3.1 Supply Distribution Systems

Parameters Of Electricity Supply Systems:

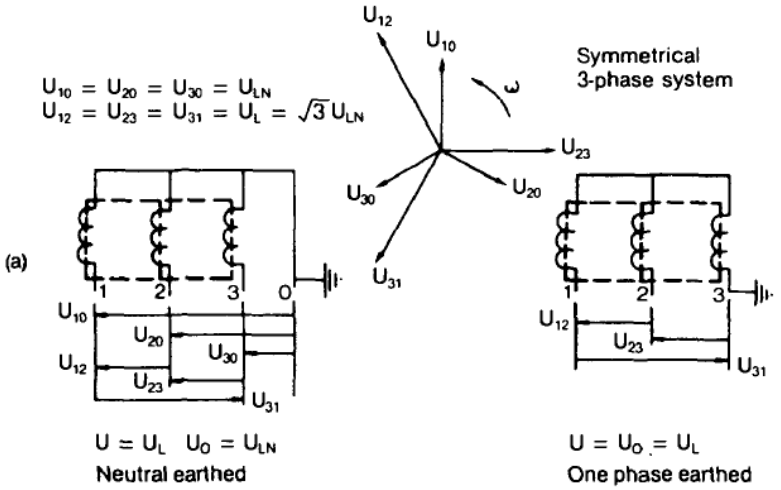
In the development of early electricity supply systems, many direct and alternating voltages, In the development of early electricity supply systems, many direct and alternating voltages, frequencies, phase numbers and connections were used to achieve the most economical use of capital, but the arrangements discussed below have become predominant in modern systems.

Frequencies and phase numbers:

- A symmetrical 3-phase a.c. system with an earthed neutral and a frequency of 50 Hz or 60 Hz is now used almost universally for main power distribution systems
- Alternating current may be generated without a commutator and transformed to higher or lower voltages by static transformers.
- A 3-phase winding makes efficient use of the armatures of cylindrical machines and of the cores of transformers.
- In a symmetrical 3-phase system the phases are mutually displaced by the same angle,120 °, and the magnitudes of the voltages between the phases are all equal, as are the magnitudes of the voltages between the phases and the neutral.
- A 3-phase supply will excite a magnetic field rotating in a definite direction which is easily reversed.
- The voltage applied to a symmetrical load that is normally connected in delta may be reduced by connecting it in star without the use of a neutral conductor.
- A frequency of 50Hz or 60Hz relates well to the normal speeds of mechanical drives and is high enough to prevent discernible flicker from electric lamps and low enough to avoid undue interference with telecommunications equipment.
- A 3-phase system with loads connected between phase and neutral may be supplied from a 3-phase system without a neutral conductor by the use of a transformer with a star-connected secondary winding.
- single-phase system may be supplied from a transformer connected between two phases of a 3-phase system.

Single-pole-and-neutral system:

In the UK isolated low voltage single-pole-and-neutral systems are used where the total demand is less than 50 kV A and a small number of single-phase loads would be difficult to balance between three phases.



Voltage relationships of some systems currently in use and diagrams showing the arrangements and connections of the secondary windings of the in feeding transformers. The heavy broken lines represent the magnetic cores

Centre-point-earthed single-phase system:

Some systems have two live conductors carrying potentials relative to an earthed neutral that are in phase opposition to each other, If a neutral conductor is provided, the current from loads connected between opposite poles and the neutral will tend to cancel in the neutral, as in the 3-phase system.
Such a system may be supplied from a centre tapped winding on a single-phase transformer

Importance of the neutral conductor:

In all the systems using a neutral conductor to give supply to single-phase loads, its integrity is essential to prevent excessive voltages from being applied to the loads on the less heavily loaded phases.

Cable Networks:

In underground distribution systems, the lower limit of the range of conductor size S that may be used at each voltage level is set by the short-circuit current 1 that could flow and the total operating times T of the protection and switchgear in the approximate relationship S = kI~/T. The result is that a mat of cables in a small range of sizes is operating at each voltage level in most urban and industrial areas.

The cables operating at each voltage level can be arranged into a contiguous network of distributing interconnectors connecting substations that feed in from a higher voltage as well as

feeding loads directly or through transformers stepping down to a lower voltage network.