Nature and causes of faults

A power system fault may be defined as any condition or abnormality of the system which involves the electrical failure of primary equipment such as generators, transformers, bus bars, over headlines and cables and all other items of plant which operate at power system voltage.

Electrical failure generally implies one or the other (or both) two type of failure, namely insulation failure resulting in a short-circuit condition or conducting path failure resulting in an open-circuit condition the former being by far the more common type of failure**.**

- Over voltage due to switching
- Over voltage due to the direct and indirect lightning strokes
- Bridging of conductors by birds
- Breakdown of insulation due to less dielectric strength
- Mechanical damage to the equipments

FAULT STATISTICS

S.No.	Equipment	% of total faults
1	Overhead lines	50
2	Switchgear	15
3	Transformer	12
4	Cables	10
5	Miscellaneous	8
6	Control equipment	3
7	CTs and PTs	2

Fault current component using symmetrical components:

When the load is unbalanced, the analysis normal techniques becomes difficult.

- A balanced system of 3-phase currents having positive phase are called positive sequence components.
- A balanced system of 3-phase currents having opposite or negative phase sequence are called negative sequence components.
- A system of three currents equal in magnitude and having zero displacement are called zero sequence components
- The positive, negative and zero phase sequence components are called the symmetrical components of the original unbalanced system

Consequence of faults

- Damage to the equipment due to abnormally large and unbalanced currents and low voltages produced by the short circuits
- Explosions may occur in the equipments which have insulating oil, particularly during short circuits. This may result in fire and hazardous conditions to personnel and equipments
- Individual generators with reduced voltage in a power station or a group of generators operating at low voltage may lead to loss of synchronism, subsequently resulting in islanding.
- Risk of synchronous motors in large industrial premises falling out of step and tripping out.

Types of faults

Under normal conditions, a power system operates under balanced conditions with all equipments carrying normal load currents and the bus voltages within the prescribed limits. This condition can be disrupted due to a fault in the system. A fault in a circuit is a failure that interferes with the normal flow of current. A short circuit fault occurs when the insulation of the system fails resulting in low impedance path either between phases or phase(s) to ground. This causes excessively high currents to flow in the circuit,

requiring the operation of protective equipments to prevent damage to equipment. The short circuit faults can be classified as:

- Symmetrical faults
- Unsymmetrical faults

1.3.1 Symmetrical faults

All 3 phases are shorted to each other and to ground also.

a) Occurrence is rare.

b) Severest of all the types of faults.

c) Fault current is maximum.

Only one phase or two phases are involved.

1. Line to Ground fault (LG fault)
2. Line to Line fault (LL fault)
3. Line to Line to Ground fault (LLG fault)