IJRISE International Journal of Research In Science & Engineering e-ISSN: 2394-8299
Volume: 2 Issue: 3 March-April 2017 p-ISSN: 2394-8280

REVIEW OF THREE PHASE FAULT ANALYSIS FOR OVERHEAD TRANSMISSION LINE

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Abstract—A fault in a circuit is any failure that interferes with the normal system operation. Lighting strokes cause most faults on high-voltage transmission lines producing a very high transient that greatly exceeds the rated voltage of the line. This voltage usually causes flashover between the phases and/or the ground creating an arc. Since the impedance of this new path is usually low, an excessive current may flow.If one, or two, or all three phases break or if insulators break due to fatigue or inclement weather, this fault is called a permanent fault since it will remain after a quick power removing. Hence adequate protection is required to protect the system from this faults. In this paper we have done the review of three phase fault analysis.

I. INTRODUCTION

The fault analysis of a power system is required in order to provide information for the selection of switchgear, setting of relays and stability of system operation. A power system is not static but changes during operation (switching on or off of generators and transmission lines) and during planning (addition of generators and transmission lines). Thus fault studies need to be routinely performed by utility engineers (such as in the CEB).

Faults usually occur in a power system due to either insulation failure, flashover, physical damage or human error. These faults, may either be three phase in nature involving all three phases in a symmetrical manner, or may be asymmetrical where usually only one or two phases may be involved. Faults may also be caused by either short-circuits to earth or between live conductors, or may be caused by broken conductors in one or more phases. Sometimes simultaneous faults may occur involving both short-circuit and brokenconductor faults (also known as open-circuit faults).

Balanced three phase faults may be analyzed using an equivalent single phase circuit. With asymmetrical three phase faults, the use of symmetrical components help to reduce the complexity of the calculations as transmission lines and components are by and large symmetrical, although the fault may be asymmetrical.

Fault analysis is usually carried out in per-unit quantities (similar to percentage quantities) as they give solutions which are somewhat consistent over different voltage and power ratings, and operate on values of the order of unity.

In an electric power system, a fault or fault current is any abnormal electric current. 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", 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 and operate circuit breakers and other devices to limit the loss of service due to a failure.

In a poly-phase system, a fault may affect all phases equally which is a "symmetrical fault". If only some phases are affected, the resulting "asymmetrical fault" becomes more complicated to analyze. The analysis of these types of faults is often simplified by using methods such as symmetrical components.

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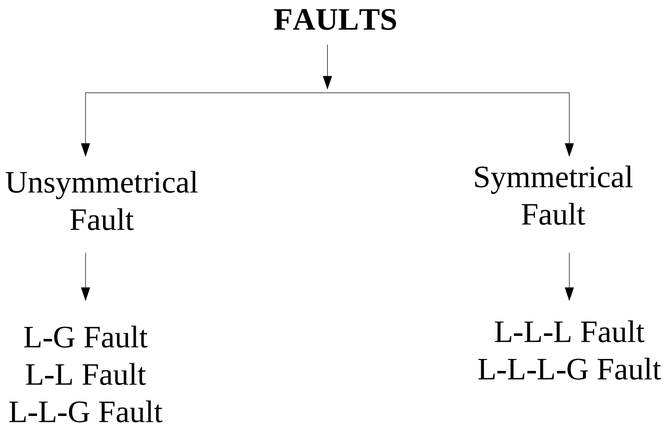
A symmetric or balanced fault affects each of the three phases equally. In transmission line faults, roughly 5% are symmetric. This is in contrast to an asymmetrical fault, where the three phases are not affected equally

An asymmetric or unbalanced fault does not affect each of the three phases equally. Common types of asymmetric faults, and their causes:

- *Line-to-line* - a short circuit between lines, caused by ionization of air, or when lines come into physical contact, for example due to a broken insulator. In transmission line faults, roughly 5% - 10% are asymmetric line-to-line faults.
- *line-to-ground* - a short circuit between one line and ground, very often caused by physical contact, for example due to lightning or other storm damage. In transmission line faults, roughly 65% - 70% are asymmetric line-to-ground faults.
- *double line-to-ground* - two lines come into contact with the ground (and each other), also commonly due to storm damage. In transmission line faults, roughly 15% - 20% are asymmetric double line-to-ground.



II. FAULT CURRENT

When a symmetrical 3-phase fault occurs at the terminals of a synchronous generator, the resulting current flow in the phases of the generator can appear as shown. The current can be represented as a transient DC component added on top of a symmetrical AC component. Before the fault, only AC voltages and currents are present, but immediately after the fault, both AC and DC currents are present.

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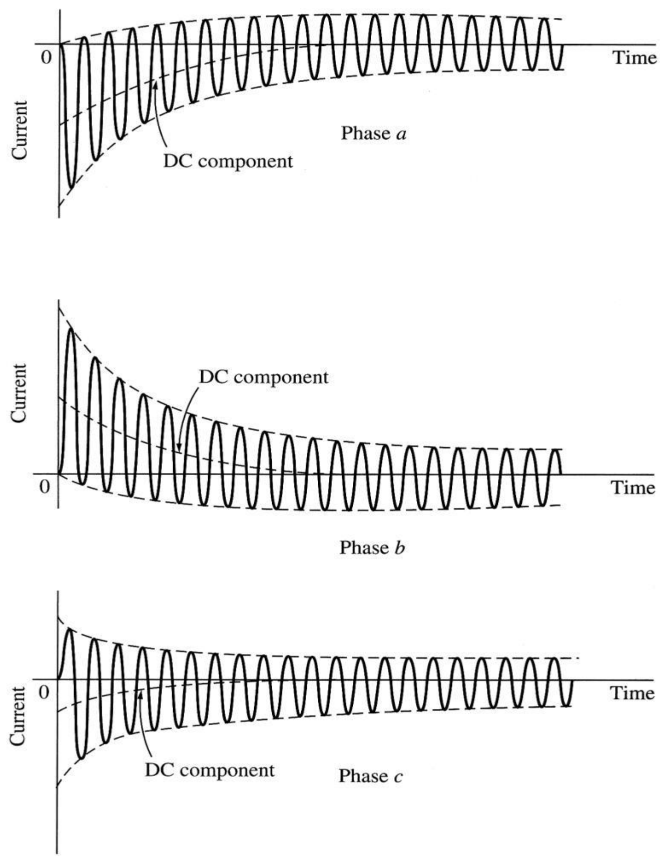

Fig. Fault current waveform in generator

III. UNSYMMETRICAL FAULT USING SYMMETRICAL COMPONENT

The method of symmetrical components provides a technology for understanding and analyzing power system operation during unbalanced conditions and it also prevents undesirable operation due to switching.

$$\begin{bmatrix} I_0 \\ I_1 \\ I_2 \end{bmatrix} = \frac{1}{3} \times \begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix} \times \begin{bmatrix} I_a \\ I_b \\ I_c \end{bmatrix}$$

Here I1, I2 and I0 denote the positive, negative and zero sequences respectively.

The concept of symmetrical components provides a practical technology for understanding and analyzing power system operation during unbalanced conditions such as those caused by faults between phases and/or ground, open phases, unbalance impedances, and so on. Also, many protective relays operate from the symmetrical component quantities. Thus an understanding of symmetrical component quantities is of great value and a very important tool in protection.

IV. PROTECTION PROVIDED

The power system maintains its steady state mainly because of the correct and quick remedial action taken by the protective relaying equipment. Transient currents due to fault and switching events are common in power system. The operation of protective relay for transient due to switching condition is undesirable. The method of symmetrical components provides a technology for understanding and analyzing power system operation during unbalanced conditions and it also prevents undesirable operation due to switching.

V.AREA OF RESEARCH

By this fault analysis we have studied that for maintaining the stability of the system the occurrence of faults due to various reasons should be reduced. The research can be done in protection side and preventing fault.

VI. CONCLUSION

Various faults on the power system reduces the stability and reliability of the power system so, great care should be taken from the various faults on the transmission line. The frequency of occurrence of fault should be reduced by providing the required protection to the power system.

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