

DISTRIBUTION SYSTEMS

The electrical energy produced at the generating station is conveyed to the consumers through a network of transmission and distribution systems. It is often difficult to draw a line between the transmission and distribution systems of a large power system. It is impossible to distinguish the two merely by their voltage because what was considered as a high voltage a few years ago is now considered as a low voltage. In general, distribution system is that part of power system which distributes power to the consumers for utilization.

The transmission and distribution systems are similar to man's circulatory system. The transmission system may be compared with arteries in the human body and distribution system with capillaries. They serve the same purpose of the ultimate consumer in the city with the life-giving blood of civilization—electricity. In this chapter, we shall confine our attention to the

general introduction to distribution.

Distribution System

That part of power system which distributes electric power for local use is known as distribution system. In general, the distribution system is the electrical system between the substation fed by the Transmission system and the consumer's meters. It generally consists of feeders, distributors, and service mains. Fig. 12.1 shows the single line diagram of a typical low tension distribution system.

i) Feeders

A feeder is a conductor which connects the sub-station (or localized generating station) to the area where power is to be distributed. Generally, no tappings are taken from the feeder so that current in it remains the same throughout. The main consideration in the design of a feeder is the current carrying capacity.

(ii) Distributor

A distributor is a conductor from which tappings are taken for supply to the consumers. In Fig. AB, BC, CD and DA are the distributors. The current through a distributor is not constant because tappings are taken at various places along its length. While designing a distributor, voltage drop along its length is the main consideration since the statutory limit of voltage variations is $\pm 6\%$ of rated value at the consumers' terminals.

(iii) Service mains

A service mains is generally a small cable which connects the distributor to the consumers' terminals.

CLASSIFICATION OF DISTRIBUTION SYSTEMS

A distribution system may be classified according to ;

i) Nature of current

According to nature of current, distribution system may be classified as

- (a) d.c. Distribution system
- (b) a.c. Distribution system

Now-a-days, a.c. system is universally adopted for distribution of electric power as it is simpler and more economical than direct current method

ii) Type of construction

According to type of construction distribution system may be classified as

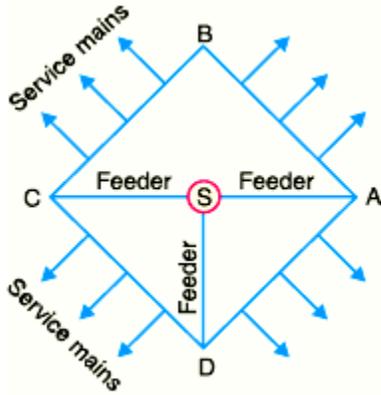
- (a) Overhead system
- (b) Underground system.

The overhead system is generally employed for distribution as it is 5 to 10 times cheaper than the equivalent underground system. In general, the underground system is used at places where overhead construction is impracticable or prohibited by the local laws

(iii) Scheme of connection

According to scheme of connection, the distribution system may be classified as

- (a) Radial system
- (b) Ring main system
- (c) Inter-connected system



AC DISTRIBUTION

Now-a-days electrical energy is generated, transmitted and distributed in the form of alternating current. One important reason for the widespread use of alternating current in preference to direct current is the fact that alternating voltage can be conveniently changed in magnitude by means of a transformer. Transformer has made it possible to transmit a.c. power at high voltage and utilise it at a safe potential. High transmission and distribution voltages have greatly reduced the current in the conductors and the resulting line losses.

There is no definite line between transmission and distribution according to voltage or bulk capacity. However, in general, the a.c. distribution system is the electrical system between the

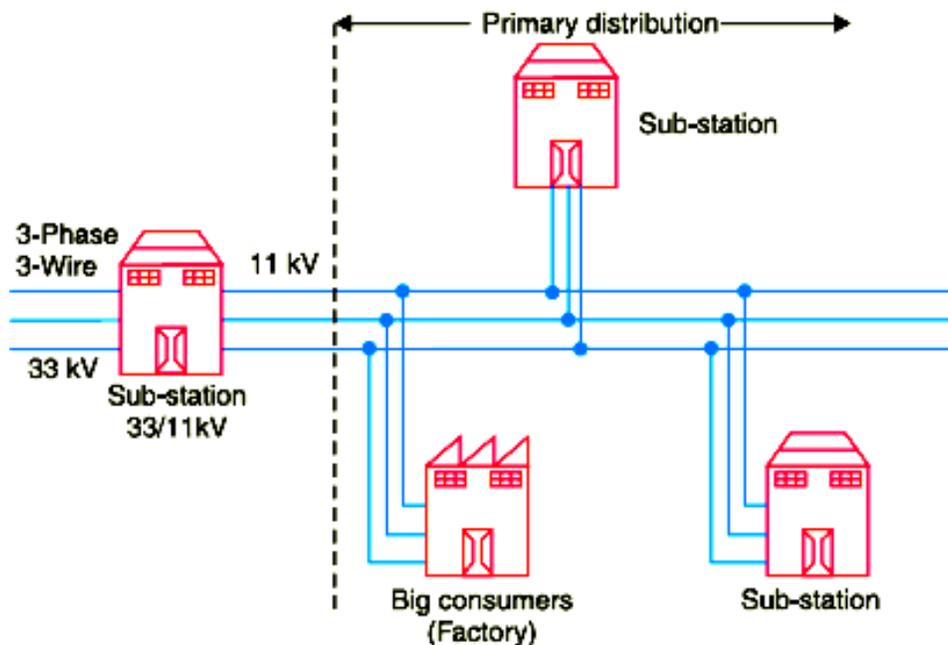
step- down substation fed by the transmission system and the consumers' meters. The a.c. distribution system is classified into

- i. primary distribution system and
- ii. Secondary distribution system.

i) Primary distribution system.

It is that part of a.c. distribution system which operates at voltages somewhat higher than general utilization and handles large blocks of electrical energy than the average low- voltage consumer uses. The voltage used for primary distribution depends upon the amount of power to be conveyed and the distance of the substation required to be fed. The most commonly used primary distribution voltages are 11 kV, 6.6 kV and 3.3 kV.

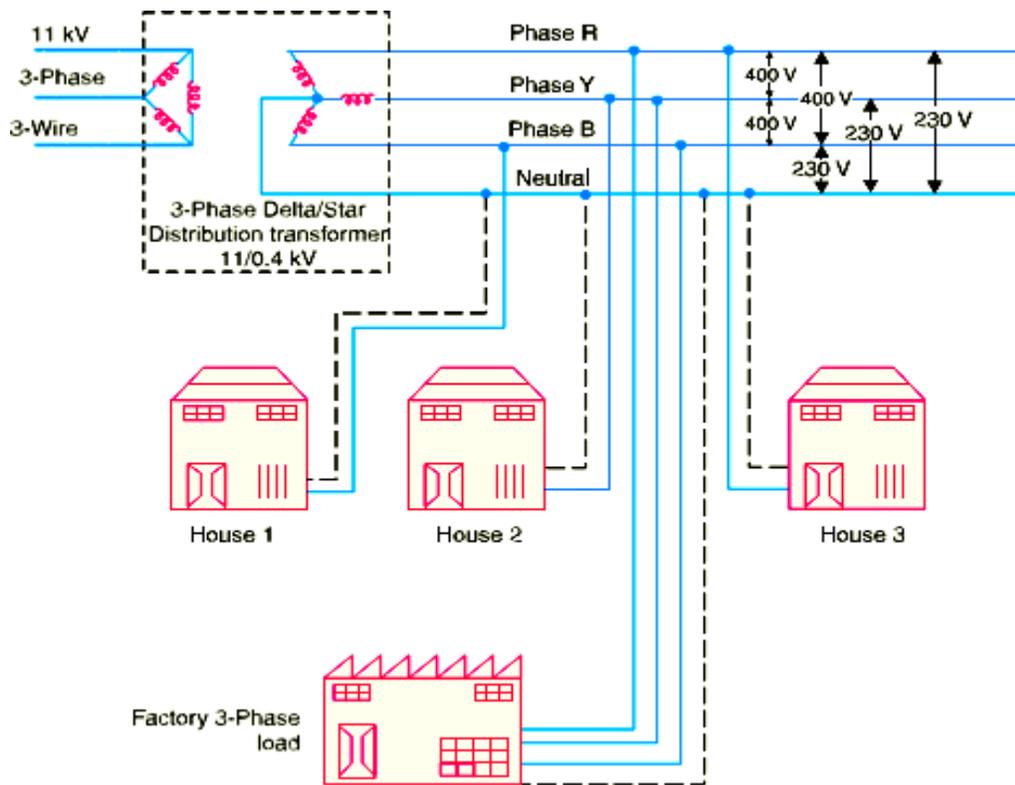
Due to economic considerations, primary distribution is carried out by 3- phase, 3-wire system Fig. shows a typical primary distribution system Electric power from the generating station is transmitted at high voltage to the substation located in or near the city.



ii) Secondary distribution system

It is that part of a.c. distribution system. These secondary distribution employs 400/230V, 3- phase, 4 wire system. Fig shows a typical secondary distribution system. The primary distribution circuit delivers power to various substations, called distribution sub-stations. The substations are situated near the consumers' localities and contain step-down transformers. At each distribution substation, the voltage is stepped down to

400V and power is delivered by 3-phase, 4-wire a.c. system. The voltage between any two phases is 400V and between any phase and neutral is 230V. The single phase domestic loads are reconnected between any one phase and the neutral, whereas 3-phase 400V motor loads are reconnected across 3-phase lines directly.



D.C. DISTRIBUTION

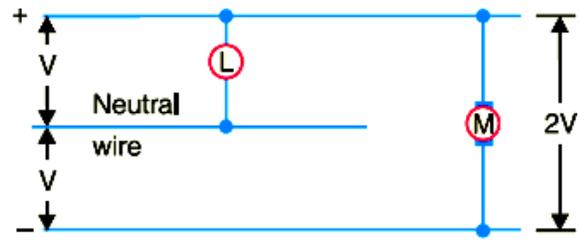
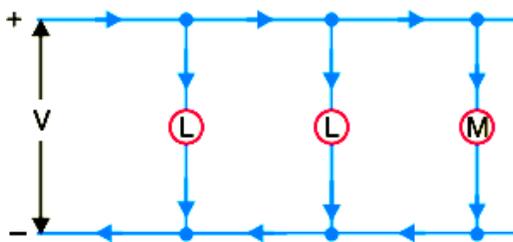
It is a common knowledge that electric power is almost exclusively generated, transmitted and distributed as a.c. However, for certain applications, d.c. supply is absolutely necessary. For instance, d.c. supply is required for the operation of variable speed machinery (d.c. motors), for electro-chemical work and for congested areas where storage battery reserves are necessary. For this purpose, a.c. power is converted into d.c. power at the substation by using converting machinery e.g., mercury arc rectifiers, rotary converters and motor-generator sets.

The d.c. supply from the substation may be obtained in the form of (i) 2-wire

(ii) 3-wire for distribution.

(i) 2-wire d.c. system.

As the name implies, this system of distribution consists of two wires. One is the outgoing or positive wire and the other is the return or negative wire. The loads such as lamps, motors etc. are connected in parallel between the two wires as shown in Fig. 12.4. This system is never used for transmission purposes due to low efficiency but may be employed for distribution of d.c. power.



*

(ii) 3-wire d.c. system.

It consists of two outers and a middle or neutral wire which is earthed at the substation. The voltage between the outers is twice the voltage between either outer and neutral wire as shown in Fig. 12.5. The principal advantage of this system is that it makes available two voltages at the consumer terminals viz., V between any outer and the neutral and $2V$ between the outers. Loads requiring high voltage (e.g., motors) are connected across the outers, whereas lamps and heating circuits requiring less voltage are connected between either outer and the neutral.