Chapter 1

Power transmission and distribution

All the strength and succour you want is within your selves. **Swami Vivekananda**

Learning Objectives

In our everyday life, alternating current (AC) and direct current (DC) supply play a vital role and are more important to study the applications of these supplies. This lesson has dealt with the methods of power supply for both AC and DC power transmission and distribution, advantages and disadvantages. Students will learn how electricity is transmitted from one place to another.

Table of Content

1.1 Introduction

Planning of the power distribution is one of the most important components of power system. Sub transmission is the efficient and economical method of power between power distribution and transmission. The power is transmitted through the overhead line distribution system and underground cable. These types of transmission have their own electrical properties and have significant effects during power distribution.

In this chapter, the properties of various types of electrical power stages are specifically explained as high voltage and low voltage transmission, overhead transmission and underground cables. From this lesson, various types of poles, insulators, and protective devices are explained clearly.

1.2 Power transmission

Electrical Power transmission is one of the major concerns in the power supply system. There are three main areas of power system. They are power generation, transmission and distribution. Transmission is done by

i. Overhead lines
ii. Underground cables

1.2.1 Power generation station

Electricity is produced in power plants, which goes through different levels to reach consumers. Generated power is stepped up and stepped down by using transformers and it is transmitted. In Tamil Nadu, power plants are far from consumers who use power. For example, the important places of power plants are located at Kalpakkam, Koodankulam (Nuclear power station), Neyveli (Thermal power station), Bhavani sagar Dam, Pykara, Kunda Dam (Water power station) and Kamuti (Solar power station) etc, The generated power is distributed to the consumers through the substations.

1.2.2 Various system of power transmission

i. DC system
   a) DC two wire
   b) DC two wire with mid point earthed
   c) DC three wire system
ii. Single phase AC system
   a) Single phase two wire
   b) Single phase two wire with midpoint earthed
   c) Single phase three wire

iii. Three phase AC system
   a) Three phase three wires
   b) Three phase four wires

1.3 Direct Transmission

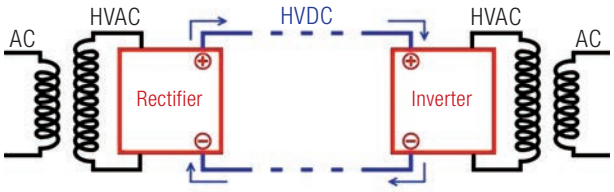

Fig. 1.1 Schematic diagram of DC transmission

Let us see the transmission of DC power from the AC power.

The single line diagram of high voltage direct current transmission is given in figure 1.1. Alternative current is generated and stepped up to high voltage through the sending end transformer. This high voltage alternating current is converted to the direct current by a mercury arc rectifier. The transmission of electric power is carried out at high DC voltage. At the receiving end, the DC voltage is converted into alternating current through the help of thyratrons. This alternating current is reduced to the low voltage through the receiving end transformer for distribution.

1.3.1 Advantages of DC transmission

i. Two conductors are sufficient for distribution of power supply
ii. There is no inductance and capacitance.
iii. No skin effect in DC transmission lines.
iv. The corona loss is lower as compared to AC system.
v. Voltage drop is very low.

1.3.2 Disadvantages of DC transmission

i. It is difficult to produce high voltage
ii. The voltage cannot be increased or decreased by using a transformer

1.4 Alternative transmission

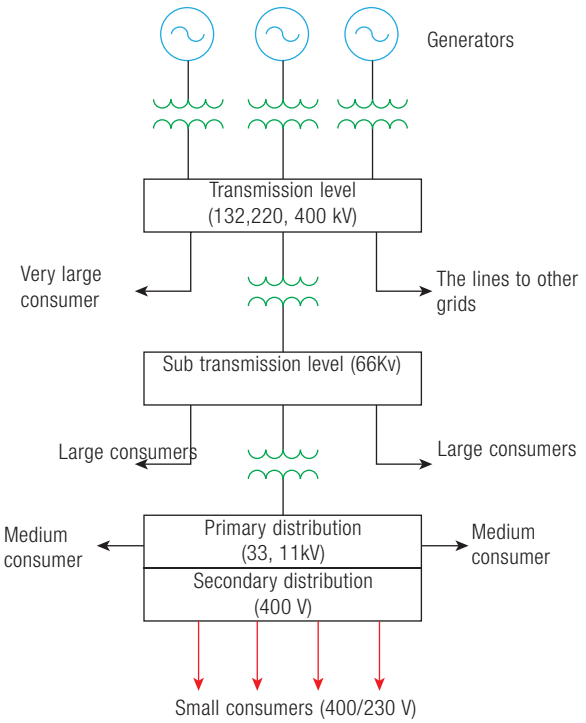

Fig. 1.2 AC power supply system

From the power generating stations, a large amount of AC supply is produced and is transmitted through transmission lines. Figure 1.2 shows the layout of a typical AC power supply system. The transmission is done caried by 3 phase 3 wire and 3 phase 4 wire systems. Other methods are also used for some special reasons.

Two types of transmission are

i. Primary transmission and
ii. Secondary transmission

1.4.1 Primary transmission

In the primary transmission, the voltage produced from power plants, transmitted over the transmission lines to the substations with the help of step up transformer.

1.4.2 Secondary transmission

The voltage transmitted by the primary transmission is reduced by a step down transformer, and is transmitted to the sub-stations in the city.

1.4.3 Advantages of AC transmission

i. Alternate current can produce voltage (33 KV) at the highest level.
ii. The voltage can be increased or decreased.
iii. High voltage transmission reduces losses.
iv. It is easy to maintain sub-stations and less expensive.

1.4.4 Disadvantages of AC transmission

i. The AC line has the capactive and inductive effect.
ii. Due to skin effect, it requires more effective conductors.
iii. The construction of AC transmission is complicated.
iv. More copper conductors are required for transmitting AC.

1.5 Overhead line transmission

The overhead lines are used to transmit electricity from power plants to consumers. A network of electrical power lines are used to transmit the electricity over a geographic area is called power grid.

1.5.1 Main components used in overhead lines

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i. Electric conductors
ii. Poles and towers
iii. Insulators
iv. Cross arm that holds electrical insulation materials
v. Transformer, lightning arrester, blocking barriers to the pole, and circuit breakers

Do you Know?

The voltage occurs when the solar light on the system with two semi conductors. Photons are absorbed in solar light when sunlight shines in one semi-conductor. Thus the electrons are energized and move to another semi-conductor. A small voltage is produced between two semi-conductors. This is called Solar cell.

1.5.2 Transmission line conductors

Electric power is transmitted from power plant to the load (consumers) through conductors. Copper, aluminum, steel, Aluminum Conductor with Steel Reinforced (ACSR), and cadmium copper are invariably used for transmission line conductors.

1.5.3 Properties of conductors

i. High electrical conductivity
ii. High tensile strength
iii. Low cost
iv. Less weight

The properties of copper and aluminium conductors are discussed below.

a) Copper

Copper is used to transmit large quantity of electricity from one place to another. Hard-drawn copper is often used for power transmission, because it is twice as strong as soft drawn copper. Hard drawn has a high conductivity. Lesser cross-sectional area of conductor is reduced, because the current density of copper is high. It has low specific resistance. Its life is very long.

b) Aluminium

Aluminium conductor is next to copper in its conductivity. It is cheaper than copper and lighter in weight. But conductivity of aluminium is 60% as that of copper. Its diameter is about 1.27 times thicker than that of copper. The melting point of aluminium conductor is less. Hence it creates short circuit.

c) ACSR (Aluminium Conductor with Steel Reinforced)

Fig. 1.3 **ACSR conductor**

An aluminium conductor having a central core of galvanized steel wires is used for high voltage transmission purposes as shown in figure 1.3. This conductor is mostly used for power transmission because, it has less sag and high tensile strength of steel and conductivity of aluminium.

1.6 Types of poles

Line supports or the poles which hold the conductors to a height they are above the ground level. In general, four types of poles are used, depending on the size and shape of the conductor used.

i. Wooden poles
ii. Concrete poles
iii. Tubular steel poles
iv. Latticed steel tower

i. Wooden poles

Fig. 1.4 **Wooden poles**

Figure 1.4 shows the wooden pole structure used for LV transmission lines. The limitations of wooden poles are that they must be straight, strong with gradual tapper and free from knots. These poles are cheap. Some portion of the pole below the ground level is impregnated with preservative compounds like creosote oil. These poles are suitable for shorter spans between 40 m to 50 m and voltage level of 11 KV.

ii. Concrete poles

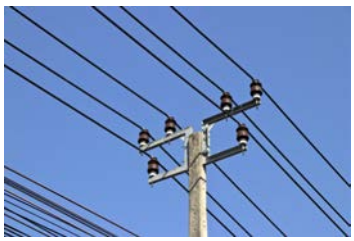

Fig. 1.5 Concrete pole

The concrete poles are strong and reinforced with iron rods and it is shown in figure 1.5. They have high mechanical strength, long life, durability and working conditions. These poles are used for longer spans (80 m to 100 m). The maintenance cost is very low. These types of poles are used to transmit up to 33 KV.

iii. Tubular steel poles

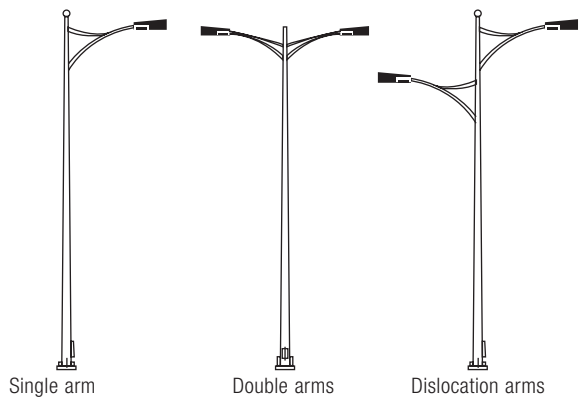

Fig. 1.6 Tubular poles

The iron tubular pipe is shown in Figure 1.6. This structure is stronger than the concrete pole. The poles are coated with zinc plating. In the same tube, more than one pipe is plugged or attached. Since the tube is circular shape, the air pressure attack is less than the concrete pole. These types of poles are required to be earthed. These are suitable for low voltage areas such as street lighting. This type of pole is suitable for the span between 50 m to 80 m.

iv. Latticed steel tower

Fig. 1.7 Latticed steel tower

A Latticed steel tower is shown in figure 1.7. These are designed to be of greater strength and longer life. The purpose of this tower is to carry a high voltage through the conductor to a long distance of high level. The span of the tower is 100m to 300m.

1.7 Effects of transmission

1.7.1 Skin effect

When an alternating current flows through a conductor, a flux will be produced in it. This flux will be higher at the center of the conductor than outer

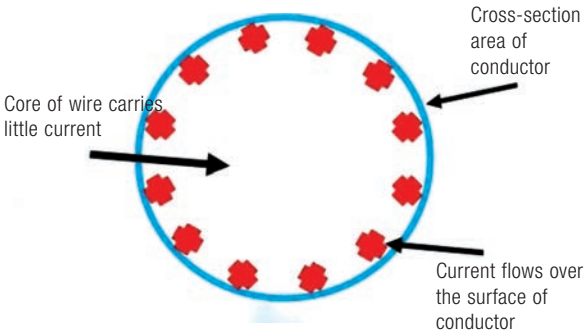

Fig. 1.8 **Skin effect**

surface. The high reactance of center area causes the alternating current to flow near the surface of the conductor. This is called skin effect. Due to skin effect, the effective area of cross-section of the conductor through which current flow is reduced. When the diameter of the wire is increased, skin effect will also increase.

1.7.2 Corona

Fig. 1.9 **Corona**

When an alternating voltage is applied across two conductors, whose space is large in comparison with the diameter, the atmospheric air is subjected to electrostatic stresses. So, a faint luminous bluish glow appears to the conductors. This bluish discharge is known as corona.

a. Factors affecting corona

i. Atmosphere
ii. Size of conductor
iii. Spacing between conductors
iv. Line voltage

b. Advantages of corona

i. Due to corona formation, the air surrounding the conductor becomes conducted and hence virtual diameter of the conductor is increased. Due to this, the static voltage between conductors is reduced.
ii. Corona reduces the effect of transient produced by surges.

c. Disadvantages of corona

i. The corona is accompanied by power loss. This affects the transmission efficiency of the line.
ii. Ozone is produced by corona. The conductor may corrode due to chemical action of ozone.
iii. The inductive current interferes with the nearby telecommunication transmitters.
iv. Most of the areas where the dirty and rag in the conductor, the light is produced.
v. When corona occurs, charging current increases due to the harmonic current.

1.8 Types of overhead lines

The transmission line has three parameters, resistance, inductance and capacitance distributed uniformly along the whole length of the line. The resistance and inductance forms series impedance. The capacitance existing between conductor for single phase line and a conductor, to

neutralize the three-phase line, forms a shunt path through the length of the line. Therefore, capacitance effects introduce complications in transmission line calculations.

The overhead transmission lines are classified as

i. Short transmission lines
ii. Medium transmission lines
iii. Long transmission lines

i. Short transmission lines

When the length of an overhead transmission line is about 50 metres and line voltage about 20 KV is usually called as a short transmission line. Due to smaller length and low voltage, the capacitance effects are small. The total resistance and inductance are assumed to be at one point for calculation purpose.

ii. Medium transmission lines

When the length of an overhead transmission line is to a span of 50 m to 150 m and line voltage 20 KV to 100 KV. It is usually called as a medium transmission line. Due to sufficient length and voltage of the line, the capacitance effects are taken into account. For the purpose of calculation, the distributed capacitance of the line is divided in the form of condensers shunted across the line at one or more points.

iii. Long transmission lines

The length of an overhead transmission line is more than 150 metres and line voltage is 100 KV, it is called as a long transmission line.

1.8.1 Guarding

Low, medium and high voltage conductors are caused by natural disasters, such as rain or storm which cause electrical accidents. This accident causes damage to life. If a live conductor is cut down, the earthed cradle part is used to hold the conductor and protects lives. This part is called as guarding. When the conductor touches the guarding, the circuit breaker automatically disconnects the supply.

Types of guarding

i. Cradle guarding
ii. Cage guarding

1.9 Line insulators

The overhead line conductors should be supported with the poles or towers by means of insulators. These insulators act as supports in order to avoid any leakage of current from the conductor to earth.

1.9.1 Properties of insulators

Here are some of the properties of line insulators

i. Mechanical strength should be very high.
ii. Its dielectric strength should be very high.
iii. Insulators must be free from internal defects such as impurities to leakage current.
iv. Electrical insulation value of resistance must be high.
v. Environmental conditions should not be affected.
vi. Do not have porous.
vii. Price should be cheaper.

1.9.2 Line insulator materials

Porcelain, glass, magnesium silicate etc. are used to produce line insulators. The porcelain is used to produce the insulating material. It is made by suitable heat in combination with plastic, white clay and glass. It is also made with good stability and smooth surface and free from porosity.

1.9.3 Types of insulators

i. Pin type insulator
ii. Suspension insulators
    a. Hewlett suspension type
    b. Cemented cap type
    c. Core and link type
iii. Strain insulator
iv. Shackle insulator
v. Stay type insulator

i. Pin type insulator

Fig. 1.10 **Pin type insulator**

This type of insulator is fixed in the crossing arm of the pole as shown in figure 1.10. The conductor is placed in the top of semicircular groove and the conductor is placed on it. This type of insulator is used to capture straight conductors

ii. Suspension insulators

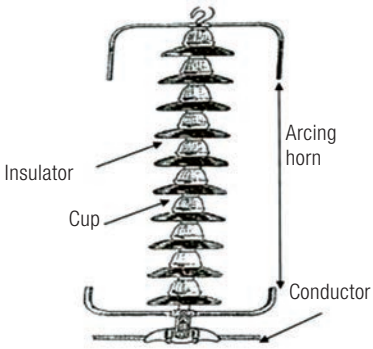

Fig. 1.11 **Suspension type insulator**

The suspension type line insulator is shown in figure 1.11. This insulator is in hanging shape and is connected to the steel tower. The line conductor is connected in the base. In suspension type insulator, a number of similar units are connected one by one with bi-metallic links. Each suspension insulator is designed for 11KV. Therefore, by connecting a number of such insulator discs, a string of insulator can be designed for any required voltage.

a. Hewlett type

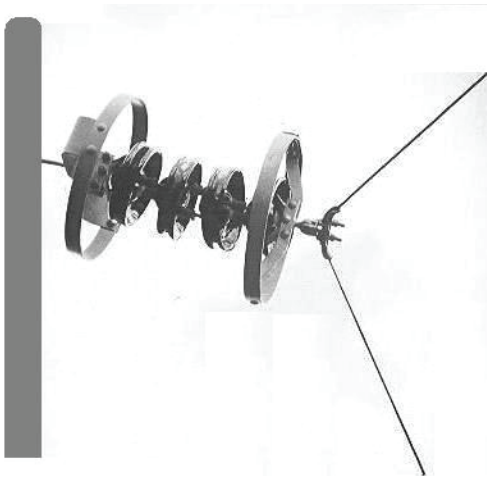

Fig. 1.12 **Hewlett type insulator**

The Hewlett type line insulator is shown in figure 1.12. The insulator part

is made up of porcelain material. In the middle of the structure, a U shaped groove is provided. Using metal connectivity on it, more than one circular plates are connected through the screws. If the insulator is broken the conductor does not fall down.

b. Cemented cap type

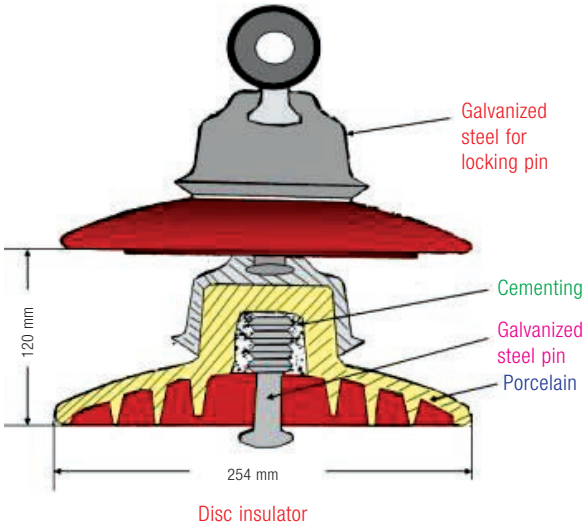

Fig. 1.13 Cemented cap type insulator

Cemented cap type insulator is shown in figure 1.13.This insulator unit is made up of porcelain. The galvanized cast iron cap is cemented to the top. A steel screw is cemented to the cavity at the bottom. The other end of the steel screw is placed in the ball shape to fit into the pit in the back of the iron cap.

c) Core and link type

It is a combination of both the above two types of suspension insulators. It is better than the above two types. In this type, porcelain discs are placed symmetrically. The metallic cylinder is pressed and tied to the fringe circular of porcelain plate. This type of insulators are unaffected by temperature.

iii. Strain type insulators

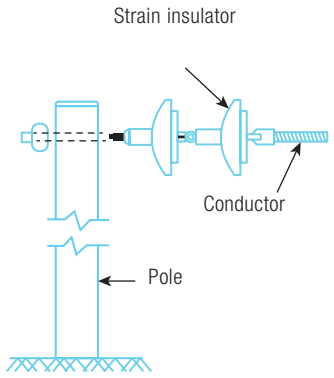

Fig. 1.14 Strain type insulator

Strain type insulator is as shown in figure 1.14. These insulators are used in places where there are very high tensions such as dead ends, sharp curves, corners and line which crosses the river. This type of insulator can be used for low voltages up to 11 KV. For the longer spans across river, two or more strings of insulators are used in series. Two or more strings of insulators are used in parallel where having high tensions.

iv. Shackle insulator

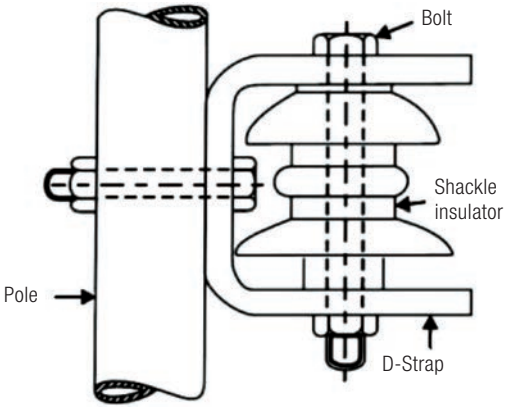

Fig. 1.15 Shackle insulator

A Shackle type insulator is as shown in figure 1.15. This type of insulator mostly used for low voltage distribution lines. Such insulators can either be used in a horizontal position or in a vertical position.

v. Stay insulator

Fig. 1.16 **Stay insulator**

The insulator used in the stay wire is called a stay insulator. This type of insulator is as shown in figure 1.16 is made of porcelain. The size of insulator depends upon the tensile strength of stay wire. It is used to prevent the leakages from the poles up to 33KV. These are provided at a height of 3m from the ground level.

1.10 Power distribution system

The medium voltage transformer using transmission lines are reduced by step down transformer (415V, or 240V) are used to the consumer. This system includes the feeder lines, distributors and service mains.

1.10.1 Feeder line

The feeder line is nothing but similar as power transmission conductors. It connects the power from sub-station and power supply to the consumers. The voltage is uniform throughout the conductor.

1.10.2 Distributor

Electric power is distributed to the consumer by tapings. Since electric power is taken from many tappings and the current is not uniform in all. Therefore, when designing the distribution system, care must be taken to the voltage drop.

1.10.3 Classification of distribution system

According to scheme of connections the distribution system is classified as,

a. Radial distribution system
b. Ring main distribution system
c. Grid or interconnected distribution system

a. Radial distribution system

In this system, each load junctions are connected through separate feeders and they are controlled by the sub-stations. This method is used when the low voltage exists in the center of the city. If there is a fault in any feeder, the whole circuit will be affected.

b. Ring main distribution system

This system designed like a closed ring. Each load junctions were constructed one after another. Electricity is provided from two supply sources in different places for each load junctions. If one gets faulted, the other can be used to get power supply. This system is used in places where low and medium voltage is required. In this way there may be a chance of low voltage fluctuations happening for the consumers. Power supply can be provided by more than one feeder. Reliability can be generated by supply of electricity through each of the two feeders.

c. Grid or interconnected distribution system

More than one power plants and sub-stations are connected in series feeders are called as 'Interconnected distribution

system.' It is also called as grid. In this system, the power plant and sub-station are connected together, and the voltage is reduced to 33KV, by using transformer. This method increases the reliability and efficiency. Electricity can be provided from different power plants during high power consumption.

1.10.4 Service lines

Service line is low length connecting conductor. These service lines act as conductor between distribution pole and consumer.

1.11 Underground cables

By using underground cable, the power is transmitted from the generating station to the consumers. When electrical power is unable to transmit by overhead lines or in a thickly populated area, underground cables are used. An underground cable consists of one or more conductor covered with suitable insulation and surrounded by a protecting core. Normally the number of cores in underground cables are 1, 2, 3, 3 ½ and 4.

1.11.1 Advantages of cables

i. Underground cables are not subjected to lightning discharges, thunder, storms, birds and other severe weather conditions.
ii. As there is no tension on the conductor, it will not break due to mechanical reasons after being installed. Hence there are very few chances for a power failure. It reduces accidents.
iii. Less maintenance is required.
iv. There is no interference with tele communication circuits.

1.11.2 Disadvantages of cables

i. The installation cost is high.
ii. High voltage cables are difficult to manufacture due to the insulation problem.
iii. Joining of underground cables is difficult.
iv. Fault location is not easy.

1.11.3 Classification of cables

a. According to the rating of voltage the cables are classified into
   i. Low tension cables up to 1 KV
   ii. High tension cable up to 11KV
   iii. Super tension cables 22 KV to 33KV
   iv. Extra high-tension cables 33KV to 66 KV
   v. Oil filled cables 66KV to 132 KV
   vi. Extra super voltage cables beyond 132 KV
b. According to insulation, cables are classified into
   i. PVC insulated cables
   ii. Mineral insulated cable
   iii. Paper insulated lead sheathed cable
   iv. Cross linked poly ethylene cable
   v. Paper insulated lead covered double tap armored cable
c. According to number of conductors, cables are classified into
   i. Single core cable
   ii. 2 core cable
   iii. 3 core cable

iv. 4 core cable
v. 3 ½ core cable

1.11.4 Three phase cable

Commonly, underground cables are used to transmit three phase power supply. For three phase service, the following cables are used.

a. Belted cable up to 11 KV
b. Screened cable 22KV to 66 KV
c. Pressure cable above 66 KV

a. Belted cable up to 11 KV

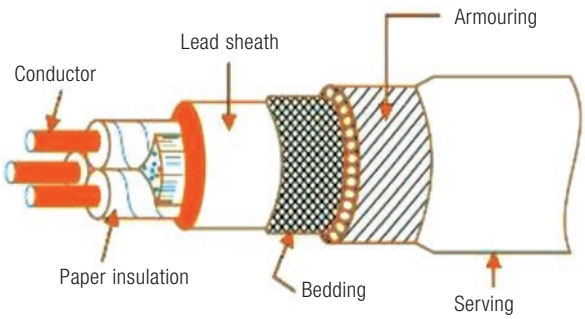

Fig. 1.17 **Belted cable**

Figure 1.17 shows the cross-section view of the belted cable. Each conductor is insulated by separate layers of impregnated paper. Thus, the insulated 3 conductors are set up as a part in the same set and then wrapped in an impregnated paper tape called a paper belt. Between insulated containers, it is filled with insulating material like jute or fiber. A lead sheath is laid on the paper bar to protect from mechanical damage and moisture. In this one or more layers are shielded and protected. These types of electric cables are used to transmit voltage up to 11 KV and sometimes voltage can be extended upto 22 KV.

b. Screened cable

It is of two types

i. H – type cable (Hochstadter type)
ii. S.L. type cable (Separate lead type)

i. H Type cables 22 KV to 66 KV

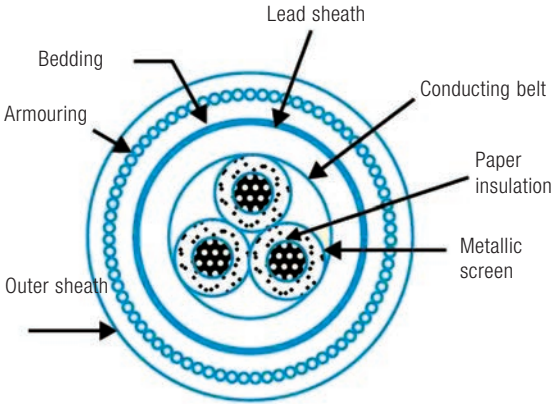

Fig. 1.18 **H type cable**

Figure 1.18 shows the H type screened cable. Each conductor is insulated by separate layers of impregnated paper. Then it will be wrapped with metal insulation separately. The metal shield is made of thin aluminum and made to touch each other. These three containers are wrapped in copper fabric tape. There will be a lead sheath casing on it. There is one or more armors on it. These types of cables are used to transmit low and medium voltages. It is used to transmit 33 KV and sometimes to carry up to 66 KV.

ii. S.L. type cable (22KV to 66KV)

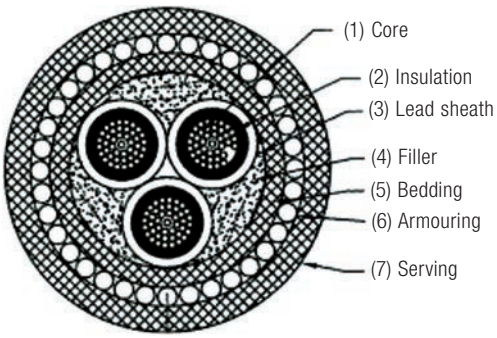

Fig. 1.19 S.L type cable

The structure of SL type cable is shown in figure 1.19 Even though this type is similar to that of H-type, each conductor is constructed with separate lead sleeves. Hence this cable can be handled easily for bending.

c) Pressure cables

A vacuum occurs when the solid power cord is used. It causes an electro chemical breakdown. Therefore, these pressure cables are used for distributing the voltage over 66 KV. The pressure of joint components used in these cable is increased and vacuum is reduced.

There are two types of pressure cables:

i. Oil filled cables
ii. Gas pump/pressure cables.

i. Oil filled cables

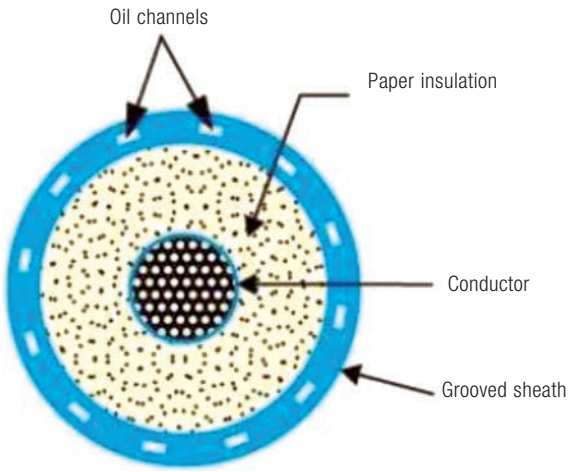

Fig. 1.20 Oil filled cables

The pipes are set up for oil circulation in oil-filled cables as shown in figure 1.20. The oil under pressure is kept supplied to the channel from a tank. The oil tank is set at a distance of about 500m along the cable route. Pressure oil is prevented from vacuum by pressing the paper insulation. This type of cable is used for distributing voltages from 66 KV to 230 KV.

ii. Gas filled cable

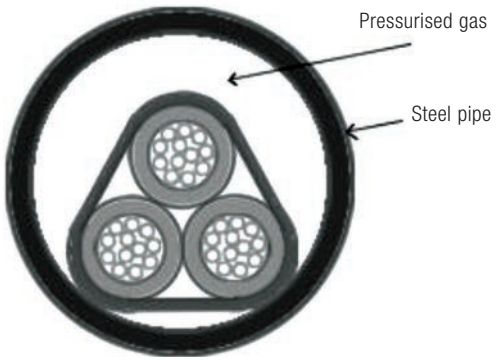

Fig. 1.21 Gas filled cable

Gas filled cable is shown in figure 1.21. The construction of gas pressure cable is similar to that of ordinary solid cable. It is designed in a triangular shape. The thickness of lead sheath of gas pressure cable is 75% of solid cable. The sheath is protected by a thin metal tape. The cable is kept in a gas tight steel pipe. The pipe is filled with dry nitrogen gas at 12 to 15 atmospheric pressure. The gas pressure produces radial compression and closes the voids formed between the layers of paper insulation. These cables carry more load current and operate at higher voltage than a normal cable. The nitrogen gas helps in quenching any flame. Its maintenance cost is low.

1.11.5 Difference between Overhead line and Underground cables

Sl. No.	Overhead Lines	Underground Cables
1	To increase the load, conductors can be included easily. To increase the working voltage, it is enough to change the insulator.	Change the new cable for two reasons like to increase the load and the conductors cannot be included easily.
2	If need, load can be easily increased.	Load cannot be increased, otherwise cable will get damage.
3	More space is required to install.	Less space is required to install.
4	Maintenance is easy.	Maintenance is complicated.
5	Easy to find the fault.	Difficult to find the fault.
6	Power factor loss is high.	Power factor loss is low.
7	It is suitable for long transmission	It is suitable for short transmission
8	It can be affected by lightning.	It cannot be affected by lightning.
9	Installation cost is low.	Installation cost is high.
10	It is cheap	It is costly.

Points to remember

- The power supply from power plants to the consumers is called power transmission.
- A large amount of alternating current is produced at power stations.
- The specific resistance of copper is less than aluminum.
- Aluminum Conductor with Steel Reinforced is extensively used for power transmission.
- Wooden poles are not currently used.
- The Lattice steel tower is suitable for the distance between 100 meters and 300 meters.
- Bluish green sparking around the conductor is called corona.
- Types of guarding

  i. Cradle guarding ii. Cage guarding
- The insulator used in the stay wire is called stay insulator.
- When electrical power is unable to transmit by overhead lines area underground cables are used.
- The underground cable is not affected by lightning

Glossary

Corona	–	வெளிச்சுடரொளி
Di-electric strength	–	மின்காப்பு வலிமை
Feeder lines	–	ஊட்டளிப்புத் தொடர்
Grid	–	வலையிணைப்பு (அ) மின்கட்டமைப்பு
Insulator	–	மின்காப்பான்
Peak load	–	உச்சக்கட்ட பளு
Regulation	–	ஒழுங்கு முறை
Power factor	–	திறன்காரணி
Receiving station	–	ஏற்பு நிலையம்

Activities

1. Students to make their own solar? to turn a small generator capable of lighting an array of LEDs or giving an output voltage measured on a voltmeter.
2. Students to make their own wind-mill to turn a small generator capable of lighting an array of LEDs or giving an output voltage measured on a voltmeter.

Evaluation

Z6NL0

PART-A

Choose the correct answer **(1 Marks)**

1. Which of the following is usually not the generating voltage?
   a) 6.6 KV
   b) 9.9 KV
   c) 11 KV
   d) 13.2 KV
2. Which of the following is not the distribution system normally used?
   a) 3 phase - 4 wire
   b) 3 phase - 3 wire
   c) Single phase - 3 wire
   d) Single phase - 4 wire

3. The disadvantage of constant voltage transmission is
   a) short circuit current of the system is increased
   b) load power factor in heavy loads
   c) large conductor area is required for same power transmission
   d) less current during short circuit

4. The voltage of low-tension transformer is
   a) 132 KV
   b) 220 KV
   c) 33 KV
   d) 400 KV

5. Generally which conductor is used for power transmission _____
   a) Steel
   b) Copper
   c) Aluminium
   d) ACSR

6. Pin type insulators are normally used up to voltage of about
   a) 100 KV
   b) 66 KV
   c) 33 KV
   d) 25 KV

7. For 66 KV lines, the number of insulator discs used are
   a) 3
   b) 5
   c) 8
   d) 12

8. Which type of insulator is used on 132 KV transmission lines?
   a) Pin type
   b) Disc type
   c) Shackle type
   d) Pin and shackle type.

9. The effect of corona is
   a) increased energy loss
   b) increased reactance
   c) increased inductance
   d) increased resistance

10. Wooden poles for supporting transmission lines are used for voltages up to
   a) 440 V
   b) 11 KV
   c) 22 KV
   d) 66 KV.

11. Which of the following regulation is considered to be the best?
   a) 2%
   b) 30%
   c) 70%
   d) 98%.

12. The power transmitted will be maximum while
   a) sending end voltage is more
   b) receiving end voltage is more
   c) reactance is high
   d) corona losses are least.

13. Stranded conductors arc used for transmitting power at high voltages because of
   a) increased tensile strength
   b) better wind resistance
   c) ease-in handling
   d) low cost.

PART-B

Answer the questions in brief (3 Marks)

1. What is meant by power transmission?
2. State some electrical power generating stations.
3. What are the advantages of DC transmission?
4. What are the disadvantages of AC transmission?
5. What are the advantages of high voltage transmission?
6. What are the properties of overhead line conductors?
7. Write short notes on ACSR conductor.
8. Write the name of four types of electrical poles.
9. What is skin effect?
10. What are the methods used to reduced corona effect?
11. What are uses of guarding?
12. What is meant by service lines?

PART-C

Answer the questions in one page

(5 Marks)

1. What are the various methods of power transmission?
2. Draw the power transmission diagram and point out the parts.
3. Explain the metal conductors used for power transmission.
4. Draw the shackle type insulator diagram and label the parts.
5. Write down the types of distributors.
6. What are the main objectives, advantages and disadvantages of underground cable for power distribution?
7. Draw the diagram of suspension type insulator.

PART-D

Answer the questions in two page

(10 Marks)

1. Explain with a neat sketch the various types of electrical poles.
2. Explain the reasons, advantages and disadvantages of corona?
3. Tabulate the differences between the overhead transmission lines and underground cables.

Reference Book

1. A text book of 'Electrical Technology' Volume-III B.L.Theraja and A.K.Theraja, S.Chand & Company Ltd.

Reference Internet Source

1. http://www.wikipedia.org
2. https://www.electrical4u.com