Power System Faults: A Review

Neha Kumari, Sonam Singh, Rubi Kumari, Rupam Patel, Nutan A. Xalxo
Department of EEE
RVS College of Engineering and Technology,
Jamshedpur India

***Abstract*— Fault in a power system is an abnormal condition that involves an electrical failure of power system equipment operating at one of primary voltage within the system. This paper is a review of power system faults and their detrimental effects are also discussed. Also a classification of fault is given in brief. At last, we present some of the fault prevention techniques in a power system.**

Keywords—Power System Faults; Fault prevention

I. INTRODUCTION

The electrical power system is very large, complex and spread over a large geographical area. The electrical power system consists of a generator, transformer, transmission lines and load. A fault in a circuit is the disturbance or failure, which interfere the normal system operation.

Fault (shown in Fig.1) usually occurs in a power system due to insulation failure, flashover, physical damage such as wire blowing together in the wind, an animal coming in contact with the wire. Fault usually causes the flow of excessive current, abnormal voltages, induce overvoltage on neighboring equipment and cause hazards to human, animals, etc. Fault analysis is generally needed to select the size of circuit breaker fuse and characteristics, setting of the relay. Fuse, circuit breaker, relays, lighting power protection device are some of the fault limiting devices.

In this paper, we present a review of power system faults and their prevention methods. The organization of the paper is as follows. The next section presents the types of faults. The effects of faults are discussed in the third section. Methods for prevention of faults are discussed in the fourth section and finally in the last section the conclusions are presented..

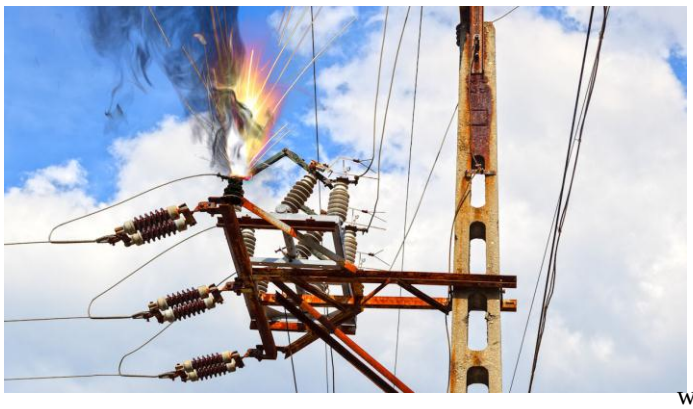

Fig 1. Fault in a transmission line

II. TYPES OF FAULTS

Faults are classified into two types, i.e. short circuit fault due to the sudden overvoltage condition also said as shunt fault and open circuit fault due to cessation of current flow and also called as a series fault. Series fault is categorized by the increase of voltage and frequency and fall in current in the faulted phase such as when system hold one or two broken lines. Further, short circuit fault is classified into two types, namely: symmetrical fault and unsymmetrical fault.

A. *Symmetrical fault*- A fault due to short circuit in all three phases is categorized as a symmetrical fault. It is the most severe fault. Generally symmetrical fault is found rarely. Roughly 5 % of all faults involve all three phases. It affects each of three phases equally.

B. *Asymmetrical fault*- It is unbalanced in nature. This fault happens due to a short circuit of phase with ground. It occurs as single line to ground fault, line to line fault, and double line to ground fault. Fig 2.b, 2.c, 2. d shows Line to ground fault, Line to line fault and double line to ground fault respectively

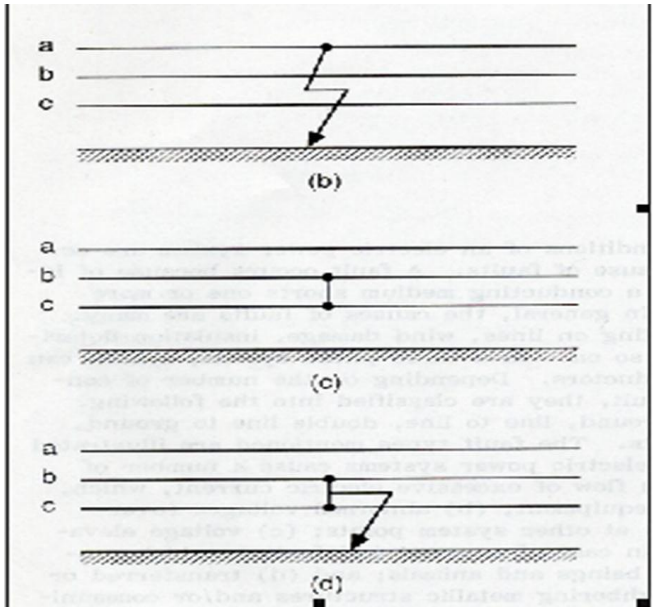

Fig. 2. Types of Faults

• *Line to ground fault*- It is the most common type of fault, which is generally caused by lightning or by conductor making contact with grounded structure. 70% of the entire fault is found due to this. It occurs by wind, falling trees, etc. For LG fault to occur, I_b=0,I_c=0 & V_a=0.

• *Line to Line fault*- If one phase touches another phase it is called as a line to line fault. It generally happens through high wind. About 15% of all transmission faults are line to line fault. For this fault to occur the condition is $I_a=0, I_b+I_c=0, V_b=V_c$.

• *Double line to ground fault*- When the two phases come in come in contact with the ground it lead to the this type of fault. It may occur through falling trees, birds etc. 10% of transmission line faults are under this type. The Boundary condition is $I_a=0, V_b=V_c=0$.

III. Effects Of Faults

The damaging effect of faults depends upon the type of fault ,as we know short circuit is the most dangerous fault as the current is maximum approximately 10 times the nominal current of instrumentation, given below is the effect:

• Due to heating by fault, electrical equipment like bus bar, generator, transformer are going to be broken & excessive heating of lines, cables may result in fire or explosion.

• Negative sequence current rises from unsymmetrical fault will result in heating.

• Stability of the power system may be adversely affected and can lead to a complete shutdown of the power system.

• Sometimes the short circuit takes the form of arc on an overhead transmission line if not quickly cleared will burn the conductor causing it to break resulting in long time interruption in supply.

• A reduction in the voltage in power system due to a fault sometimes be so large so that relays having pressure coil tends to fail.

• In an industry where we see interconnected system, when a fault develops it is followed by a fall in voltage and frequency, this may result in loads such as motor which normally takes the power from supply will start to feed or deliver the power to fault location. During the fault, induction motor and synchronous motor feed the fault.

IV. Methods to Overcome Faults

To overcome fault in the system we isolate the faulted parts from the rest of the electrical network. Many devices are introduced such as relay, Instrument transformer, circuit breaker, fuses, etc. to provide this isolation of fault. These devices are used for safety purpose, are also accurate and economical.

• *Relay*- It senses the fault and sends the command to circuit breaker for tripping unhealthy parts from healthy parts. It prevents from damages to alternator or to transform. It can handle the high power required to directly control electric motors and other load.

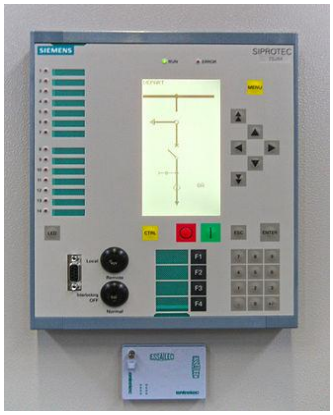

Fig. 3. Relay

• *Instrument transformer*-It includes current transformer or voltage transformer. It is used to isolate or transform voltage or current level. The most common use of this is to operate instrument or metering device from high voltage or high current circuit.

• *Circuit breaker*-It is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. It is used to detect fault condition and interrupt current flow.

V. Conclusion

From the above explanation we conclude that due to flowing of current (may be due to switching, short circuit, or lightning) a severe fault may be occur in power system which are described above and we can overcome it by knowing its cause and effect ,so that we can use protecting devices like the relay, circuit breaker, etc.

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