

IMPORTANCE SHORT CIRCUIT (OR) FOR FAULT ANALYSIS

A fault in a circuit is any failure which interferes with the normal flow of current. The faults are associated with abnormal change in current, voltage and frequency of the power system.

Faults occur in a power system

The faults occur in a power system due to

- (i). Insulation failure of equipment
- (ii). Flashover of lines initiated by a lighting stroke
- (iii). Due to permanent damage to conductors and towers or due to accidental faulty operations.

Various types of faults

- (i) Series fault or open circuit fault

One open conductor fault

Two open conductor fault

- (ii) Shunt fault or short circuit fault.

Symmetrical fault or balanced fault

§ Three phase fault

Unsymmetrical fault or unbalanced fault

§ Line to ground (L-G) fault

§ Line to Line (L-L) fault

§ Double line to ground (L-L-G) fault

Relative frequency of occurrence of various types of fault

Types of fault	Relative frequency of occurrence of faults
Three phase fault	5%
Double line to ground fault	10%
Line to Line fault	15%
Line to ground fault	70%

Symmetrical fault or balanced three phase fault

This type of fault is defined as the simultaneous short circuit across all the three phases. It occurs infrequently, but it is the most severe type of fault encountered. Because the network is balanced, it is solved by per phase basis using Thevenin's theorem or bus impedance matrix or KVL, KCL laws.

ASSUMPTIONS IN SHORT CIRCUIT ANALYSIS

Basic assumptions in fault analysis of power systems.

- (i). Representing each machine by a constant voltage source behind proper reactance which may be X'' , X' , or X
- (ii). Pre-fault load current are neglected
- (iii). Transformer taps are assumed to be nominal
- (iv). Shunt elements in the transformers model that account for magnetizing current and core loss are neglected
- (v). A symmetric three phase power system is conducted
- (vi). Shunt capacitance and series resistance in transmission are neglected

(vii). The negative sequence impedances of alternators are assumed to be the same as their positive sequence impedance $Z_+ = Z_-$

Need for short circuit studies or fault analysis

Short circuit studies are essential in order to design or develop the protective schemes for various parts of the system. To estimate the magnitude of fault current for the proper choice of circuit breaker and protective relays.

Bolted fault or solid fault

A Fault represents a structural network change equivalent with that caused by the addition of impedance at the place of a fault. If the fault impedance is zero, the fault is referred as bolted fault or solid fault.

Reason for transients during short circuits

The faults or short circuits are associated with sudden change in currents. Most of the components of the power system have inductive property which opposes any sudden change in currents, so the faults are associated with transients.

Doubling effect

If a symmetrical fault occurs when the voltage wave is going through zero then the maximum momentary short circuit current will be double the value of maximum symmetrical short circuit current. This effect is called doubling effect.

DC off set current

The unidirectional transient component of short circuit current is called DC off set current.