UPS Topologies as defined by the IEEE

5.5.3.1 Double-conversion systems

Double-conversion systems are characterized by their topology. In these systems, the incoming line is first converted to dc. The dc then provides input power to a dc-to-ac converter (i.e., an inverter). The inverter output is ac, which is used to power the critical load. Many different types of inverters are used, each employing a variant of available technology. (Note that the recently revised NEMA PE 1-1993 [B23], identifies the double-conversion system as a "rectifier-inverter.")

Historically, the double-conversion UPS has found the most prominence in the industry. The double-conversion UPS system has been available for many years and has proven to be reliable when operated within its design limits. This type of system is the static electrical equivalent to the motor-generator set. The battery is connected in parallel with the dc input to the inverter, and provides continuous power to it any time the incoming line is outside of its specification or fails. Switching to the battery is automatic, with no break in either the input to the inverter or the output from it.

The double-conversion system has several advantages:

- It provides excellent frequency stability.
- There is a high degree of isolation from variations in incoming line voltage and frequency.
- A zero transfer time is possible.
- Operation is relatively quiet.
- Some systems can provide a sinusoidal output waveform with low distortion.

In the lower power UPS applications (0.1-20 kW), the double-conversion UPS has the following disadvantages. (Many of these disadvantages can be minimized if the system is carefully specified to use the latest topologies.)

- There is lower overall efficiency.
- A large dc power supply is required (typically, 1.5 times the full rated load rating of the UPS).
- Noise isolation line to load can be poor.
- There is greater heat dissipation, which may effect the service life of the UPS.

In addition, if the inverter is the pulse width modulated type, the high-frequency circuitry may produce electromagnetic interference (EMI). This may require special filtering and shielding to protect sensitive equipment from radiated and conducted interference. The double-conversion UPS may also produce excessive battery ripple current, possibly resulting in reduced battery life (see IEEE Std 1184-1994).

5.5.3.2 Single-conversion systems

Single-conversion UPS systems are those in which, during normal operation, the incoming line is used to provide power to the critical load either through a transformer or in conjunction with some series impedance. Some forms of single-conversion UPS products are classified as "line-interactive" (see 5.5.3.2.1). The single-conversion UPS usually provides a higher operating efficiency at lower cost than the double-conversion UPS at a comparable system reliability. (Note that the recently revised NEMA PE 1-1993 [B23], identifies the single-conversion system as a "single-conversion converter.")

Unlike the double-conversion system, the incoming line to the single-conversion UPS is not rectified to produce dc power to provide input to the inverter. The normal ac power is supplied directly to the critical load through a series inductor or a linear or ferroresonant transformer. The normal ac also supplies a small charger used to maintain the UPS batteries in a fully charged condition. Thus the battery is only used when inverter requires the battery's output to supplement or replace the normal power source. Single-conversion UPSs include the ferroresonant type, some variants of the tri-port type, line interactive types, and some SPS designs.