ISSN (Online) 2395-2717

International Journal of Engineering Research in Electrical and Electronic Engineering (IJEREEE)
Vol 3, Issue 2, February 2017

Exact Fault Location of Underground Cable

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***Abstract*— Underground cables are been widely used and put into practice due to its longer life expectancy and are less susceptible to the impacts of severe weather. An exact identification of faulty system is important to minimize the disturbance time during fault. An accurate fault location plays vital role in speeding up the system restoration; reduce economical loss and has high efficiency that helps to increase the performance of the system. This paper prefers to fault location method in commercial system. The system consists of transmitter and receiver sections. The transmitter unit consists of transformer with timer circuit for injecting a series of high voltage pulse stream. The effect of noise caused by arcing voltage is received by a receiver which helps in exact location of cable fault.**

***Index Terms*— Monitor section, Receiver section, Transformer.**

I. INTRODUCTION

Now-a-days the underground cables are widely used for the transmission of power. With increase in population, the demand for the power increases. Therefore the distribution and transmission network are growing continuously and its reliability has becomes most important factor.

In developing cities, the overhead line has become a barrier for appearance and safety purpose. So the underground system is preferred for transmission and distribution. One important aspect in underground cable is to maintain its reliability which can be achieved by accurate or exact fault location and the restoring the fault within fraction of minuets. Underground cables has been widely used to reduce the sensitivity of distribution network to the environmental influence. Because they are not influenced by weather conditions, less liable to damage by storms and lightning, no susceptible trees. The underground cables are less expensive for short distant as compared to overhead lines also it is environment friendly and required low maintenance.

An underground cable provides a clean environment, less damage due to storms. The underground cables system is important for distribution especially in metropolitan cities, airports and defence services. However the disadvantages of underground cables should also be taken into consideration that it is 8-15 times more expensive then equivalent overhead line.

Increase in industrial sectors, the importance and priorities of uninterrupted services get increased. So fault in distribution Network must be quickly detected, located and repaired. Generally when fault occurs on transmission lines, the detection of fault is necessary for power system to repair the fault before it increase the damage of power system. If it is not repaired within the time large damage in power system may occurred.

II. TYPES OF FAULT IN UNDERGROUND CABLES

The most common type of faults that occur in underground cable is:

1. Open Circuit Fault.
2. Short Circuit Fault.
3. Earth Fault.

1. Open Circuit Fault: When there is a break in the conductor of a cable, it is called open circuit fault. The open circuit fault can be checked by a megger. For this purpose, the three conductors of the 3-core cable at the far end are shorted and earthed. Then resistance between each conductor and earth is measured by a megger. The megger will indicate zero resistance in the circuit of the conductor that is not broken. However, if the conductor is broken, the megger will indicate infinite resistance in its circuit.

2. Short Circuit Fault: When two conductors of a multi-core cable come in electrical contact with each other due to Repeated for other conductors of the cable. Insulation failure, it is called a short-circuit fault. Again, we can seek the help of a megger to check this fault. For this purpose, the two terminals of the megger are connected to any two conductors. If the megger gives zero reading, it indicates short circuit fault between these conductors. The same step is repeated for other conductors taking two at a time.

3. Earth Fault: When the conductor of a cable comes in contact with earth, it is called earth fault or ground fault. To identify this fault, one terminal of the megger is connected to the conductor and the other terminal connected to earth. If

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the megger indicates zero reading, it means the conductor is earthed. The same procedure is

III. COMMON METHODS OF FAULT LOCATION

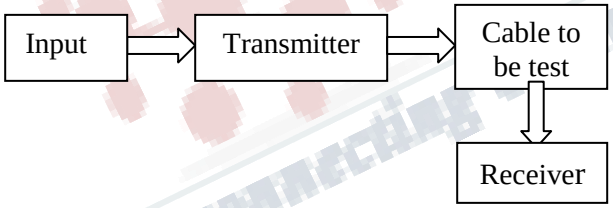
1. Sectionalizing: This procedure risks reducing cable reliability, because it depends on physically cutting and splicing the cable. Dividing the cable into successively smaller sections and measuring both ways with an ohmmeter or high-voltage insulation resistance (IR) tester enable to narrow down search for a fault. This laborious procedure normally involves repeated cable excavation.

2. Time Domain Reflectometry (TDR): The TDR sends a low-energy signal through the cable, causing no insulation degradation. A theoretically perfect cable returns that signal in a known time and in a known profile. Impedance variations in a "real-world" cable alter both the time and profile, which the TDR screen or printout graphically represents. One weakness of TDR is that it does not pinpoint faults.

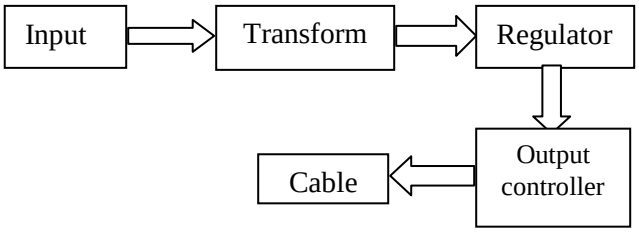
IV. BASIC CONCEPT

This paper implements the fault location in underground distribution networks. Here a series of high voltage pulse streams are injected into the faulty cable shortly after the cable fault has been established. The effect of noise caused by arcing voltage is used for the determination of accurate location of cable fault.

It basically includes transmitter and receiver section.



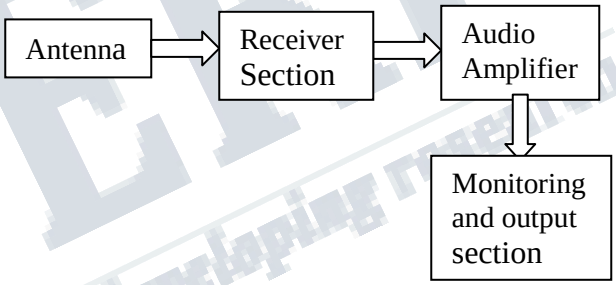
Transmitter Unit



The transmitter is basically a pulse generating unit. It consists of

1. ***Input Supply:*** The circuit uses standard single phase, 50Hz power supply and is given to the transformer.
2. ***Transformer:*** It is a step down transformer, which reduces the input voltage of 240V to 12V.
3. ***Voltage Controller***: It is a single phase autotransformer used to vary the input voltage. The voltage selection depends upon the type faulty cable and the type of fault.
4. ***Output Controller***: The output controller is contactor or electrically controlled switch used for switching the electrical power network. It is similar to a relay except with high current rating.

V. RECEIVER UNIT



1. ***Receiver Section***: It consists of an antenna which receives the noise frequency of the arc produced across the faulty position of the cable.
2. ***Audio Amplifier***: It amplifies the signal received by the antenna.
3. ***Monitoring & Output Section:*** The display part consists of 16x4 pins LCD display interfaced to the Arduino board which shows the signal strength as percentage, in case of any fault and also display the time, date and year.

***A] Arduino*:** The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. Arduino is open-source hardware.

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The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter."Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform. Arduino board designs use a variety of microprocessors and controllers. Arduino provides an integrated development environment (IDE) based on the Processing language project.

B] LCD: LCD (Liquid Crystal Display) screen is an electronic display module and have a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs.

The advantages of using this LCD are: economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

Procedure

This paper implements the fault location in underground distribution networks. It includes a transmitter and receiver unit. In order to determine the location of fault in a cable, first of all isolate the faulty cable from both the feeder end and consumer end. Using a megger, check which type of fault being occurred in the cable. This will help to understand the type fault and also we can select appropriate value of input supply.

After isolating the cable, the core and shield of the underground cable is connected to the output terminals of the transmitter unit. Transmitter unit consists of transformer with output controller and for injecting a series of high voltage pulse streams (as per capacity of cable) into the faulted cable shortly after the cable fault has been established. Now the receiver unit is traced along the length of the cable. The fault in the underground cable produces arcing which is accomplished by high frequency noise. The effect of noise caused by arcing voltage is received by a receiver. The strength of the detected signal is display on the LCD display. Thus provide an accurate location of the cable fault.

VI. CONCLUSION

In the power system, the detection and location of fault is very important. If it is not located within the time it may cause severe damage in the power system. This paper reviews a method of locating the exact fault point in underground cables using RF (radio frequency).In this system the receiver unit is carried by human along the path of the underground cable layout.

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