CHAPTER TWO

Literature Review

2.1 Introduction To Fault Detection

In an electric power system, a fault is detected by any abnormal electric current follow . For example, a short circuit is a fault in which current bypasses the normal load. An open-circuit fault occurs if a circuit is interrupted by some failure. In three-phase systems, a fault may involve one or more phases and ground, or may occur only between phases. In a "ground fault" or "earth fault", charge flows into the earth. The prospective short circuit current of a fault can be calculated for power systems. In power systems, protective devices detect fault conditions and operate circuit breakers and other devices to limit the loss of service due to a failure.[4] In a poly phase system, a fault may affect all phases equally which is also called symmetrical fault. If only some phases are affected, the resulting asymmetrical fault becomes more complicated to analyze because the simplifying assumption of equal current magnitude in all phases is no longer applicable. The analysis of this type of fault is often simplified by using methods such as symmetrical components.

A symmetric or balanced fault affects each of the three phases equally. In transmission line faults, roughly 5% are symmetric This is in contrast to an asymmetrical fault, where the three phases are not affected equally.

An asymmetric or unbalanced fault does not affect each of the three phases equally Power transmission and distribution lines are the vital links that achieve the essential continuity of service of electrical power to the end users. Transmission lines connect the generating stations and load centers. Faults are caused either by insulation failures and conducting path failures. Most of the faults on transmission and distribution lines are caused by over voltage due to lighting and switching surges or by external conducting objects falling on over head lines. Birds, tree branches may also cause faults on over head lines. Other causes of faults on over head lines are direct lightning strokes, aircraft, snakes, ice and snow loading, storms, earthquakes, creepers etc. In the case of cables, transformers, generators the causes may be failure of solid insulation due to ageing, heat, moisture or over voltage, accidental contact with earth . [5]

The overall faults can be classified into two types:

1. Series faults   2. Shunt faults

A fault if unclear has the following effects on a power system.

- Heavy short circuit current may cause damage to equipment or any other element of the power system due to over heating or flash over and high mechanical forces set up due to heavy current.
- There may be reduction in the supply voltage of the healthy feeders, resulting in the loss of industrial loads. Short circuits may cause the unbalancing of the supply voltages and currents, there by heating rotating machines.
- There may be a loss of system stability. The faults may cause an interruption of supply to consumers.[5]

2.2 Related Works

2.2.1 Travelling Waves for Finding The Fault Location

Transmission lines are considered the most vital components in power systems connecting both generating and consumer areas with huge interconnected networks. They consist of a group of overhead conductors spreading in a wide area in different geographical and weather circumstances. These conductors are dispensed on a special metallic structure "towers", in which the conductors are separated from the tower body with some insulating components and from each other with an adequate spacing to allow the air to serve as a sufficient insulation among them. Unfortunately these conductors are frequently subjected to a wide variety of fault types. Thus, providing proper protection functions for them is an attractive area for research specialists. Different types of faults can occur including phase faults among two or more different conductors or ground faults including one or more conductors to ground types. However, the dominant type of these faults is ground ones [6].Excellent fault Location Estimation Benefits are :

- **Time And Effort Saving:** After the fault, the related relaying equipment enables the associated circuit breakers to De energize the faulted sections. Once the fault is cleared and the participated faulted phase(s) are declared, the adopted fault locator is enabled to detect the fault position. Then, the maintenance crews can be informed of that location in order to fix the resultant damage. Later, the line can be reenergized again after finishing the maintenance task. Since transmission line networks spread for some hundreds of kilometers in different environmental and geographical circumstances, locating these faults based on the human experience and the available information about the status of all breakers in the faulted area is not efficient and time consuming. These efforts can therefore effectively help to sectionalize the fault (declare the faulted line section) rather than to locate precisely the fault position. Thus the importance of employing dedicated fault location Schemes are obvious.[6]

- **Improving the System Availability :**There is no doubt that fast and effective maintenance processes directly lead to improve the power availability to the consumers. This consequently enhances the overall efficiency of the power nets. These concepts of (availability, efficiency, quality) have an increasingly importance nowadays due to the new marketing policies resulting from deregulation and liberalization of power and energy markets.
- **Assisting Future Maintenance Plans :**It is quite right that temporary faults (the most dominant fault on overhead lines) are self cleared and hence the system continuity is not permanently affected. However, analyzing the location of these faults can help to pinpoint the wake spots on the overall transmission nets effectively. This hopefully assists the future plans of maintenance schedules and consequently leads to avoid further problems in the future. These strategies of preventive maintenance enable to avoid those large problems such as blackouts and help to increase the efficiency of the overall power system.
- **Economic Factor:** All the mentioned benefits can be reviewed from the economical perspective. There is no doubt that time and effort saving, increasing the power availability and avoiding future accidents

can be directly interpreted as a cost reduction or a profit increasing. This is an essential concept for competitive marketing.

2.2.1.1 Classification of Developed Fault Location Methods

Generally speaking, fault location methods can be classified into two basic groups, travelling wave based schemes and impedance measurement based ones as shown in Fig(2.1) Travelling wave schemes can be used either with injecting a certain travelling wave from the locator position or with analyzing the generated transients due to the fault occurrence. Impedance measurement schemes are classified whether they depend on the data from one or both line ends.

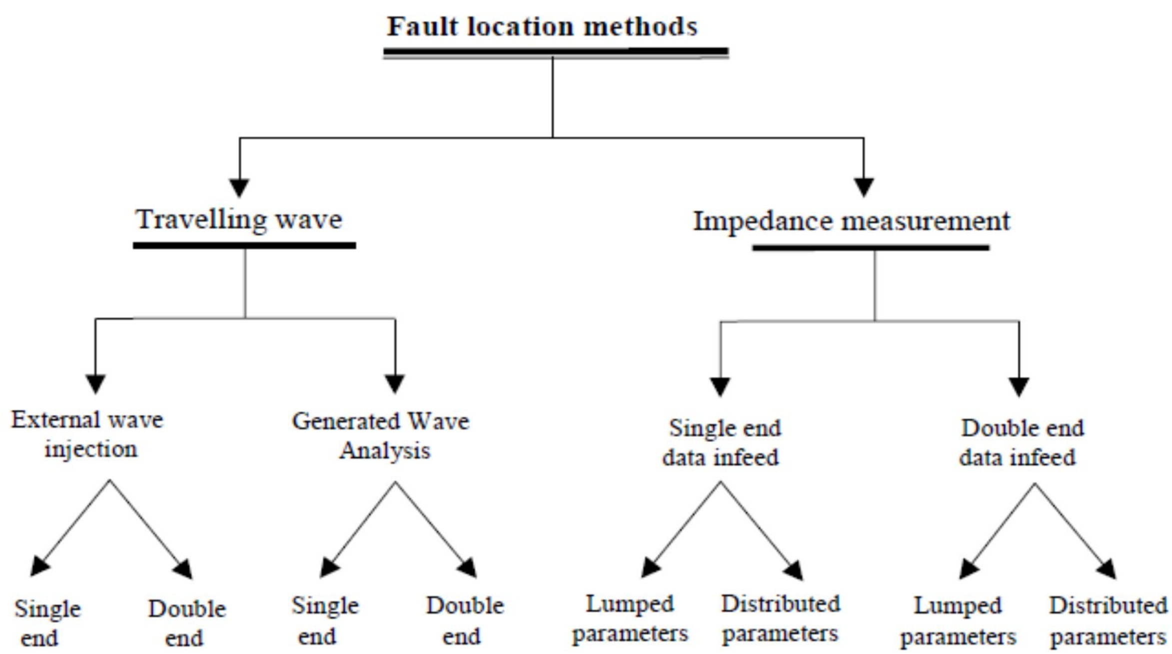

Fig. (2.1) Classification of fault location methods

- **Travelling Wave Based Fault Locators :**Employing travelling wave phenomena for fault location purposes for both underground cables and overhead lines was reported since 1931. In 1951, Lewis classified travelling wave based schemes into different four types A, B, C and D according to their modes of operation using the travelling voltage waves. Types A and D depend on analyzing the resulting transients from the fault itself needing no further pulse generating circuitry. Type A is a single end one capturing the transients only at one end. It relies on the generated transients from the arcing flashover during the fault. However the assumption of getting generated transients at the line end is not always satisfied. Moreover, the arc itself may extinguish rapidly. They rely on measuring the required time for the injected pulses to go and to be captured after reflection from the fault point. This time can be directly interpreted as a fault distance.[6]

- **Impedance Measurement Based Fault Locators :**These schemes provide another alternative for the fault location estimation problem. Fig. (2. 2)shows the one line diagram of a three phase double in feed faulted transmission line. A line to ground fault occurred on phase A at point F through a resistance RF at a distance x from the locator position. The fault current IF is comprised from two components IFs and IFr flowing from sending and receiving ends respectively. The essential task of the fault location algorithm is to estimate the fault distance x as a function of the total line impedance ZL using the sending end measurements (for single end algorithms) or both end measurements (for double end algorithms)with the most possible accuracy. [2]

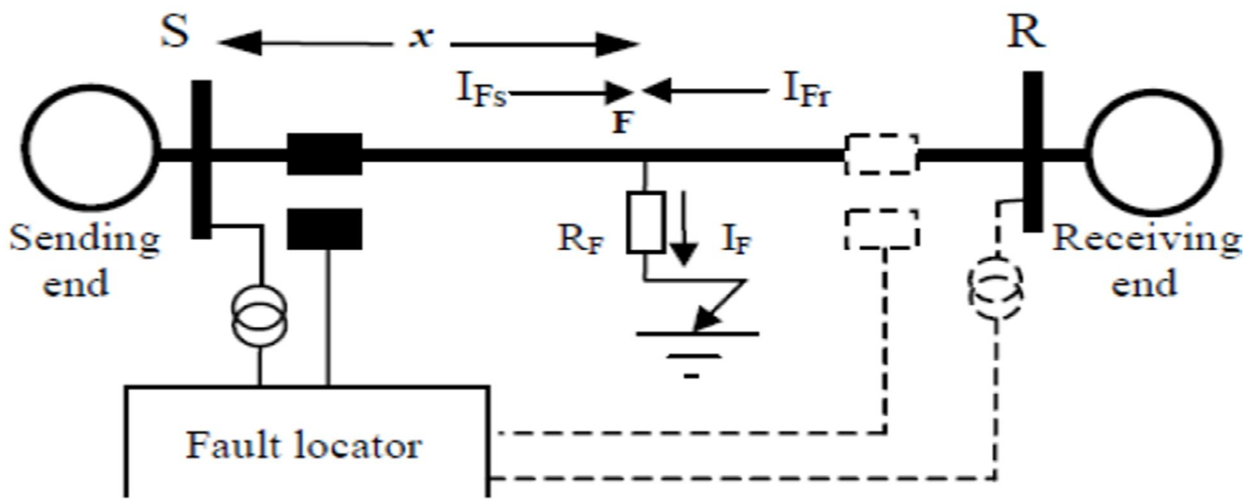

Fig. (2. 2)One line diagram of a faulted transmission line.

2.2.2 Fault Location Using Magnetic Field Sensing Coils

A variety of methods of detecting and locating faults on power transmission lines exist. Most of these methods utilize the measurements from voltage and current transformers at substations or switching stations to perform their analyses. This thesis examines the effectiveness of using magnetic field sensing coils as alternative measurement devices for the purpose of fault detection and location. A review of common methods of fault location is presented. This review is focused on impedance-based and traveling wave-based fault location as they are the most common traditional methods. A few previous uses of magnetic field sensing coils in fault detection and location schemes are also discussed in order to determine the previously recognized benefits of using such coils. The underlying mathematics used in determining the magnetic field due to an unspecified number of conductors and due to a three-conductor system are then examined. The results of this analysis are used in simulating the magnetic field for a variety of conductor configurations under normal operating conditions and for line to ground and line to line fault conditions. This information is used to determine the potential effectiveness of monitoring the magnetic field to detect faults. Based on these findings, four algorithms are constructed which monitor the magnetic field near the transmission line for the purpose of fault detection. Each of these algorithms determines some aspect of the steady-state behavior of the magnetic field and attempts to detect any deviations from this behavior. These algorithms are described in detail and their comparative benefits and drawbacks are determined.[7]

An implementation of a complete fault detection and location procedure which uses these algorithms in conjunction with one another is then described. This implementation is then used to test the combined effectiveness of the algorithms for a variety of fault types and fault resistances. The fault location errors for these tests are then presented. This information is used in determining the effectiveness of the magnetic field sensor as a measurement device for the purpose of fault detection and location. [7]

2.2.3 Use G.P.S in EHV for Fault Detection and Protection :

The majority of systems rely upon three phase AC electric power is the product of two quantities: current and voltage. These two quantities can vary with respect to time (AC power) or can be kept at constant levels (DC power).Alternating current generators can produce a variable number of phases of power. A higher number of phases leads to more efficient power system operation but also increases the infrastructure requirements of the system. Power systems deliver energy to loads that perform a function. These loads range from household appliances to industrial machinery. Most loads expect a certain voltage and, for alternating current devices, a certain frequency and number of phases. The appliances found in your home, for example, will typically be single-phase operating at 50 or 60 Hz with a voltage between 11 and 260 volts (depending on national standards). All devices in your home will also have a wattage, this specifies the amount of power the device consumes. At any one time, the net amount of power consumed by the loads on a power system must equal the net amount of power produced by the supplies in addition to the power lost in transmission system [8]

In these days high voltage transmission lines cover long distances, hundreds of kilometers, particularly when the line passes through hilly terrains like Pirpanjal , Himalayan ranges. When a fault occurs on these transmission lines it is extremely difficult to patrol the line from tower to tower to identify the faulty spot. Accurate location of faults is not only save the time but also saves different recourse for the power. Power system operator needs accurate information so that he can deploy men and machinery to the accurate spot immediately and rectify the fault thereby saving lot of time and resources. Soft ware system, communication system such as SCADA and PLCC hardware system can be designed. For fault location data from SCADA such as oscillo graphs, relays and the sequence of events are used for fault location Now available latest technology. GPS which can be used to locate a fault on long high voltage transmission lines. Self monitoring hardware can be configured at foundation sites for both conditions. By inserting the information of a fault location (GPS) into Geographical information system computer. Some power system operators have adopted this system.[9]

2.3 Analysis Of Related Works

Most previous studies have focused in determination and detect of the location of fault on current mechanism in the power transmission lines approximated by the calculation of the impedance obtained from voltage and current data.

Also Account time attended a signal , Signal is sent to the line that the error occurred when the signal reach to the location of fault back accordingly it is estimated the location of fault by determining time to go and return.

Also some previous studies spoke on detect the location of fault by using magnetic field sensing coils which determining the magnetic field due to an unspecified number of conductors and due to a three-conductor system are then examined. The results of this analysis are used in simulating the magnetic field for a variety of conductor configurations under normal operating conditions and for line to ground and line to line fault conditions. This information is used to determine the potential effectiveness of monitoring the magnetic field to detect faults.

Therefore , this thesis present a circuit that capable of detecting and locating the fault with less proportion of error . This circuit use the global positioning system (GPS) to locate the position and the global system for mobile (GSM) to send these message to system supervisor .