Arc extinction theories

The insulating material (may be fluid or air) used in circuit breaker should serve two important functions. They are written as follows:

- It should provide sufficient insulation between the contacts when circuit breaker opens.
- It should extinguish the arc occurring between the contacts when circuit breaker opens

The second point needs more explanation. To understand this point let us consider a situation if there is some fault or short circuit in the system, the relay provides desired signals to the circuit breaker so as to prevent system from ongoing fault. Now when circuit breaker opens its contacts, due to this an arc is drawn. The arc is interrupted by suitable insulator and technique.

Methods of Arc Interruption

There are two methods by which interruption is done. High resistance method,

- Low resistance method
- Low resistance method or zero interruption method

In high interruption method we can increase the electrical resistance many times to such a high value that it forces the current to reach to zero and thus restricting the possibility of arc being restruck. Proper steps must be taken in order to ensure that the rate at which the resistance is increased or decreased is not abnormal because it may lead to generation of harmful induced voltages in the system.

The arc resistance can be increased by various methods like lengthening or cooling of the arc etc. Limitations of high resistance method: Arc discharge has a resistive nature due to this most of the energy is received by circuit breaker itself hence proper care should be taken during the manufacturing of circuit breaker like mechanical strength etc.

There are two theories which explains the phenomenon of arc extinction:

- Energy balance theory,
- Voltage race theory.

Energy Balance Theory:

When the contact of circuit breaker are about to open, restriking voltage is zero, hence generated heat would be zero and when the contacts are fully open there is infinite resistance this again make no production of heat. We can conclude from this that the maximum generated heat is lying between these two cases and can be approximated, now this theory is based on the fact that the rate of

generation of heat between the the contacts of circuit breaker is lower than the rate at which heat between the contact is dissipated. Thus if it is possible to remove the generated heat by cooling, lengthening and splitting the arc at a high rate the generation, arc can be extinguished.

Voltage Race Theory :

The arc is due to the ionisation of the gap between the contact of the circuit breaker. Thus the resistance at the initial stage is very small i.e. when the contact are closed and as the contact separates the resistance starts increasing. If we remove ions at the initial stage either by recombining them into neutral molecules or inserting insulation at a rate faster than the rate of ionisation, the arc can be interrupted. The ionisation at zero current depends on the voltage known as **restriking voltage**.