

# Chapter 01

## Conventional Generation, Load Curves and Tariffs:

Lecture : 12

**TOPIC:**

1. Tariff
2. Desirable characteristics of tariff
3. Types of tariff

# Chapter: 01

## Conventional Generation, Load Curves and Tariffs:

- Generation scenario in India and Gujarat
- Steam power station, Schematic arrangement of steam power station, Equipment's of steam power station,
- Hydroelectric power station, Schematic arrangement of hydro-electric power station, Constituents of hydro-electric plants,
- Nuclear power station, Schematic arrangement of nuclear power station, Nuclear reactor,
- Gas turbine power plant, Schematic arrangement of gas turbine power plant,
- Comparison Of Various Power Plants.
- Load curves, Important terms and factors, Load duration curve, Examples. Tariff, Desirable characteristics of tariff, Types of tariff, Examples.

# Tariff

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

*Objectives of tariff.* Like other commodities, electrical energy is also sold at such a rate so that it not only returns the cost but also earns reasonable profit. Therefore, a tariff should include the following items :

- (i) Recovery of cost of producing electrical energy at the power station.
- (ii) Recovery of cost on the capital investment in transmission and distribution systems.
- (iii) Recovery of cost of operation and maintenance of supply of electrical energy *e.g.*, metering equipment, billing etc.
- (iv) A suitable profit on the capital investment.

# Desirable characteristics of tariff

- (i) *Proper return* : The tariff should be such that it ensures the proper return from each consumer. In other words, the total receipts from the consumers must be equal to the cost of producing and supplying electrical energy plus reasonable profit. This will enable the electric supply company to ensure continuous and reliable service to the consumers.
- (ii) *Fairness* : The tariff must be fair so that different types of consumers are satisfied with the rate of charge of electrical energy. Thus a big consumer should be charged at a lower rate than a small consumer. It is because increased energy consumption spreads the fixed charges over a greater number of units, thus reducing the overall cost of producing electrical energy. Similarly, a consumer whose load conditions do not deviate much from the ideal (*i.e.*, non-variable) should be charged at a lower\* rate than the one whose load conditions change appreciably from the ideal.
- (iii) *Simplicity* : The tariff should be simple so that an ordinary consumer can easily understand it. A complicated tariff may cause an opposition from the public which is generally distrustful of supply companies.

- (iv) *Reasonable profit*: The profit element in the tariff should be reasonable. An electric supply company is a public utility company and generally enjoys the benefits of monopoly. Therefore, the investment is relatively safe due to non-competition in the market. This calls for the profit to be restricted to 8% or so per annum.
- (v) *Attractive*: The tariff should be attractive so that a large number of consumers are encouraged to use electrical energy. Efforts should be made to fix the tariff in such a way so that consumers can pay easily.

# Types of Tariff

1. Simple Tariff
2. Flat Rate Tariff
3. Block rate tariff
4. Two Part tariff
5. Maximum demand tariff
6. Power Factor Tariff
7. Three-part Tariff

# Simple Tariff

1. **Simple tariff.** *When there is a fixed rate per unit of energy consumed, it is called a **simple tariff** or **uniform rate tariff**.*

In this type of tariff, the price charged per unit is constant *i.e.*, it does not vary with increase or decrease in number of units consumed. The consumption of electrical energy at the consumer's terminals is recorded by means of an energy meter. This is the simplest of all tariffs and is readily understood by the consumers.

## Disadvantages

- (i) There is no discrimination between different types of consumers since every consumer has to pay equitably for the fixed\* charges.
- (ii) The cost per unit delivered is high.
- (iii) It does not encourage the use of electricity.

# Flat Rate Tariff

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

In this type of tariff, the consumers are grouped into different classes and each class of consumers is charged at a different uniform rate. For instance, the flat rate per kWh for lighting load may be 60 paise, whereas it may be slightly less† (say 55 paise per kWh) for power load. The different classes of consumers are made taking into account their diversity and load factors. The advantage of such a tariff is that it is more fair to different types of consumers and is quite simple in calculations.

## Disadvantages

- (i) Since the flat rate tariff varies according to the way the supply is used, separate meters are required for lighting load, power load etc. This makes the application of such a tariff expensive and complicated.
- (ii) A particular class of consumers is charged at the same rate irrespective of the magnitude of energy consumed. However, a big consumer should be charged at a lower rate as in his case the fixed charges per unit are reduced.



# Block rate tariff

**3. 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**.*

In block rate tariff, the energy consumption is divided into blocks and the price per unit is fixed in each block. The price per unit in the first block is the highest\*\* and it is progressively reduced for the succeeding blocks of energy. For example, the first 30 units may be charged at the rate of 60 paise per unit ; the next 25 units at the rate of 55 paise per unit and the remaining additional units may be charged at the rate of 30 paise per unit.

The advantage of such a tariff is that the consumer gets an incentive to consume more electrical energy. This increases the load factor of the system and hence the cost of generation is reduced. However, its principal defect is that it lacks a measure of the consumer's demand. This type of tariff is being used for majority of residential and small commercial consumers.

# Two Part tariff

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

In two-part tariff, the total charge to be made from the consumer is split into two components *viz.*, fixed charges and running charges. The fixed charges depend upon the maximum demand of the consumer while the running charges depend upon the number of units consumed by the consumer. Thus, the consumer is charged at a certain amount per kW of maximum†† demand plus a certain amount per kWh of energy consumed *i.e.*,

$$\text{Total charges} = \text{Rs } (b \times \text{kW} + c \times \text{kWh})$$

where,

$b$  = charge per kW of maximum demand

$c$  = charge per kWh of energy consumed

This type of tariff is mostly applicable to industrial consumers who have appreciable maximum demand.

### Advantages

- (i) It is easily understood by the consumers.
- (ii) It recovers the fixed charges which depend upon the maximum demand of the consumer but are independent of the units consumed.

### Disadvantages

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

# Maximum demand tariff

**5. 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. This removes the objection of two-part tariff where the maximum demand is assessed merely on the basis of the rateable value. This type of tariff is mostly applied to big consumers. However, it is not suitable for a small consumer (*e.g.*, residential consumer) as a separate maximum demand meter is required.

# Power Factor Tariff

**6. Power factor tariff.** *The tariff in which power factor of the consumer's load is taken into consideration is known as power factor tariff.*

In an a.c. system, power factor plays an important role. A low\* power factor increases the rating of station equipment and line losses. Therefore, a consumer having low power factor must be penalised. The following are the important types of power factor tariff :

- (i) kVA maximum demand tariff* : It is a modified form of two-part tariff. In this case, the fixed charges are made on the basis of maximum demand in kVA and *not* in kW. As kVA is inversely proportional to power factor, therefore, a consumer having low power factor has to contribute more towards the fixed charges. This type of tariff has the advantage that it encourages the consumers to operate their appliances and machinery at improved power factor.
- (ii) Sliding scale tariff* : This is also know as average power factor tariff. In this case, an average power factor, say 0.8 lagging, is taken as the reference. If the power factor of the consumer falls below this factor, suitable additional charges are made. On the other hand, if the power factor is above the reference, a discount is allowed to the consumer.
- (iii) kW and kVAR tariff* : In this type, both active power (kW) and reactive power (kVAR) supplied are charged separately. A consumer having low power factor will draw more reactive power and hence shall have to pay more charges.

# Three-part Tariff

**7. Three-part tariff.** When the total charge to be made from the consumer is split into three parts viz., fixed charge, semi-fixed charge and running charge, it is known as a **three-part tariff**. i.e.,

$$\text{Total charge} = \text{Rs } (a + b \times \text{kW} + c \times \text{kWh})$$

where

$a$  = fixed charge made during each billing period. It includes interest and depreciation on the cost of secondary distribution and labour cost of collecting revenues,

$b$  = charge per kW of maximum demand,

$c$  = charge per kWh of energy consumed.

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It may be seen that by adding fixed charge or consumer's charge (i.e.,  $a$ ) to two-part tariff, it becomes three-part tariff. The principal objection of this type of tariff is that the charges are split into three components. This type of tariff is generally applied to big consumers.

**Example 5.1.** *A consumer has a maximum demand of 200 kW at 40% load factor. If the tariff is Rs. 100 per kW of maximum demand plus 10 paise per kWh, find the overall cost per kWh.*









**Example 5.2.** *The maximum demand of a consumer is 20 A at 220 V and his total energy consumption is 8760 kWh. If the energy is charged at the rate of 20 paise per unit for 500 hours use of the maximum demand per annum plus 10 paise per unit for additional units, calculate : (i) annual bill (ii) equivalent flat rate.*

# Precape

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- Electrical Supply System

Thank You