POWER SYSTEM FAULT ANALYSIS USING SIMULINK-A REVIEW

Suraj Upadhaya,Assistant Professor, ECE, Institute of Engineering Technology, Dr. R.M.L. AwadhUniversity, Ayodhya, U.P.-India.
Shri Om Mishra,Assistant Professor, ECE, Institute of Engineering Technology, Dr. R.M.L. AwadhUniversity, Ayodhya, U.P.-India.
Praveen Mishra,Assistant Professor, IT, Institute of Engineering Technology, Dr. R.M.L. AwadhUniversity, Ayodhya, U.P.-India.

Abstract—**Electrical power is now become an essential part of our daily life work such as; households, agriculture, commercial, industrial sectors etc. This paper is developed in order to maintain that electrical power required by these sectors, as in an electrical system, due to line to ground fault (L-G), line to line fault (L-L), three lines (L-L-L) various fault occurs. In this paper it has been discussed how to analyze the three phase transient fault and for this MATLAB simulation is used, which will show how the three phase fault occur in the transmission system, and by using the auto reclose system how fault will recovered.**

Index Terms—***Simulation, Transient Fault, Transmission Line.***

I. INTRODUCTION

In an electric power system, a fault or fault current is nothing but a any abnormal electric current flow in the circuit and "Current always flows in short circuit path or least resistive path''. The faults in power system causes over current, under voltage, unbalance of the phases, reversed power and high voltage surges.
A fault in an electric power system can be defined as, any abnormal condition of the system that involves the electrical failure of the equipment, such as, transformers, generators, busbars, etc. The fault creates the abnormal condition which reduces the insulation strength between the conductors. The reduction in insulation causes excessive damage to the system.
Faults may occur in the three phase or single phase power system due to the number of reasons like natural disturbances (lightning, high-speed winds, earthquakes), equipment insulation failure, falling of a tree, bird shorting, Line Over loads etc.
There are some more reason for power system fault such as frequent electrical surges, sag and dips in transmission line, circuit overload, circuit breaker tripping etc. Fault detection and classification on transmission lines are important tasks in order to protect the electrical power system. Electrical fault is the deviation of voltages and currents from nominal values or states. Under normal operating conditions, power system equipment or lines carry normal voltages and currents which results in a safer operation of the system.
A Power System is a network composed of passive and active electrical components which are used to supply and transmit electric power. In these systems, faults are considered to be abnormal electric current parameter. Numbers of factors are responsible for the fault occurrence a system. Thus, systems are designed for the power system analysis in order to detect and interrupt different types of faults in power system. To fulfill this requirement is the main objective of power system protection.A variety of methods of detecting & locating faults in a power systems exist. Here we have tried to made a short review of some of the common methods of Power System Analysis for Different types of faults in power system and their consequences in brief.

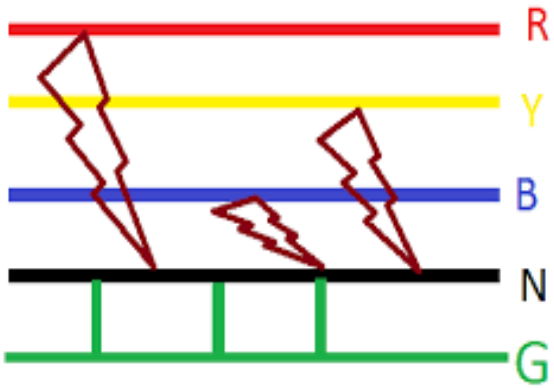

Fig. 1 Three phase fault

II. TYPES OF THREE PHASE FAULT

A short circuit or earth fault is a fault in which the Normal current bypasses the normal load. An open-circuit fault occurs if a circuit is interrupted by some failure; electrically to say any one of the conductor gets open due to some electrical phenomenon such as heavy load current or physical phenomenon such as conductor may get opened physically due to lose contact or it may get cut. In three-phase systems, a fault may involve Ground faults (L-G, L-L-G, L-L-L-G) or Short Circuit Faults. In a "ground fault" or "earth fault", current flows into the earth.The prospective short-circuit current of a predictable fault can be calculated for most situations. In power systems, protective devices can detect fault conditions using instrument transformer such as voltage transformer/current transformer and operate circuit breakers and other devices to limit the loss of service due to a failure. When fault occurs, it causes excessively high currents to flow which causes the damage to equipments and devices. Fault detection and analysis is necessary to select or design suitable switchgear equipments, electromechanical relays, circuit breakers and other protection devices. When fault occurs, it causes excessively high currents to flow which causes the damage to equipments and devices. Fault detection and analysis is necessary to select or design suitable switchgear equipments, electromechanical relays, circuit breakers and other protection devices.

Types of Power System Fault

Transient fault: The fault occurs in very short time or an insulation fault which only temporarily affects a device's dielectric properties which are restored after a short time. **Example:** lightning strike on transmission line.

Persistent fault: Fault in the underground cable. **Example:** cable drench broken due to heavy loads (JCB or Lorry going on the drench closing plates) on the drench shield.

Symmetric fault: Symmetrical fault involves all the three phases, and these phases carry the identical fault current which makes the system balance.

Asymmetric fault: it means the fault involves one phase to ground or between the phase. In asymmetric faults all three phase lines become unbalanced. Asymmetric faults are L-G, L-L-G, L-L-L-G, L-L, L-L-L.
where, L= Line, G= Ground.

Open Circuit Fault: The open circuit fault mainly occurs because of the failure of one or two conductors. The open circuit fault takes place in series with the line, and because of this, it is also called the series fault. Such types of faults affect the reliability of the system. The open circuit fault is categorized as:

- Open conductor fault
- Two conductors open fault
- Three conductors open fault.

Short-Circuit Fault: In this type of fault, the conductors of the different phases come into contact with each other with a power line, power transformer or any other circuit element due to which the large current flow in one or two phases of the system. The short-circuit fault is divided into the symmetrical and unsymmetrical fault.

Symmetrical Fault: The faults which involve all the three phases is known as the symmetrical fault. Such types of fault remain balanced even after the fault. The symmetrical faults mainly occur at the terminal of the generators. The fault on the system may arise on account of the resistance of the arc between the conductors or due to the lower footing resistance. The symmetrical fault is sub-categorized into line-to-line-to-line fault and three-phase line-to-ground-fault.

(a) Line–Line–Line Fault – Such types of faults are balanced, i.e., the system remains symmetrical even after the fault. The L – L – L fault occurs rarely, but it is the most severe type of fault which involves the largest current. This large current is used for determining the rating of the circuit breaker.

(b) L–L–L–G (Three-phase line to the ground fault) – The three-phase line to ground fault includes all the three phase of the system. The L – L – L – G fault occurs between the three phases and the ground of the system. The probability of occurrence of such type of fault is nearly 2 to 3 percent.

Unsymmetrical Fault: The fault gives rise to unsymmetrical current, i.e., current differing in magnitude and phases in the three phases of the power system are known as the unsymmetrical fault. It is also defined as the fault which involves the one or two phases such as L- G, L – L, L – L – G fault. The unsymmetrical makes the system unbalanced. It is mainly classified into three types. They are as follows-

1. Single Line-to-ground (L – G) Fault
2. Line-to-Line Fault (L – L)
3. Double Line-to-ground (L – L – G) Fault

The unsymmetrical fault is the most common types of fault occur in the power system.

1. Single Line-to-Line Ground – The single line of ground fault occurs when one conductor falls to the ground or contact the neutral conductor. The 70 – 80 percent of the fault in the power system is the single line-to-ground fault.

2. Line – to – Line Fault – A line-to-line fault occurs when two conductors are short circuited. The major cause of this type of fault is the heavy wind. The heavy wind swinging the line conductors which may touch together and hence cause short-circuit. The percentage of such type of faults is approximately 15 – 20%.

3. Double Line – to – line Ground Fault – In double line-to-ground fault, the two lines come in contact with each other along with the ground. The probability of such types of faults is nearly 10 %.

III. NEED OF FAULT ANALYSIS

- Rapid information about the type and location of the fault can assist the task of repair and maintenance, thereby minimizing the economic effect of power interruption.
- High voltage transmission and distribution network are the backbone of modern power generation and distribution and fault in the transmission section can lead to serve economic loss.
- Analysis of the system disturbances provides a wealth of valuable information regarding power system phenomena and the behaviour of protection system.
- It help to improve the reliability and availability of the system.

Fault Statics and Its Scenario

- Most fault in electrical power system with the network of overhead line are one phase to ground fault resulting primarily from lightning induced transient high voltage from falling trees and limbs contact.
- One phase to ground fault- 70% to 80%
- Phase to phase to ground- 17% to 10%
- Phase to phase – 10% to 8%

Three phase – 3% to 2%

IV. BRIEF LITERATURE SURVEY

C. VijayaTharani, M. Nandhini, R. Sundar, Dr K. Nithiyananthan(2016),basic aim of this research paper to make a simulink model for the phase fault for both symmetrical and unsymmetrical faults.Fault Analysis for different sorts of faults has been done and it impacts are appeared in simulation output, for example, voltage, current, control alongside the positive, negative and zero grouping segments of voltage and current output as far as waveforms[1].

MrsSuparna pal and MrAritrasChakraborty,Stability and the fault analysis of the power system is the main focus of this research paper. System is observed during both steady state condition as well as fault state condition. By making the bus model and power network model in the MATLAB Simulink, they have analysis bus bar voltage and current curves in output in normal working condition as well as faulty condition[2].

Dauda A. Folarin, Japhet D. Sakala, Edwin Matlotse&Mandu A. Gasennelwe-Jeffrey(2018),In this model they have analysis the distribution network. In this system they have generate the voltage and current waveform in MATLAB by making the distribution network. During the analysis the value of the voltage and current at normal condition and abnormal or faulty condition has been checked [3].

Pooja.P, Preethi.K.R, Prof. Chetan H R, Prof. Nandish B M(2016),The approach of this research paper is to classify various kinds of fault and to check which kind of fault occurring frequently or occasionally. The output of the simulink model of the paper can be seen from the scope tool of the MATLAB, which shows the output current and voltage waveform of the system during the fault condition and after the fault condition[4].

Pooja.P, Preethi.K.R, Prof. Chetan H R, Prof. Nandish B M(2016) this paper is also based on the MATLAB software, a transmission section is made by using this tool which is used to analyze the various type of fault condition and effect of the fault on the power system network and its stability. This model also help us to see various effect on the bus system, the bus voltage and current during fault condition and after the fault condition[5].

Raunak Kumar(2013)This paper presents a technique to detect the location of the different faults on a transmission lines for quick and reliable operation of protection schemes.The simulation is developed in MATLAB to generate the fundamental component of the transient voltage and current. MATLAB software is used to simulate different operating and fault conditions on high voltage transmission line, namely single phase to ground fault, line to line fault, double line to ground and three phase short circuit [6].

SushmitaSrivastava, Km. Reshu, Smriti Singh(2014),In this paper an example of a 3 bus system is taken with a faulted bus. The hand calculation for fault current, bus voltages is done. Also, a MATLAB program created for the same is then executed with the input data and compared with the hand calculation. A fault represents the structural network change equivalent caused by the addition of impedance at the place of Fault. The faulted network can be solved conveniently by MATLAB software [7].

Md. TanjilSarker, Md. AnisurRahman, Md.Timur Rahman1 Md. Arafat Sarker, Vidyut Kumar Sarker Prf. Dr. ZahidHasan Mahmud(2017) Output of the project is resets automatically after a brief interruption in the

eventtemporary fault while it remains in tripped condition in case of permanent fault .The concept can be make longer to developing a mechanism for sending message to the authorities via SMS by interfacing a GSM modem[8].

Hui Hwang Goh*, SyyiSim, MohamadAmirul Hafiz Mohamed, Abdul Khairi Abdul Rahman, Chin Wan Ling, Qing Shi Chua, Kai Chen Goh(2017) This paper discusses type of fault occurs in the electrical power system and technique used to locate the fault and also the general protection device used to isolate the electrical system at fault.This paper will review the type of fault that possibly occurs in an electric power system, the type of fault detection and location technique that are available together with the protection device that can be utilized in the power system to protect the equipment from electric fault [9].

SathishBakanagari, A. Mahesh Kumar, M. Cheenya(2013)This project is designed in the form of Hardware for three single phase transformers 230v to 12V of output for to develop an automatictripping mechanism for the three phasesupply system while temporary fault and permanent fault occurs. Here we used 555 timer with relay for the fault is temporary or permanent [10].

VI.CONCLUSION

The rapid growth of the electric power system has in recent decades resulted in an increase of the number of transmission lines and total power outage. The challenge of a fast growing electrical grid has also resulted in huge increases of overhead lines and their total length. These lines are experiencing faults due to various reasons that cause major disruptions. Fault detection and classification on transmission lines are important tasks in order to protect the electrical power system. In recent years, the power system has become more complicated under competitive and deregulated environments and a fast fault location technique is needed to maintain security and supply in thegrid.

REFERENCES

[1] Priyankamani, Nithiyananthan. K and PratapNair,(2015), “Energy saving hybrid solar lighting system model for small houses”, World Applied Sciences Journal, Asia,Vol. 33, No. 3, pp. 460 – 465.

[2] Brijesh R. Solanki1, Dr. MahipalSinh C. Chudasama in, (2014). "Artificial Neural Network based Fault Classifier and Distance," In International Journal for Scientific Research & Development, Vol. 2, Issue 02, 2014.

[3] Pavithern, Raman Raghuraman, Pratap Nair, Nithiyananthan.K,(2015), “Voltage stability analysis and stability improvement of Power system”, International Journal of Electrical and Computer Engineering, Asia, Vol. 5, No. 2,pp. 189 – 197April 2015.

[4] BehnamMahamedi and JianGuo Zhu, “Unsynchronized Fault Location Based on the Negative -Sequence Voltage Magnitude for Double-Circuit Transmission Lines”, IEEE Transactions On Power Delivery, Vol. 29, No. 4, August 2014.

[5] Nithiyananthan. K and Ramachandran.V (2014),“Effective Data compression model for online power system applications”, International Journal of Electrical Energy, USA, Vol. 2, No. 2, pp. 138 – 145June 2014.

[6] C. A. Apostolopoulos and G. N. Korres, “A novel fault-location algorithm for double-circuit transmission lines without utilizing line parameters,” IEEE. Trans. Power. Del., vol. 26, no. 3, pp. 1467–1478, July 2011.

[7] Nithiyananthan.K and Ramachandran.V(2013),“Versioning –based service oriented model for multi are power systems on-line Economic load dispatch”, Computers and Electrical Engineering, Elsevier Publications,USA, Vol. 39, No. 2, pp. 433 – 440.

[8] Santosh B. Kulkarni&Rajan H. Chile, “MATLAB/SIMULINK Simulation Tool for Power Systems”, International Journal of Power System Operation and Energy Management,Vol. 1, Issue 2, 2011, pp. 33 – 38.

[9] S. Samson Raja, R.Sundar, A.Amutha, Dr K. Nithiyananthan, (2016), “Virtual State Estimation calculator model for Three Phase Power System Network”, Journal of Energy and Power Engineering, vol. 10, no. 8, pp. 497–503, USA.

[10] SekethVerma and Nithiyananthan. K (2016), “MATLAB Based Simulations Model For Identification of Various Points in Global Positioning System”, International Journal of Computer Applications,USA, Vol. 138, No. 13, pp. 15 – 18.