The new technologies used for fault detection in underground cables

Krati Haldiya

Bachelor's Student
Department of Electrical Engineering
Poornima College of Engineering, Jaipur, India

***Abstract*: This paper deals with the technologies used for the fault detection and location of the fault in the underground cables. Faults in underground cables can be detected through various algorithms and simulation techniques. The voltage and current measurements tell where the fault has occurred.**

***Index terms*: Incipient faults, wavelet analysis, fault locator.**

I. INTRODUCTION

Today, the underground cables are used generally for the power transfer in distribution system. The underground cables are effective in the urban areas and require proper insulation. Generally, the incipient fault and permanent fault occurs in the cables due to many factors and since the underground cable distribution system is reliable and widely used it is important to find the exact location of the fault and to solve it.

There are various methods used to detect the fault location. Some of these are wavelet analysis, simulation through PSCAD-EMPT, fibre optic technology, estimation through instantaneous frequency. These methods require certain parameters to be set and determines the fault location through the transient states and voltages and current measurements. Though they have certain disadvantages also, so it is essential to use an efficient method for fault detection. In this paper we will compare the study of two or more methods of fault detection.

II. DISCUSSION

A. *Incipient fault transients*

The incipient fault is type of transients. It can be a sub cycle or multicycle. The electromagnetic transients can be analysed by wavelet analysis. The algorithm is designed such that it analyses the sudden spikes and different frequency components at different frequency bands. The transients are detected at different stages and through it the fault is detected.

For detection of fault up to 240-960Hz frequency band

If, $\frac{energy\ latest - mean(energy\ past)}{STD(energy\ past)} \rangle$ transient

Then transients can be detected for low noise environment. For high noise environment

$\frac{RMS(latest\ half\ cycle) - RMS(\ one\ cycle\ before)}{RMS(one\ cycle\ before)} \rangle$ transient

The transients are mostly detected correctly, only a few single cycles and multi cycle are left undetected at small current variations.

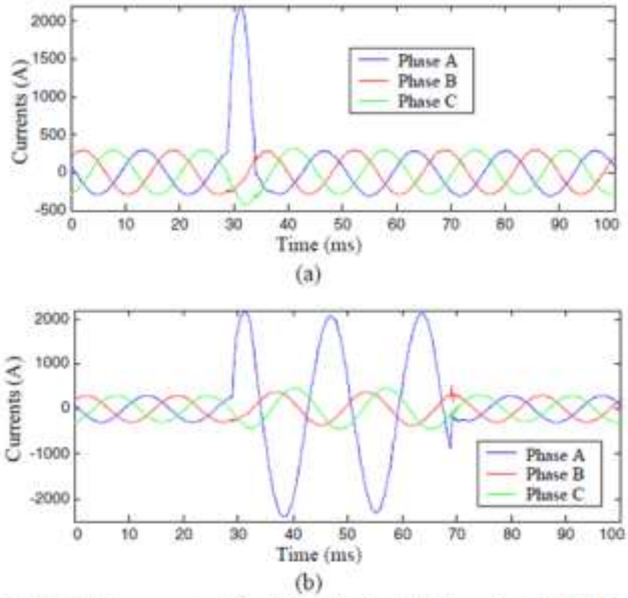

Figure 1the figure shows sub cycle and multi cycle transients

B. Simulation modelling through PSCAD

Here the algorithm uses the voltage and current measurement of terminals where fault locator has been placed. The cable is modelled using PSCAD where varies modes are used for accurate result.

Here cable sections are represented by pi model where the series and shunt impedances as well as admittance before the fault location and after the fault location are taken and are used for current and voltage measurement in fault condition.

The fault resistance can be calculated using fault current and voltage. Through this the fault location can be calculated by using the fact that at actual fault point imaginary part of fault resistance is zero.

The absolute error found in this method is 0.3-0.9 maximum under different situations. The maximum error will be always less than 1%. Taking a Simulink model at few fault resistances. The fault location calculated is 5km. The plot shows the fault location at different fault resistances.

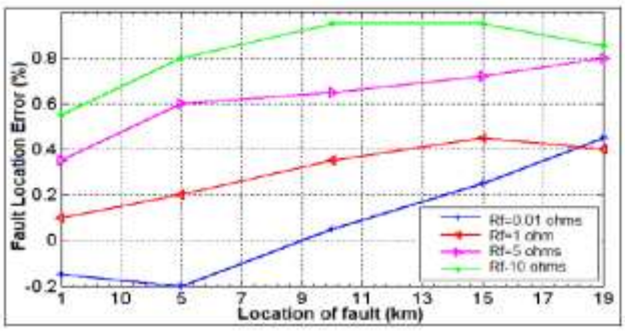

Figure 2 fault location at different fault resistances

III. CONCLUSION

The two models are being discussed here to find the fault location. The simulation through PSCAD gives the accurate results. The cable modelling is done by taking different grounding modes and taking in account the shunt capacitance and sheath current.

The second paper go through the algorithm with high detection. It is used for different fault conditions, transients, and have high accuracy and low chances of missing a fault.

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