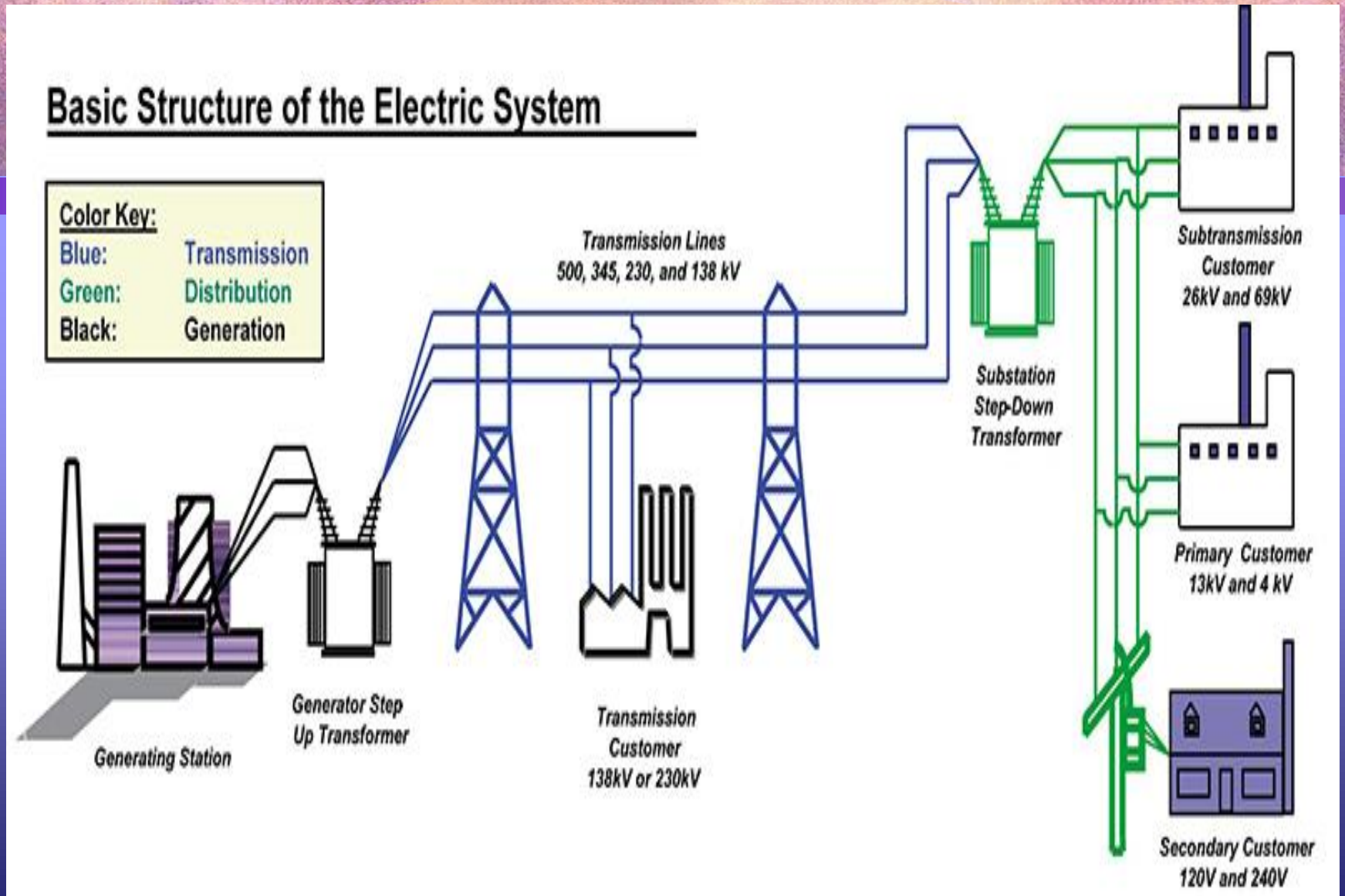
ELECTRICAL POWER-II

TARIFF

Basic Structure of the Electric System



Types of Loads

- Domestic Load
- Commercial Load
- Industrial Load
- Municipal Load
- Irrigation Load
- Traction Load

Variable load on Power station

The load on a power station varies from time to time due to uncertain demands of the consumers and is known as ***variable load on the station.***

Effects of variable load

- Need of additional equipment
- Increase in production cost

Load Curve

The curve showing the variation of load on the power station with respect to time is known as a load curve.

Importance of Load Curve:

- The Daily Load Curve gives the information of load on the power station during different running hours of the day.
- The number of unit's generation per day is found from the area under the daily Load Curve.
- Average load is found from the Load Curve.
- **Average load= [Area (KWh) under daily load curve/24 hours]**
- The maximum demand of the station on that day is found from the highest point of the daily Load Curve.
- The size and the number of generating units can be determined from the load curve.
- This Load Curve helps to determine the operation schedule of the station. In that case when all the units or the less units needs to running is found.

Important terms and factors

Connected load: It is the sum of continuous rating of all the equipments connected to supply system.

Maximum Demand: It is the greatest demand of load of the power station during a given period.

Demand factor: it is the ratio of maximum demand on the power station to its connected load.

Important terms and factors

Average load: The average of loads occurring on the power station in a given period (day or month or year)is known as average load or average demand.

Load factor: The ratio of average load to the maximum demand during a period is known as load factor.

Diversity factor: The ratio of the sum of individual maximum demands to the maximum demand on power station

Important terms and factors

Coincidence factor: The coincidence factor is the reciprocal of the diversity factor

Contribution factor: it is the contribution of a particular load ,in per unit of the individual demand ,to the group maximum demand

Important terms and factors

Plant Capacity factor: it is the ratio of actual energy produced to the maximum possible energy that could have been produced during a given period.

Plant use factor: It is ratio of kWh generated to the product of plant capacity and the number of hours for which the plant was operation.

Plant Utilization factor: it is the ratio of maximum load to the rated capacity.

Tariff

The rate at which electrical energy is supplied to a consumer is known tariff.

Objectives of tariff

- Recovery of production cost
- Recovery of capital investment cost
- Recovery of operation and maintenance cost
- A suitable profit

Desirable characteristics of a tariff

- Proper return
- Fairness
- Simplicity
- Reasonable profit
- Attractive

Types of tariff

- Simple tariff
- Flat rate tariff
- Block rate tariff
- Two part tariff
- Maximum demand tariff
- Power factor tariff
- Three part tariff

Simple tariff or uniform rate tariff

There is a fixed rate per unit of energy consumed.

Advantages:

Simplest tariff method and is readily understood by the consumers.

Disadvantages:

- There is no discrimination between consumers
- The cost per unit delivery is high
- it does not encourage the use of electricity

Flat rate tariff

When different types of consumers are charged at different uniform per unit rate ,it is called a flat rate tariff.

Advantanges: it is more fair to different types of consumers and is quite simple in calculations.

Disadvantages:

- Separate meters are requires for light and power load.
- A particular class of consumers are charged at the same rate irrespective of the magnitude of energy consumed.

Block rate tariff

When a given block of energy is charged at a specified rate and the succeeding blocks of energy are charged at progressively reduced rates, it is called a block rate tariff.

Advantages:

Consumer gets an incentive to consume more energy. It increases the load factor.So cost of generation reduced.

Disadvantages:

it lacks a measure of consumers demand.

Two part tariff

When the rate of electrical energy is charged on the basis of maximum demand of the consumers and the units consumed ,it is called a two-part tariff.

In two-part tariff ,the total charges to be made from the consumer is split in to two components ,fixed charges and running charges. The fixed charge depends on the maximum demand in kW and running cost depends on the number of units consumed by the consumer in kWh.

Total charges = b X kW+ c X kWh

Two part tariff

Advantages:

- it is easily understood by the consumers
- it recovers the fixed charges which depend upon the maximum demand

Disadvantages:

- The consumer has to pay the fixed charges irrespective of the fact whether he has consumed or not.
- There is always error in assessing the maximum demand of the consumer.

Maximum demand tariff

It is similar to two-part tariff with the only difference that the maximum demand is actually measured by installing maximum demand meter in the premises of the consumer.

Advantages: This removes the objection of two-part tariff

Disadvantages: Not suitable for small consumers as a separate maximum demand meter is required.

Power factor tariff

The tariff in which power factor of the consumer's load taken in to consideration is known as power factor tariff.

Types of power factor tariff:

1.kVA maximum demand tariff :It is modification of two part tariff. In this case fixed charges are made on the basis of maximum demand kVA and not in kW.

Power factor tariff

2.Sliding scale tariff : This is also known as average power factor tariff. In this case, an average power factor , say 0.8 lagging , is taken as reference. If the pf of consumer falls below this factor ,suitable additional charges are made or if pf of consumer above the reference ,a discount allowed to the consumer.

3.kW and kVAR tariff: In this type both kW and kVAR charged separately.

Three part tariff

When the total charges to be made from the consumer is split into three parts ,fixed charge ,semi fixed charge and running charge ,it is known as three part tariff.

Total charge = a + bXkW + cXkWh

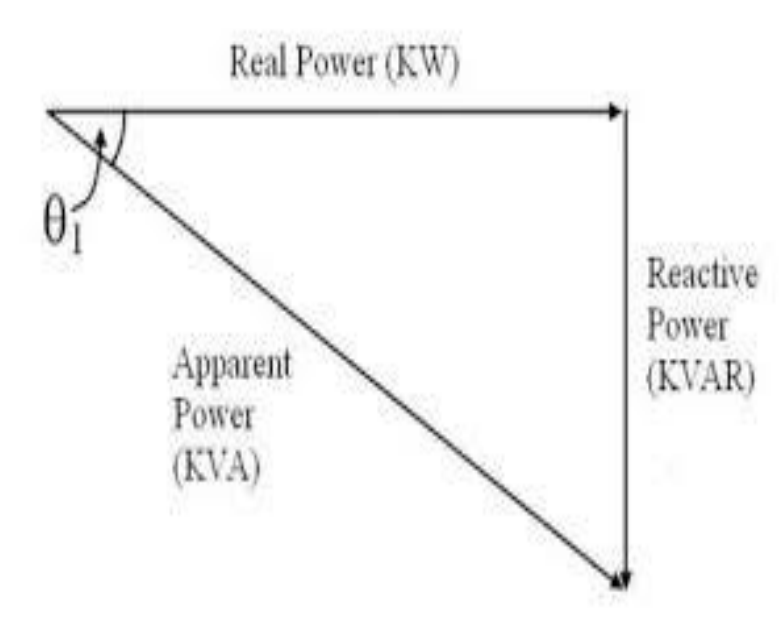
a – fixed charge including intrest and depreciation on the cost of secondary distribution and labor cost of the collecting revenues.

b – charge per kW maximum demand

c – charge per kWh of energy consumed.

Power factor and economics of power factor correction

Power factor : The cosine of the angle between voltage and current in an AC circuit is known as power factor



Disadvantages of low power factor

- Large kVA rating equipment

$$kVA = kW/\cos \phi$$

- Greater conductor size
- Large copper losses
- Poor voltage regulation
- Reduced handling capacity of system

Causes of low factor

- AC induction motors
- Arc lamps ,electric discharge and industrial heating furnaces
- Varying load on the power system

Power factor improvement equipment

Static Capacitors: The power factor can be improved by connecting capacitors in parallel with the equipment operating at lagging power factor.

Advantages:

- They have low losses
- Little maintenance
- Easily installed
- Can work under ordinary atmosphere condition

Disadvantages

- Short service life
- Easily damaged with higher voltage
- Repair uneconomical

Synchronous Condenser

An over-excited synchronous motor running on no load known as synchronous condenser.

Advantages:

- Power factor can be controlled
- Highly stable
- Faulty can be removed easily

Disadvantages:

- Considerable losses in the motor
- High maintenance cost
- It produces noise
- Not self starting one

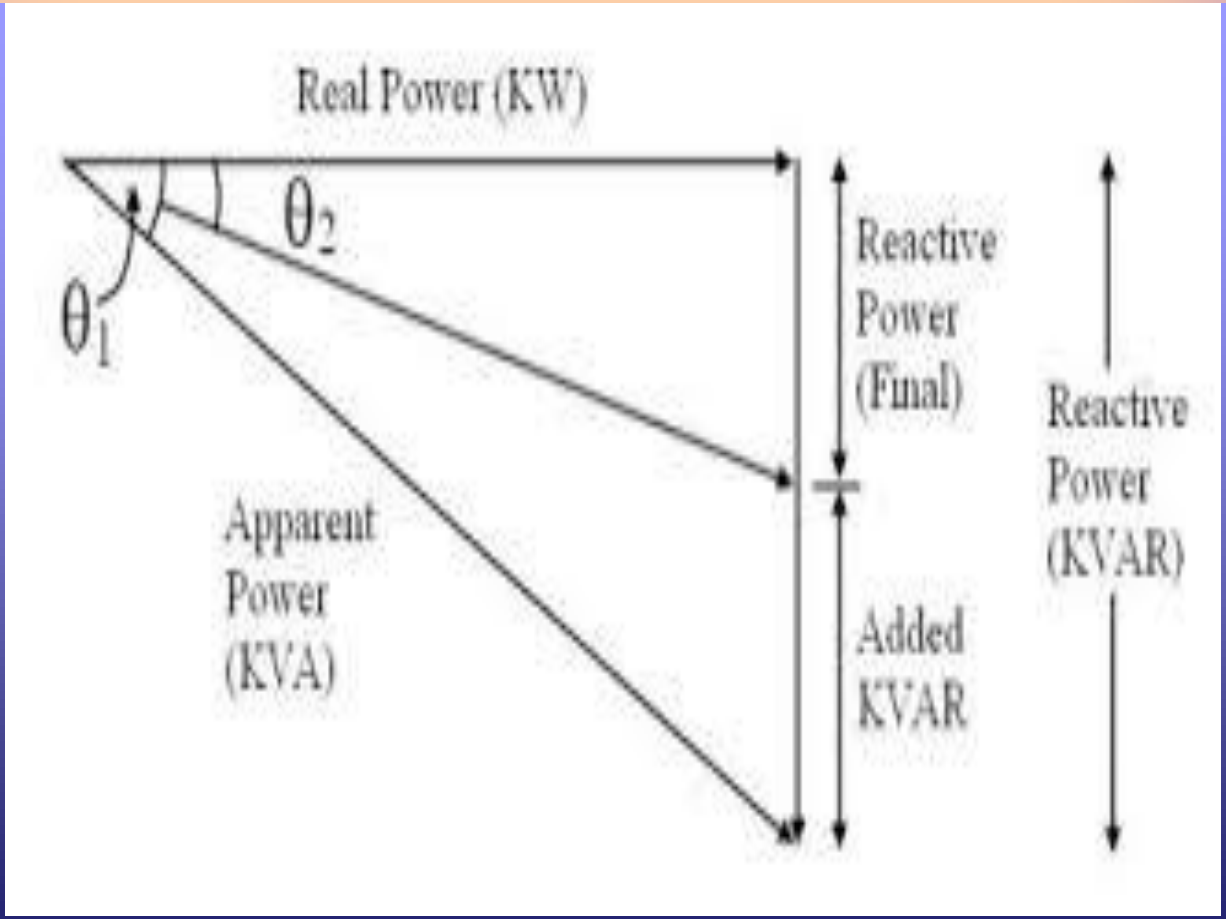
Phase advancers

Phase advancers are used to improve the power factor of induction motors. The low power factor of an induction motor is due to the fact that its stator winding draws exciting current which lags behind the supply voltage by 90 degree. If the exciting ampere turns can be provided from some other AC source then the stator wining will be relieved of exciting current and the power factor of the motor can be improved.

Advantages: kVAR lagging reduced ,convenient

Disadvantages: Not economical for motors below 200HP

Calculation of Power factor correction



THANK YOU