

**CONT**

**Economics of Power Generation**

C H A PTR



**Example 4.1.** *A transformer costing Rs 90,000 has a useful life of 20 years. Determine the annual depreciation charge using straight line method. Assume the salvage value of the equipment to be Rs 10,000.*

Initial cost of transformer, *P* = $ 90,000 Useful life, *n* = 20 years

Salvage value, *S* = $ 10,000 Using straight line method,

Annual depreciation charge = *P*  *S*  Rs 90,000  10,000 = **$ 4000**

*n* 20

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**Example 4.3.** *The equipment in a power station costs Rs 15,60,000 and has a salvage value of Rs 60,000 at the end of 25 years. Determine the depreciated value of the equipment at the end of 20 years on the following methods :*

1. Straight line method ;

## Solution :

Initial cost of equipment, *P* = Rs 15,60,000 Salvage value of equipment, *S* = Rs 60,000 Useful life, *n* = 25 years

1. *Straight line method*

Annual depreciation = *P*  *S*  Rs 15,60,000  60,000 = Rs 60,000

*n* 25

Value of equipment after 20 years

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# Importance of High Load Fa ctor

The load factor plays a vital role in determining the cost of energy. Some important advantages of high load factor are listed below :

* + 1. *Reduces cost per unit generated* : A high load factor reduces the overall cost per unit generated. The higher the load factor, the lower is the generation cost. It is because higher load factor means that for a given maximum demand, the number of units generated is more. This reduces the cost of generation.
    2. *Reduces variable load problems* : A high load factor reduces the variable load problems on the power station. A higher load factor means comparatively less variations in the load demands at various times. This avoids the frequent use of regulating devices installed to meet the variable load on the station.

**Example 4.4.** *A generating station has a maximum demand of 50,000 kW. Calculate the cost*

*per unit generated from the following data :*

*Capital cost = Rs 95*  *106 ; Annual load factor = 40%*

*Annual cost of fuel and oil = Rs 9*  *106 ; Taxes, wages and salaries etc. = Rs 7·5*  *106 Interest and depreciation = 12%*

## Solution :

Units generated/annum = Max. demand  L.F.  Hours in a year

= (50,000)  (0·4)  (8760) kWh = 17·52  107 kWh

## Annual fixed charges

Annual interest and depreciation = 12% of capital cost

= Rs 0·12  95  106 = Rs 11·4  106

## Annual Running Charges

Total annual running charges = Annual cost of fuel and oil + Taxes, wages etc.

= Rs (9  106 + 7·5  106) = Rs 16·5  106

Total annual charges = Rs (11·4  106 + 16·5  106) = Rs 27·9  106

 Cost per unit = Rs 27  9  106 17  52  107

= Re 0·16 = **16 paise**

**Example 4.5.** *A generating station has an installed capacity of 50,000 kW and delivers 220*  *106 units per annum. If the annual fixed charges are Rs 160 per kW installed capacity and running charges are 4 paise per kWh, determine the cost per unit generated.*

## Solution :

Annual fixed charges = 160  Plant capacity

= Rs 160  50,000 = Rs 80  105

Annual running charges = Rs 0·04  220  106 = Rs 88  105

Total annual charges = Rs (80  105 + 88  105) = Rs 168  105

Cost per unit = Rs 168  105

220  106

= Re 0·0764 = **7·64 paise**

**Example 4.6.** *A generating plant has a maximum capacity of 100 kW and costs Rs 1,60,000. The annual fixed charges are 12% consisting of 5% intererst, 5% depreciation and 2% taxes. Find the fixed charges per kWh if the load factor is (i) 100% and (ii) 50%.*

## Solution :

Maximum demand = 100 kW

Annual fixed charges = Rs 0·12  1,60,000 = Rs 19,200

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1. *When load factor is 100%*

Units generated/annum = Max. demand  L.F.  Hours in a year

= 100  1  8760 = 8,76,000 kWh

Fixed charges/kWh = Rs 19,200 = Rs 0·0219 = **2·19 paise**

8,76,000

1. *When load factor is 50%*

Units generated/annum = 100  0·5  8760 = 4,38,000 kWh

Fixed charges/kWh = Rs 19,200 = Re 0·0438 = **4·38 paise**

4,38,000

It is interesting to note that by decreasing the load factor from 100% to 50%, the fixed charges/ kWh have increased two-fold. Incidentally, this illustrates the utility of high load factor.

**Example 4.7.** *Estimate the generating cost per kWh delivered from a generating station from*

*the following data :*

*Plant capacity = 50 MW ;Annual load factor = 40%*

*Capital cost = 1·2 crores ; annual cost of wages, taxation etc. = Rs 4 lakhs ; cost of fuel, lubrication, maintenance etc. = 1·0 paise/kWh generated. Interest 5% per annum, depreciation 6% per annum of initial value.*

**Solution :** The maximum demand on the station may be assumed equal to the plant capacity *i.e.*, 50 MW.

## Annual fixed charges

Interest and depreciation = Rs 120  105  (5 + 6)/100 = Rs 13·2  105 Wages and taxation = Rs 4  105

Total annual fixed charges = Rs (13·2  105 + 4  105) = Rs 17·2  105

## Annual running charges

Units generated/annum = Max. demand  L.F.  Hours in a year

= (50  103)  (0·4)  (8760) kWh

= 1752  105 kWh

Cost of fuel, lubrication etc. = Rs 1752  105  0·01 = Rs 17·52  105

Total annual charges = Rs (17·2  105 + 17·52  105) = Rs 34·72  105

34  72  105

 Cost per kWh = Rs 1752  105

= Re 0·02 = **2 paise**

**Example 4.8.** *A generating station has the following data :*

*Installed capacity = 300 MW ; Capacity factor = 50% ; Annual load factor = 60%*

*Annual cost of fuel, oil etc. = Rs 9*  *107 ; capital cost = Rs 109 ; annual interest and deprecia- tion = 10%. Calculate* (*i*) *the minimum reserve capacity of the station and* (*ii*) *the cost per kWh generated.*

## Solution :

1. Capacity factor, C.F. = Average demand

Installed capacity

Load factor, L.F. = Average demand

Max. demand

...(*i*)

...(*ii*)

Dividing (*i*) by (*ii*), we get,

C. F.

L. F.

= Max. demand Installed capacity

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or Max. demand = Installed capacity  C. F. = 300  0  5 = 250 MW

L. F.

 Reserve capacity = 300  250 = **50 MW**

0  6

1. Units generated/annum = Max. demand  L.F.  Hours in a year

= (250  103)  (0·6)  8760 kWh = 1314  106 kWh

Annual fixed charges = Annual interest and depreciation

= Rs 0·1  109 = Rs 108

Annual running charges = Rs 9  107

 Total annual charges = Rs (108 + 9  107) = Rs 19  107

 Cost per kWh = Rs 19  107

1314  106

= Re 0·14 = **14 paise**

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