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FAULTED POLE INDICATOR FOR UTILITY GRID

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Abstract - *A faulted pole indicator circuit provides visual, noise indication and remote detection of the abnormal condition on pole in electrical power distribution system. Fault indicators can be installed at pole/tower along the distribution line. Whenever ground fault occurs on three phase- four wire distribution system poles, abnormal current will flowthrough pole, by mistakes touch this pole get shock, there is a need to detect the location, to reduce the accidents. This paper reviews the fault indicator applications in distribution systems. Principles, merits and demerits of each fault location technique are discussed. This paper suggests an advanced fault indicator based on fault generated signal, which is mounted between earth wire and tower/pole. This technology gives the exact location of fault and aware fault to avoid the accident and save human life.*

1. INTRODUCTION

There are lots of fault causes could lead to power outage, are caused by the fault in distribution system for the large number of distribution lines distributed in the complex environments. This paper focuses on the investigation about fault causes in distribution system, especially the fault on overhead line. The fault is inevitable in distribution system for many uncontrollable factors, such as animals, weather related factors. The different kinds of fault causes have the similar fault features. The fault causes can be identified by the fault feature analysis which is useful for the faultfinding and fault-clearing when a fault happened. Electric power systems have grown rapidly over the past fifty years. This has resulted in a large increase of the number of lines in operation and their total length. These lines experience faults which are caused by storms, lightning, snow, freezing rain. Insulation breakdown and, short circuits caused by birds and other external objects. In most cases, electrical faults manifest in mechanical damage which must be repaired before returning the line to service. The restoration can be expedited if the location of the fault is either known or can be estimated with reasonable accuracy. Fault locators, which provide estimates for the locations of faults. Are useful when overhead lines are long and patrolling is time-consuming. Also, visual inspection is difficult during adverse weather conditions. Fault locators could be relied on for obtaining the needed fault location estimates.

The subject of fault location has been of considerable interest to electric power utility engineers and researchers for over twenty-five years. Most of the research done so far, has been aimed at finding the locations of distribution line faults. Of late, the location of faults on distribution systems has started receiving some attention as utilities are operating in a deregulated environment and are competing with each other to increase the availability of power supply to the customers. Also, distribution systems are being gradually automated and microprocessor based relays are being used for line protection. Therefore, development of an improved fault location technique is possible utilizing data that the relays are now able to collect.

2. LITERATURE REVIEW

Distribution lines are usually operated in the radial mode. Loads are usually tapped along the lines; which could be single and/or multi-phase taps. The construction of the line is usually non-homogeneous because distribution lines are extended as loads develop. Previously proposed approaches for estimating the locations of distribution line faults consist of using voltages and currents measured at the line terminal. The methods used in this approach can be divided into two categories.

The first category uses the high Frequency components of currents and voltages caused by the faults which start voltage and current traveling waves between the fault and the line terminals [12]. This method is similar to that proposed for transmission lines and is complex and expensive. The methods in the second category use the Fundamental Frequency voltages and currents at the terminals of a line and parameters of *the* line and loads [I;]. This method consists of calculating the line impedance as seen from the line terminal and uses the calculated impedance to estimate the distance of the fault from the line terminals. Reference [I31 does not consider the dynamic nature of the loads and multiphase taps which are normally encountered in such cases.

Another technique, that uses the fundamental frequency components of voltages and currents measured at the line terminal. Has been proposed for estimating the locations of shunt faults on radial distribution lines [14. 151. The technique is suitable for non homogeneous lines with or without capacitor banks and dynamic loads. However. This technique does not consider the presence of laterals in the distribution system.

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Another method, that is used to identify the faulted section. Consists of using a fault indicator in each section of the line. This technique is not of much help if the section is more than a couple of miles. Most fault indicators provide indication locally which makes it difficult to use the information during inclement weather. To alleviate this problem, some manufactures are now providing fault indicators which communicate with a remote receiver over a radio link.

3. OBJECTIVES OF THE THESIS

The work reported in this thesis, was conducted keeping the following objectives in mind.

1. To develop a technique for indication of shunt faults in radial distribution systems which include several single and/or multi-phase laterals.
2. To perform sensitivity studies of the developed technique.
3. To design, build and test a prototype fault location system in the laboratory.

4. DISTRIBUTION SYSTEM FAULTS

Introduction

Distribution systems generally experience shunt faults.

Shunt Faults

Distribution lines experience faults more often than the faults experienced by other power system facilities [21]. Most line faults are caused by insulation failure resulting in single-phase-to-ground and multi-phase short circuits. For a three-p hase line, shunt faults are classified in the following four categories.

1. Single-phase-to-ground faults.

2. Two-phase-to-ground faults.

3. Phase-to-phase faults.

4. Three-phase faults.

Experience has shown that between 70 and 80 percent of all faults are single-phase-to ground Faults. All faults, except the three-phase faults cause power systems to operate in unbalanced modes. The use of symmetrical component theory makes it convenient to study the operation of the system during such conditions.

4.1 Single-phase-to-ground faults

The following three types of single-phase-to-ground faults are experienced

1. Phase R-to-ground faults.

2. Phase Y-to-ground faults.

3. Phase B-to-ground faults.

Figure 2.2 (a) depicts the electrical circuits for these faults. In this figure. *R,-* is the fault resistance. It can be shown that a single-phase-to-ground fault can be represented by the sequence network diagram shown in Figure 1.2 (b). The derivation of this circuit is given in Appendix A.

4.2 Two-phase-to-ground faults

Two-phase-to-ground faults are of the following three types.

1. Phase I3 and phase C-to-ground faults.

2. Phase C and phase A-to-ground faults.

3. Phase A and phase B-to-ground faults.

The single line diagram of these faults is shown in Figure 2.3 (a). When fault resistances *RD* and *Rfl* are equal, a two-phase-to-ground fault can be represented by the sequence network diagram shown in Figure 2.3 (b).

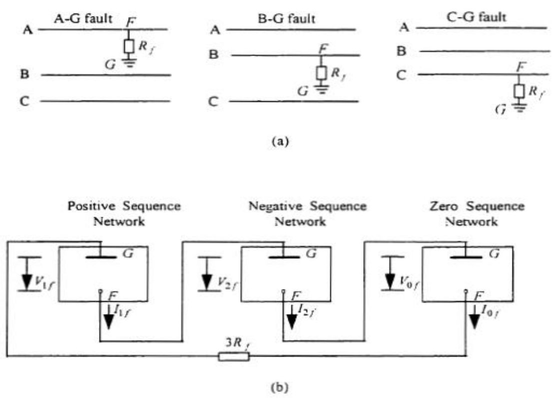

Figure 2.2. Single-phase-to-ground faults experienced on three-phase lines. (a) Types of faults. (b) Sequence network diagram with faulted phase as reference.

4.3 Phase-to-phase faults

The three types of phase-to-phase faults that can be experienced on lines are as

follows.

1. Phase B-to-phase C faults.

2. Phase C-to-phase a faults.

3. Phase A-to-phase B faults.

These faults are shown in Figure 2.4 (a) with a fault resistance *RJ.* Using symmetrical component theory, a phase-to-phase fault can be represented by the sequence network diagram shown in Figure 2.4 (b).

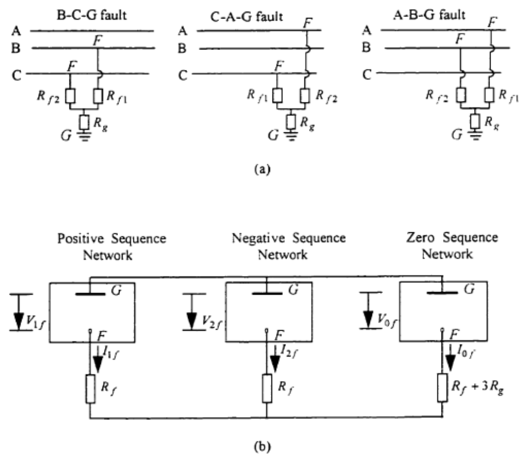

Figure 2.3. Two-phase-to-ground faults. (a) Types of faults. (b) Sequence network diagram with unfaulted phase as reference.

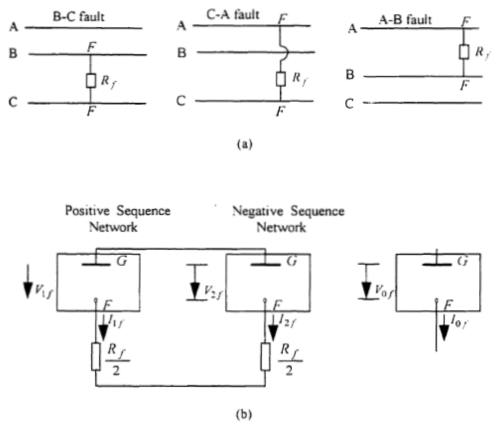

Figure 2.4. Phase-to-phase faults. (a) Types of faults. (b) Sequence network diagram with unfaulted phase as reference.

4.4 Balanced three-phase faults

Three-phase faults that have equal fault resistances in the three phases are called balanced three-phase faults. These faults can be divided into two categories; those involving ground and those not involving ground as shown in Figure *2.5* (a). The ground connection is of no major significance in an otherwise balanced three phase system. A balanced three-phase fault can be represented by the sequence network diagram shown in Figure *2.5* (b) or Figure *2.5* (c) depending on the ground connection at the location of the fault.

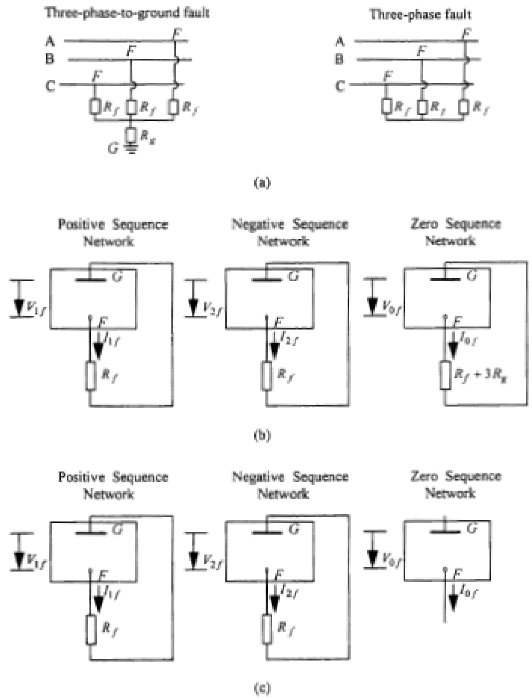

Figure 2.5. Balanced three-phase fault. (a) Types of faults. (b) Sequence network diagram for fault with ground. (c) Sequence network diagram for fault without ground.

4.5 Ground resistance

The ground resistance is the sum of the tower footing resistance at the fault location and the resistance of the current path through the ground from the fault to the source if overhead ground wires are insulated or are not used. Electric utilities measure and record data on tower footing resistances and ground resistivities. If overhead ground wires are used, the resistances of the ground path, the tower footings and ground wires form lattice networks. The dominant resistance in the fault circuit is the resistance of the contact between the conductor and the path of the current through the ground if a conductor breaks and falls to the ground. The ground-contact resistance depends on the type of soil and moisture in it. The contact resistance also depends on the conductor voltage; it takes a finite voltage to cause the surface insulation to breakdown. Generally. the ground contact resistances are larger than the tower footing resistances. Fault resistances are small for inter-phase short circuits and do not exceed a few ohms. However, fault resistances are much larger for ground faults because tower footing resistances can be up to 10 ohms or even higher. Fault resistances are exceptionally large for contact with trees or for broken conductors lying on dry pavement. The fault resistance ranges from a few ohms to hundreds of ohms.

5. BLOCK DIAGRAM

In this idea of project, Arduino microcontroller platform with ATMEGA 328P core is used. It can be easily interfaced with alarm and indication circuit and also to update the where fault is occurring to control room. The basic block diagram is as showing in FIG.1 The explanation is given as follows:

FIG.2 shows the circuit diagram. In that power supply is gives to the controller to control the circuit. The controller is attached to buzzer and Bluetooth for indication and wireless update to control room. Input signal of sensor is connected to the analog pins of controller.

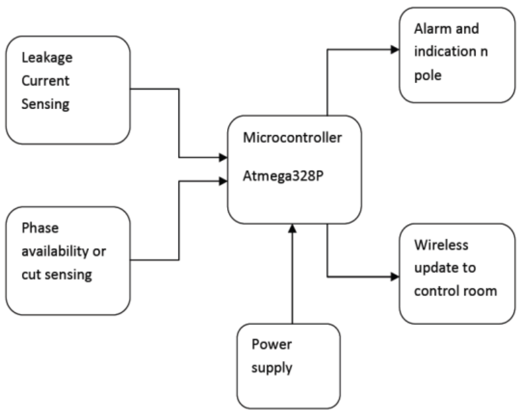

Fig -1: Block Diagram

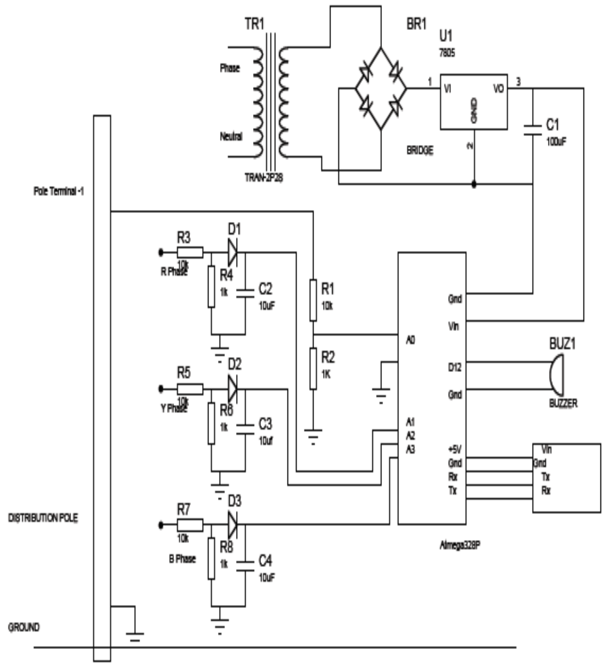

Fig -2: Circuit Diagram

6. METHODOLOGY

There are lots of faults occurring in the pole such as insulation failure, unsymmetrical faults. To solve such problems we use the simple voltage measurement to measure the voltage across the pole and ground. The leakage current and phase cutting or any phase break can be sense it can be control and provide the alarm indication for safety and wireless update for control room for further clearing the fault.

7. WORKING

Project – Distribution line safety system

This Project/ system will have a basic motive to protect the human and animals from getting shock hazards from the distribution lines and towers. Basic principles of this project will be divided into two different parts. First and mostly occurred problem in distribution lines is current leakage due to insulation failure, these leakage current flows to ground through the pole. And if accidently any human being comes in contact with the pole carrying Leakage current suffered from the electric shock. And may be death. Mainly this thing happens into the rainy seasons.

Our system will protect the human being or animals from this shock by giving the audible alert through the sirens and indicators. For doing this we will consciously monitor the leakage current through the pole. This leakage current which is flowing through the pole will create a voltage drop across the pole due to internal electrical resistance of the pole. If this voltage drop will measured by the microcontroller. If it exceeds certain limit immediate actions will be taken which include buzzer, indicators, and alert to the control room. The reason behind monitoring the voltage drop across the pole only is that monitoring voltage drop across pole and ground will have effects of season change. As change in season causes natural change in the earth resistance. It may give false indication of the fault. To avoid this only monitoring the voltage drop across the pole will be the reliable solution as pole conductor resistance has very low effect of change in atmosphere and season change.

And important part of this project works for the conductor break. Due to any accidental reason, wind storms, nigleance in maintenance distribution line conductor gets broken and comes in contact with the humans and animals. This problem can be easily overcome or indicated by our project. Phase voltage detection of each phase will be monitored by the controller. If any of the phase is brake or cut at any point our system will detect the unavailability or low level of voltage. After sensing of this system will immediately inform to the control room.

8. CONCLUSIONS

We can conclude from this project is overall study of faults which occurring in distribution pole and how to reduced the human accidents. Providing the safety by using controller logic, alarm indication, wireless update to control room for clearing the fault also the cost of project is very less. The construction wise this system is very compact and this system is more important in now a days for safety purpose.

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