IQRA National University, Peshawar

Name: _ADNAN SHAH__

Department of Electrical Engineering

Spring20

REG.No:_13692__________

Power Generation

Assignment 1

Question No 1 *(CLO -1)* ***20***

A. A 100kVA distribution transformer costs Rs 2,00,000 and has an estimated useful life of 20 years. Find the annual depreciation amount, assuming that the scrap value of the transformer to be Rs 10,000.

B. The average demand of a consumer is 40 A at 230 volts at unity power factor His total energy consumption annually is 10,000 KWh. If the unit rate is Rs 2 per kWh for the first 500hours use of the demand per annum plus Re 1 for each additional units, Calculate the annual bill of the consumer and equivalent flat rate.

Question No 2 *(CLO-2)* ***10***

A. A power station has to supply load as follows:

Timings	KW
11 pm to 5 am	500
5 am to 6 am	750
6 am to 7 am	1000
7 am to 9 am	2000
9 am to 12 noon	2500
12 Noon to 1 pm	1500
1 pm to 5 pm	2500
5 pm to 7 pm	2000
7 pm to 9 pm	2500
9 pm to 11 pm	1000

For the given data above draw the load curve. Select the number and size of generator units to supply this load. Find the reserve capacity of the plant required. Calculate the plant capacity factor. Determine the operating schedule of the units in the station. Calculate the plant factor?

Adnan Shah
(13692)

Ans ① ⓐ

Given data:-

Price = P = 200,000

Estimated useful life N = 20 years

Scarp value = 10,000

Required:

Annual depreciation amount

Solution:-

calculation of depreciation is based on the Scarp value, if P is the initial price of an equipment and S is the Scarp value, then the depreciation over "n" number of use service life of equipment is;

$$D = \frac{P - S}{n} \quad -①$$

putting values in ①

$$D = \frac{200,000 - 10,000}{20}$$

$$D = \frac{\cancel{190,000}}{\cancel{20}} = 9500$$

{ D = Rs.9500 Annually }

Required Answer

Ans (1) (b)

Given data:

Current(I) = 40A

Voltage (V) = 230V

Total energy (E) = 10000KWH

Required:

Annual bill and equivalent flat rate.

Solution:

First we will find the electricity consumption for the first 500h. for this we need power.

The power demand of consumer is;

$P = VI\cos\theta$

$P = 230 \times 40 \times \cos(1)$

$P = 230 \times 40 \times 1$

$P = 9200\ W$

$P = 9.2\ KW$

Now we can find the electricity consumption for the first 500 hours.

$\Rightarrow 500 \times 9.2 = 4600\ KWh$

The cost of electricity per kwh is given.

So the amount for the first 500 hours will be;

= 4600 x 2

500h bill : 9200 Rs — (1)

And for the remaining units;

= 10000 - 4600

= 5400

For additional units cost is Rs 1/kwh

So ;

= 5400 x 1

Additional units bill = 5400 Rs — (2)

Now the Annual bill will be;

Add (1) and (2)

Annual bill = 9200 + 5400

= 14600 Rs

The flat rate equivalent will be;

$$\text{flat rate eq.} = \frac{14600}{10000}$$

flat rate equ. = Rs 1.46 per kwh

Ans (2)

Given data:

Timings	KW
11 pm to 5 am	500
5 am to 6 am	750
6 am to 7 am	1000
7 am to 9 am	2000
9 am to 12 noon	2500
12 Noon to 1 pm	1500
1 pm to 5 pm	2500
5 pm to 7 pm	2000
7 pm to 9 pm	2500
9 pm to 11 pm	1000

Required:

(1) Load curve
(2) Number & Size of generator
(3) Reserve capacity of plant
(4) Plant capacity factor
(5) Operating Schedule of units in station.
(6) Plant factor.

Solution:

The plant would normally be diesel-electric. So the method for the Selection of Size of generating units are comman to all types of Stations.

First we calculate the energy generated during 24 hours.

= KW × no. of hours

= (500×5) + (750×1) + (1000×1) + (2000×2) + (2500×3) + (1500×1) + (2500×4) + (2000×2) + (2500×2) + (1000×9) + (500×1)

E = 38750 KWh

From the given data we know that the maximum demand is = 2500 KW

(1) Number and Size of Generators =

From the load curve it seems that the load is of small industrial town. So three generator with the following rating will be enough.

One generator of 500 KW capacity.
Two Generators of each 1000 KW capacity.

(2) Reserve capacity of plant:
In this case, 1000 KW generator will be required as a reserve.
So the total installed capacity in the station will be;
= 1000 + 1000 + 500 + 1000 (reserve)
Total installed = 3500 KW

③ Plant capacity factor:

$$= \frac{\text{Energy produced during 24 hrs (kWh)}}{\text{installed capacity (kW)} \times 24\text{ hrs}}$$

$$= \frac{38750}{3500 \times 24}$$

plant capacity factor = 0.46

= 46%

④ Operating Schedule:

we will try to set individual sets as possible and to fit the load curve.

Another important point is to decide when, how and in what sequence the sets should be started and run.

The operating schedule will be;

From 11 pm to 5am only the 500kW Generator should be running.
(Load capacity is increases)

From 5 am to 6am 1000 kW generator should be started and running.

From 6 am to 7am that 1000kW set is enough.

At 7am the load increases to 2000 Kw.
So from 7am to 9am both sets of 1000Kw should be started and running in connection parallel to each other.

At 9am load exceeded to 2500KW.
So another 500Kw generator will be started and connected parallel with other through busbars.

From 12pm to 1pm the load decreases to 1500KW so the one set of 1000Kw will be stopped.
From 1pm to 5pm the ~~at~~ load again increases to 2500Kw so the other set of 1000Kw should be started again.
From 5pm to 7pm the load decrease to 2000Kw so the set of 500Kw should be stopped.
At 7pm the load increase again to 2500Kw.
So from ~~###~~ 7pm to 9pm the set of 500Kw should be started.
At 9pm the load decreases to 1000Kw
So from 9pm to 11pm only one set of 1000Kw should be running

The energy that will be generated by the capacity of plant due to operating with the schedule fixed will be;

$$E = (500\times6) + (1000\times2) + (2000\times2) + (2500\times3) + (1500\times1) + (2500\times4) + (2000\times2) + (2500\times2) + (1000\times2)$$

$$E = 39000\,kWh$$

And Energy Actually produced

$$= 38750\,kWh$$

⑤ Plant factor:

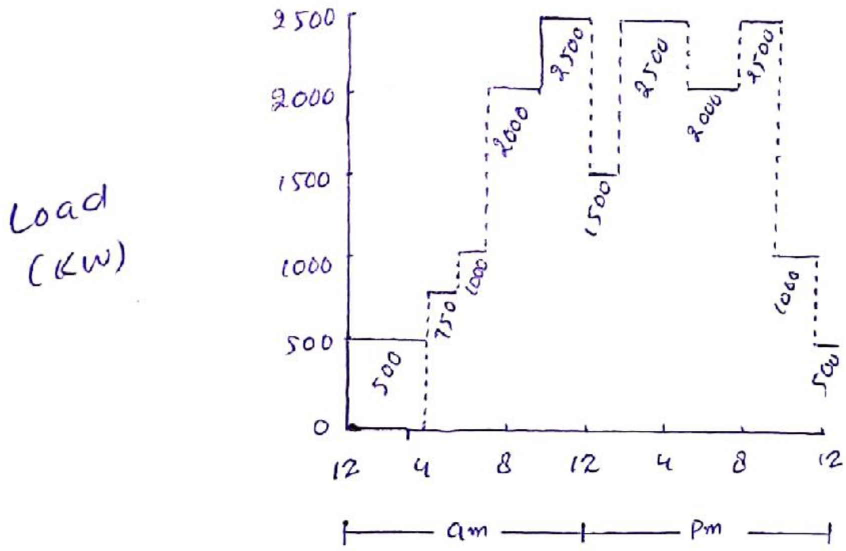
$$\text{Plant use factor} = \frac{\text{Energy produced (kWh)}}{\text{capacity of plant (kW)} \times \text{operating hours (h)}}$$

$$= \frac{38750}{39000}$$

$$= 0.994$$

$$\text{Plant use factor} = 99.4\%$$

⑥ Load Curve:


Load
(KW)
2500
2000
1500
1000
500
0
500
750
1000
2000
2500
1500
2500
2000
2500
1000
500
12
4
8
12
4
8
12
am
Pm