# Mitigation Methods II

## Electric Tap Changer

The actual tap-changer which is used in the Indian Railways locos, it will better to understand in general what tap-changers are.

The output voltage of a transformer varies according to the turn's ratio of the primary and the secondary windings of the transformer. It can appreciated that at any point of the primary or the secondary winding the voltage is different from any other point on the same winding because these points are at different ratios with respect to the other winding.

Hence each and every tap brought out from the winding gives a different voltage. Broadly tap-changers can be divided into two categories-namely off-load and on-load.

Off-load tap-changers cannot be operated while current is flowing in the circuit. Off-load tap-changers are used mainly for non-critical applications where a momentary interruption in the current can be tolerated. Hence, such tap-changers have no use in traction duty.

In traction only On-Load Tap-Changers (OLTC) are used. They are capable of changing the taps rapidly without interrupting the flow of current.

## Uninterrupted Power Supply

An **Uninterruptible Power Supply** (**UPS**), also known as an **Uninterruptible Power Source**, **Uninterruptible Power System**, **Continuous Power Supply** (**CPS**) or a **battery backup** is a device which maintains a continuous supply of electric power to connected equipment by supplying power from a separate source when utility power is not available. There are two distinct types of UPS: off-line and line-interactive (also called on-line).

An off-line UPS remains idle until a power failure occurs, and then switches from utility power to its own power source, almost instantaneously. An on-line UPS continuously powers the protected load from its reserves (usually lead-acid batteries or stored kinetic energy), while simultaneously replenishing the reserves from the AC power.

The on-line type of UPS, in addition to providing protection against complete failure of the utility supply, provides protection against all common power problems, and for this reason it is also known as a power conditioner and a line conditioner.

## On-line UPS

Figure 2.10 shows a typical configuration of an on-line UPS. In this design, the load is always fed through the UPS. The incoming ac power is rectified into dc power, which charges a bank of batteries. This dc power is then inverted back into ac power, to feed the load. If the incoming ac power fails, the inverter is fed from the batteries and continues to supply the load. In addition to providing ride-through for power outages, an on-line UPS provides very high isolation of the critical load from all power line disturbances. However, the on-line operation increases the losses and may be unnecessary for protection of many loads.

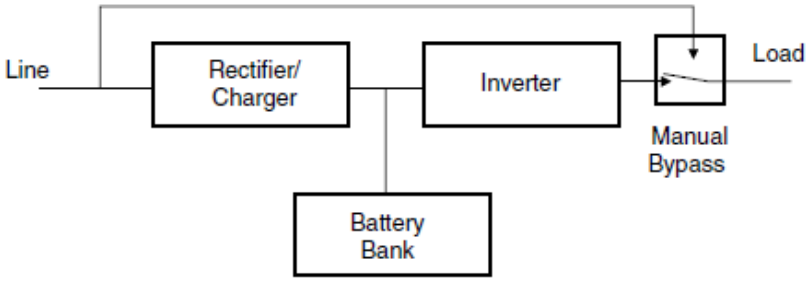


**Figure 2.10** On-line UPS

## Standby UPS

A standby power supply (Fig. 2.11) is sometimes termed *off-line UPS* since the normal line power is used to power the equipment until a disturbance is detected and a switch transfers the load to the battery backed inverter. The transfer time from the normal source to the battery backed inverter is important. The CBEMA curve shows that 8 ms is the lower limit on interruption through for power-conscious manufacturers.

Therefore a transfer time of 4 ms would ensure continuity of operation for the critical load. A standby power supply does not typically provide any transient protection or voltage regulation

as does an on-line UPS. This is the most common configuration for commodity UPS units available at retail stores for protection of small computer loads.

UPS specifications include kilovolt ampere capacity, dynamic and static voltage regulation, harmonic distortion of the input current and output voltage, surge protection, and noise attenuation. The specifications should indicate, or the supplier should furnish, the test conditions under which the specifications are valid.

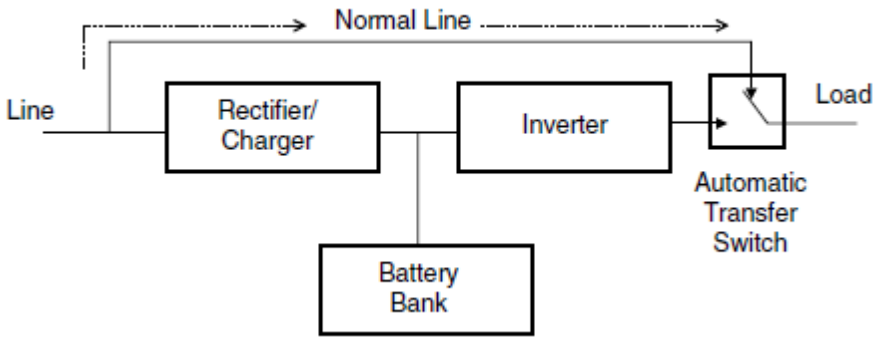


**Figure 2.11** Standby UPS

**Hybrid UPS**

Similar in design to the standby UPS, the hybrid UPS (Fig. 2.12) utilizes a voltage regulator on the UPS output to provide regulation to the load and momentary ride-through when the transfer from normal to UPS supply is made.

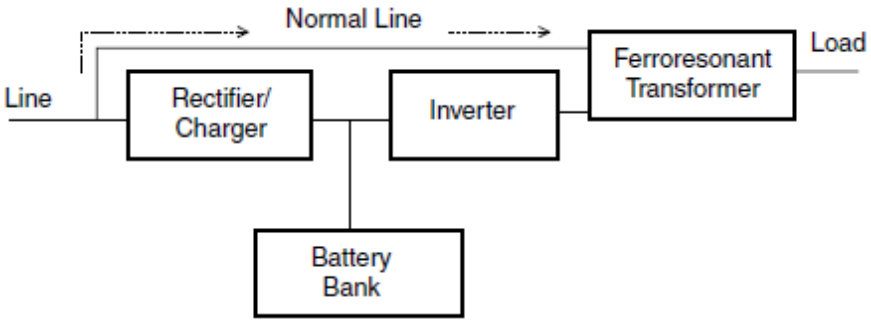


**Figure 2.12** Hybrid UPS

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