Bus-Bar Protection

When the fault occurs on the bus bars, whole of the supply is interrupted and all the healthy feeders are disconnected. The majority of the faults are single phase in nature and these faults are temporary in character. The bus zone fault occurs because of various reasons like failure of support insulators, failure of circuit breakers, foreign object accidently falling across the bus bar, etc. The clearing of a bus fault requires the opening of all the circuits branching from the faulty bus or bus section.

The most commonly used schemes for bus zone protection are:

- ✓ Backup protection
- ✓ Frame leakage protection.
- ✓ Differential Overcurrent Protection
    - Circulating current protection
    - Voltage Differential Protection

Backup protection for Bus-Bars

It is the simplest of all to protect the buses with the aid of backup protections of the connected, supplying element which should respond to any fault appearing on the buses. In the figure shown below, the bus A is covered in the second step of distance protection B. Thus in the event of a fault on bus A, the distance protection B will operate. The operating time of the second step can be of the order of 0.4 seconds.

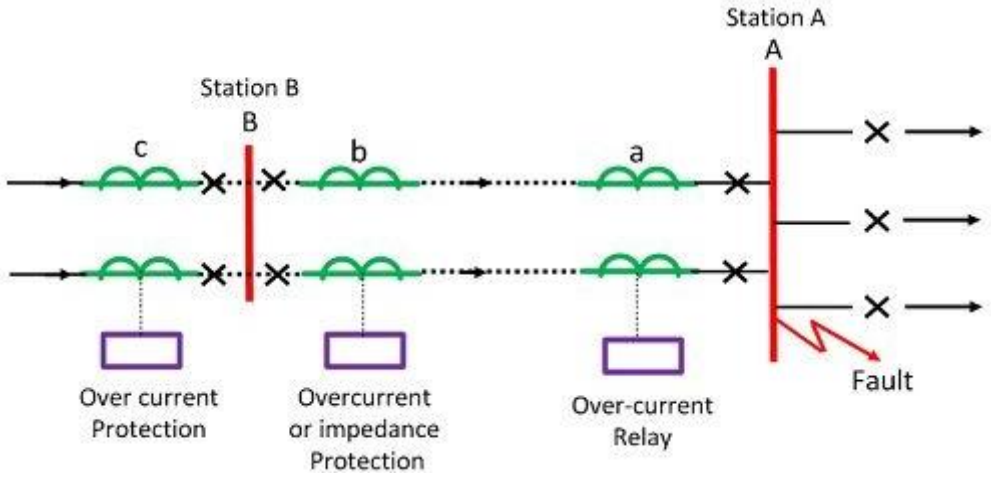

Fig: backup Protection of Bus-bars

In such a system the protection is slow, and there can be an unwanted disconnection of all incoming parallel circuits. Distance protection is widely employed for the

protection of transmission lines. Hence it is quite economical to use the same for bus protection. This scheme is quite satisfactory, for small switchgear installations, but for large and important installations a separate bus zone protection is provided.

Bus backup protection may also mean that in case the breaker fails to operate for a fault on the outgoing feeder, it must be regarded as a fault. It should then open all breakers on that bus. Such a backup protection can be provided with an appropriate time delay through a timer. Such types of protection have so many drawbacks like delayed in action, disconnection of more circuits in case there are two or more incoming lines, and exact discrimination is not possible in such types of protection.

Frame Leakage Protection

This is the simplest form of protection. This method consist of insulating the bus-supporting structure and its switchgear from the ground, interconnecting all the framework, circuit breakers tanks, etc. and provided a single ground tank connection through a CT that feeds an Overcurrent relay. The overcurrent relay controls a multi-contact auxiliary relay that trips the breakers of all circuits connected to the bus.

In such type of protection only metal supporting structure or fault-bus is grounded through a CT, secondary of which is connected to an overcurrent relay. Under normal operating condition, the relay remains inoperative, but fault involving a connection between a conductor and the ground supporting structure will result in current flow to ground through the fault bus, causing the relay to operate. The operation of the relay will trip all the breakers connecting equipment to the bus.

Differential Overcurrent Protection

Circulating Current Protection

The protection schemes are based on the simple circulating current principle that under normal operating or external fault condition the sum of current entering into a bus-bar will be equal to the sum of current leaving the bus-bar. If the sum of current is not zero, then it is because of short circuit current. Hence this type of scheme applies to both types of faults, i.e., phase-to-phase fault as well as ground fault.

Schematic diagram of bus differential protection relay is shown in the figure below. The current transformers are inserted in each phase of the incoming and outgoing feeders

of the bus bars. The secondary's of current transformers are connected in parallel with due considerations to polarity and phase.

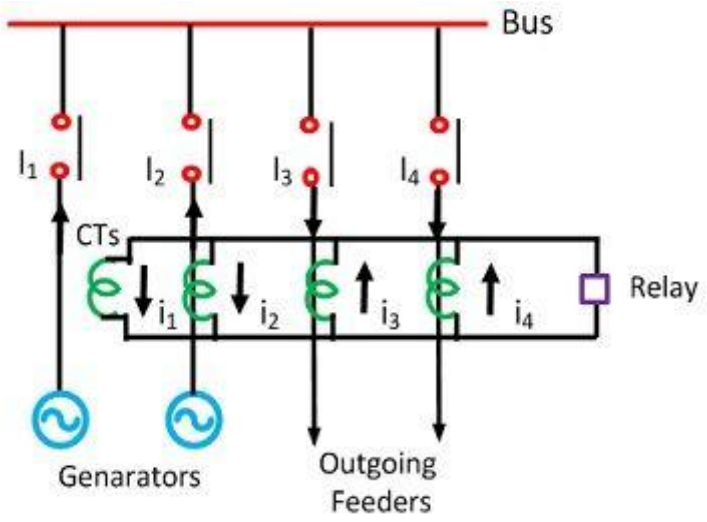

Fig: Circulating Current Protection

The relay operating coil is connected to the pilot wire in such a way that the summation current of secondary's flows through it. The flow of current in the relay is an indication of a fault within the protected zone and will initiate the opening of the breakers of each generator and feeders.

The main drawback of this scheme is that if there is any difference in the magnetic conditions of the iron cored current transformer, which may cause false operation of the relay time of an external fault.

Voltage Differential Protection Relay

In this scheme, CTS without iron cores, known as linear couplers is employed which have a much larger number of secondary turns than a core iron CT. The secondary relay of CTs is connected in series and the differential relay coil is connected across them as shown in the figure.

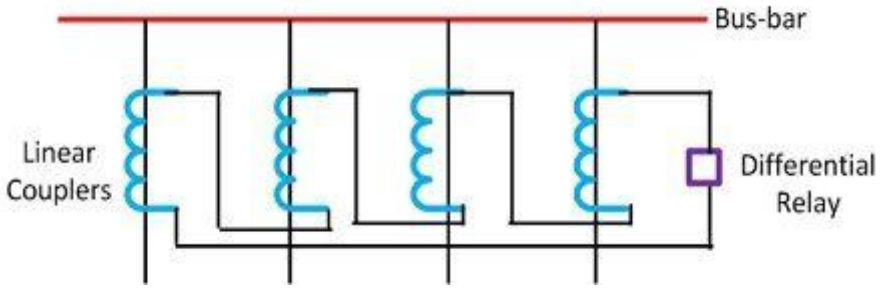

Fig: Voltage Differential Protection

Under Normal operating condition or external fault conditions, the sum of voltage induces in the secondary windings is zero. Under abnormal operating condition i.e., in the event of an internal fault on the bus bar, the voltage of the CTs in all source circuits adds to cause the flow of current through the secondary windings and the differential relay operating coil. The flow of current in the differential relay is an indication of a fault within the protected zone and will initiate the opening of the breakers of each generator and feeders. This scheme provides high protection for a relatively small net voltage in the differential current.