by the Transient meter, wavelet-based techniques for automatic signal classification and characterization, and a smart trigger circuit for the detection of disturbances. A measurement algorithm, developed by using the wavelet transform and wavelet networks, had been adopted for the automatic classification and measurement of disturbances [7]. L.W. Coombe and D. G. Lewis explained severity of the fault depends on the short-circuit location, the path taken by fault current, the system impedance and its voltage level. In order to maintain the continuation of power supply to all customers which is the core purpose of the power system existence, all faulted parts must be isolated from the system temporary by the protection schemes. When a fault exists within the relay protection zone at any transmission line, a signal will trip or open the circuit breaker isolating the faulted line. To complete this task successfully, fault analysis has to be conducted in every location assuming several fault conditions. The goal is to determine the optimum protection scheme by determining the fault currents & voltages. In reality, power system can consist of thousands of buses which complicate the task of calculating these parameters without the use of computer software such as MATLAB [8].The controlling and monitoring of electrical distribution line is also possible using IOT (internet on things). It is capable of effective integrate of the infrastructure resources in communications manage for electrical power system, make the information and communication services manage for electrical power system, increase the level of power system information and to get better the utilization efficiency of infrastructure in the existing power system [9]. But the problem associated with this approach is that it cannot deal with real time simulation and failures or abnormal conditions of power system.

III.PROPOSED SYSTEM

The distribution grid configuration proposed for simulation purposes is shown in Fig.1. The topology is started with Grid Substation that contains almost all the devices used in actual Grid substation in the form of blocks. The input supply for the below system is 132 kV. This higher voltage is step down at 11KV before start to distribution of electrical energy. The voltage is stepped down in a distribution substation to supply the energy needs of low-voltage linear loads.

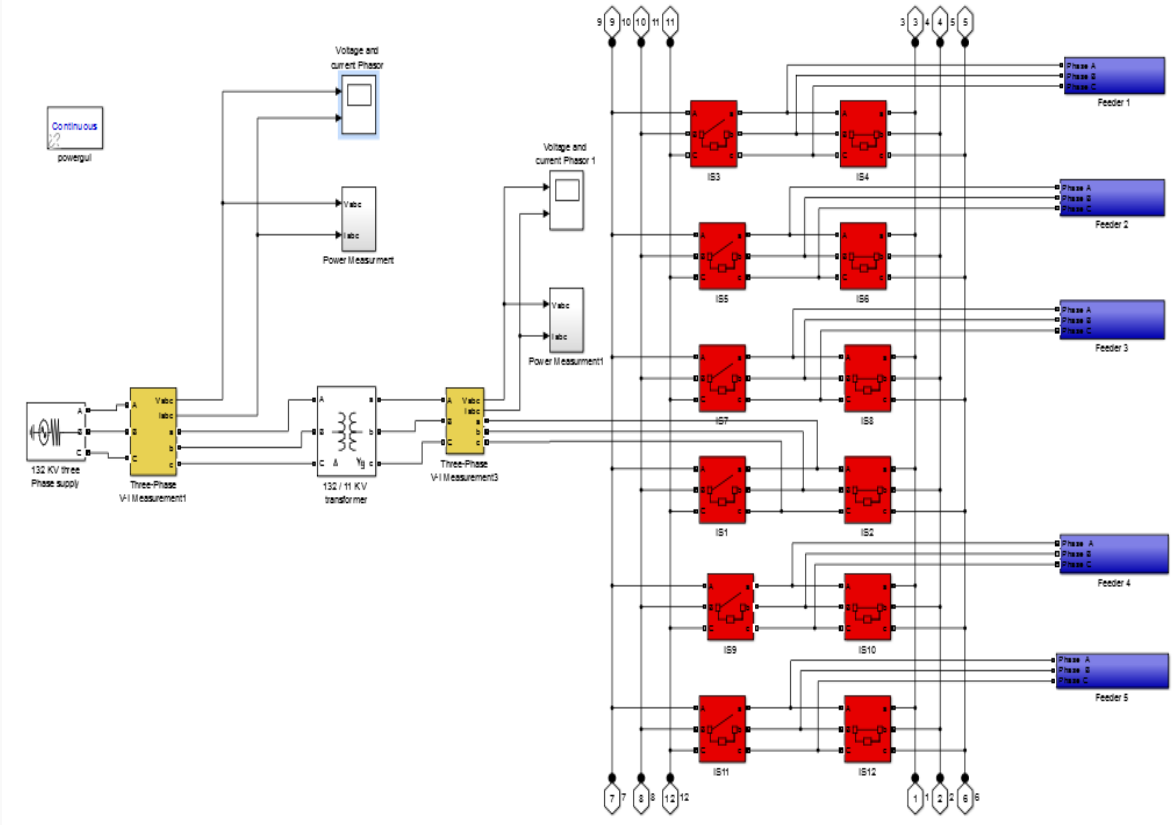

Fig. 1 Simulation model of typical substation using MATLAB

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A three phase 132 KV supply is taken from outside the substation. This 132 KV is generated by using generator block in the simulation model. This 132 KV is step down by using a Delta Star transformer. VI measurement block with active and reactive power measurement is inserted on both sides of winding of the transformer. This 11KV is used to charge a Bus Bar as shown in above model. Two parallel Bus bar system is used in generally sub-station with the help of isolator there are total five feeders connected across 11KV supply these feeders represent different loads. Faults can be created in the model by using three phase fault block by selecting the phases different faults can be crested. A three phase circuit breaker block is used to isolate the faulty part with the healthy system. A relay circuit is used to detect any abnormal condition in the feeders if any fault occurs in the system it detects the fault end give tripping signal to the circuit breaker block to isolate the faulty part. The above model is simulated in MATLAB environment with 0.2 sec.

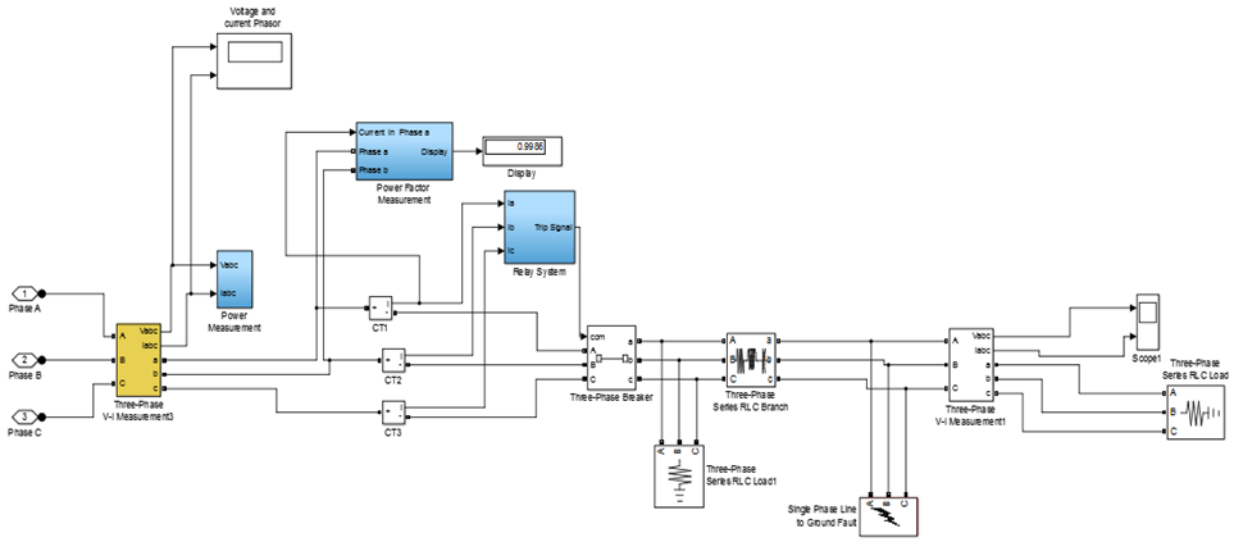

Fig. 2 Block Diagram of feeders to detect the fault

IV.RESULT AND DISCUSSION

Behaviour of system at the time of fault can be understand from fig 3, 4, and 5. Fig 3 represents the graphical representation of current in both the sides of the transformers. It is clear that all three phases will be affected in primary side of delta –star transformer.

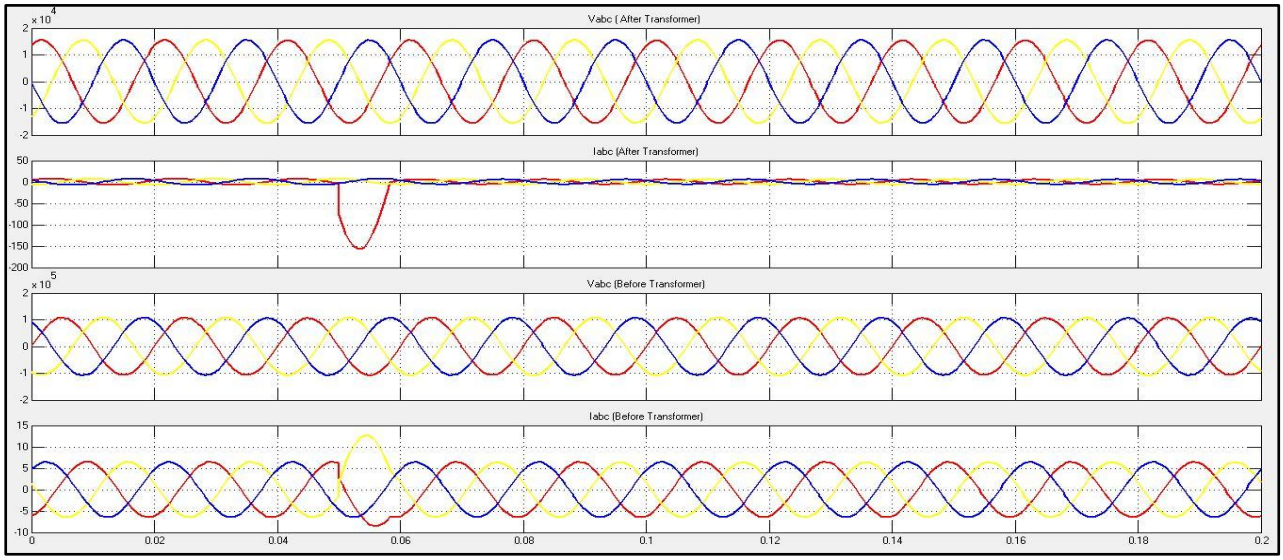

Fig. 3 Behaviour of voltage and Current in both side of transformer at L-G Fault

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Fig 4 shows the behaviour of voltage and current in the feeder in which line to ground fault occurred at 0.05 sec. when single line to ground fault occurs in the system. The short circuit current flow through that phase. But voltage profile remains same because of ideal fault situation.

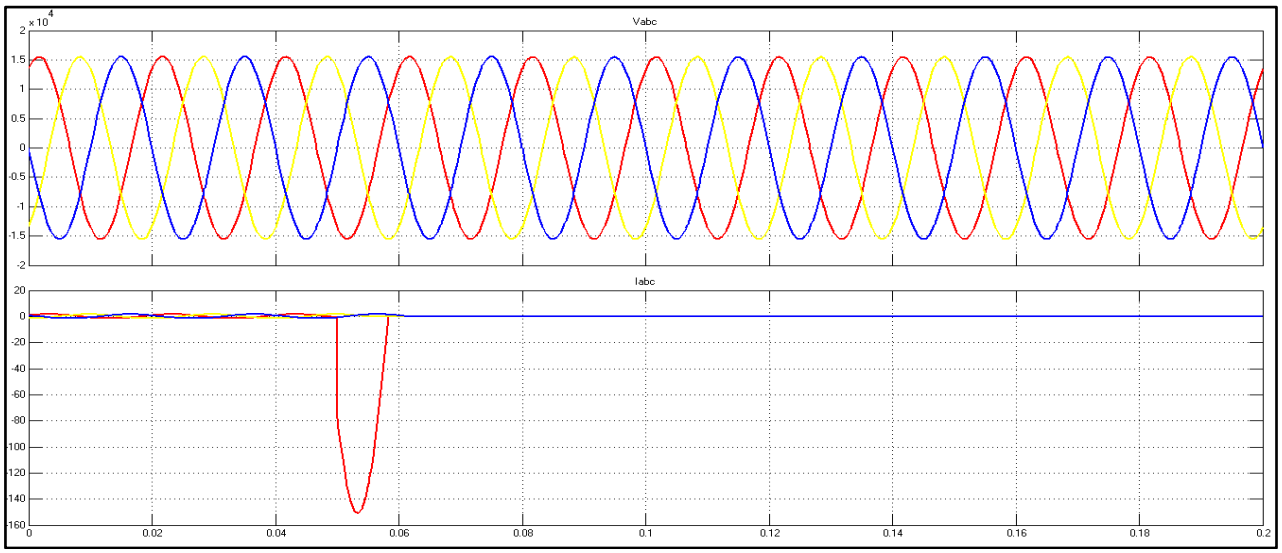

Fig. 4 Behaviour of voltage and Current in faulty feeder at L-G Fault

Fig 5 shows behavior of voltage and current profile at load side. After the fault clearance the current and voltage will be zero.

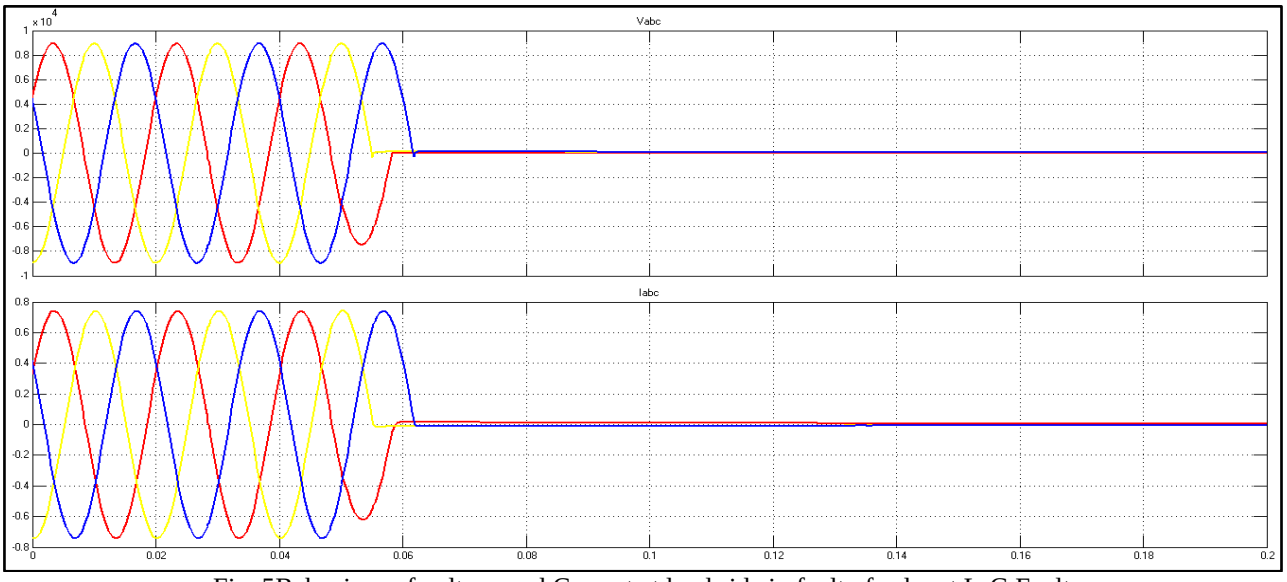

Fig. 5Behaviour of voltage and Current at load side in faulty feeder at L-G Fault

Application of proposed System

- The system can be used to create an ideal image for the existing substation to improve the performance.
- This model helps to forecasting the load in electrical distribution system.
- This model can be used to find out the behavior of system at the time of fault.
- This system creates an efficient method to monitor all the parameters of electrical system.
- Real-time increase the reliability of the system by calculating all the requiring parameters and it helps to decide the ratings of electrical equipment.

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V. CONCLUSION

In this paper we have presented a design of a system based on MATLAB environment that is used to monitor and control the voltage, current and power factor and different powers at different position of a distributed network. The proposed system which has been designed to monitor the electrical distribution system's essential parameters continuously monitors the parameters throughout its operation. If the proposed system recognizes any increase in the level of voltage, current values the unit has been made shutdown in order to prevent it from further damages. The system not only controls the substation by shutting it down, but also displays the values throughout the process in the form of graph and digital display. This claims that the proposed design of the system makes the distribution network more robust against some key power quality issues which makes the voltage, current to peak. Hence the distribution is made more secure, reliable and efficient by means of the proposed system.

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