(6) (1)

LOAD CHARACTERISTICS

Variable load on power station – Load varies on power station from time to time due to uncertain demands of the consumers and a known.

Effects of variable loads

(i) Need for additional equipments.
(ii) Increase in production cost.

Load Curve.

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

Types of Loads.

(i) Domestic Load.
(ii) Commercial load.
(iii) Industrial Load
(iv) Municipal load.
(v) Irrigation load.
(vi) Tracking load.

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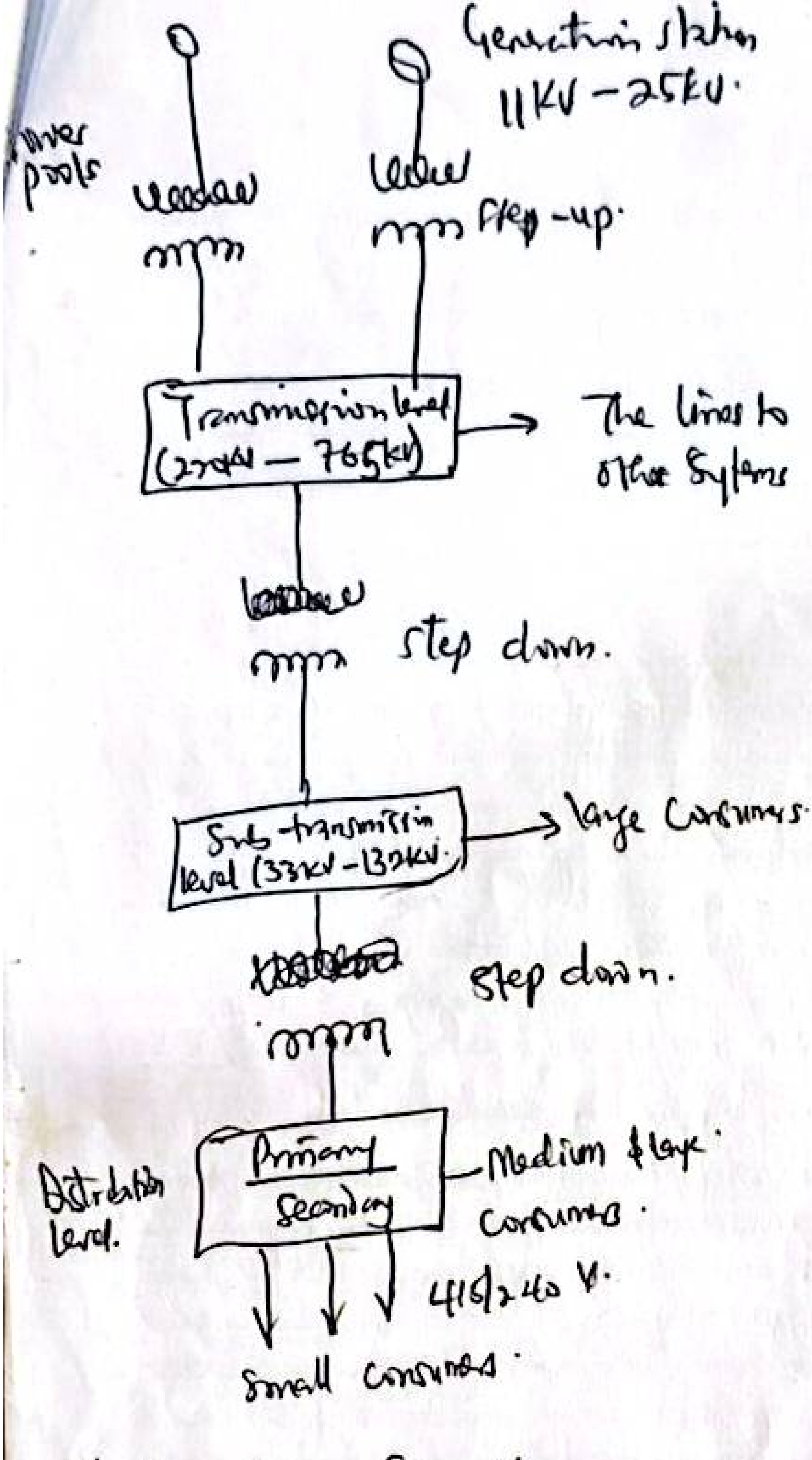
Structure of Power System

Its cheaper to transport Elect than coal.



Nuclear Power Generation

$$^{235}_{92}U(\text{fissile}) + {}^{1}_{0}n \rightarrow {}^{236}_{92}U^{*} \rightarrow {}^{140}_{54}Xe + {}^{94}_{38}Sr + 2\,{}^{1}_{0}n + E\ (200\text{MeV}).$$

neutron; excited uranium nucleus; (Strontium)

1g of uranium — 2.6 tons of coal

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EEG 441 (1).

Sources of Energy..

- Energy.
  - Store (in earth)
    - Chemical. liquid
      - Oil
      - Gas
      - Coal.
    - Atomic
      - Fision
      - Fussion
    - Geotherm.
  - continuously received.
    - Solar radiation.
      - Tiday
      - Hydro
      - Wind
      - Effect

(1) Hydro plant.
(2) steam plant.
(3) Nuclear.
(4) Wind.
(5) Gas.
(6) Solar.
(7) Oil.

In power system circle we have Generation Transmission and Distribution. Power station is consid reasonable to sit close to energy source since transport HV is considered cleaner and cheaper than its sources c but nuclear is load centre for safety reasons.

Power Stations

(1). Thermal/steam
(2) Hydro/water.

Steam power stations.

Primary energy source → Heat energy → Mechanical Energy → Electrical Energy.

The Energy sources for steam stations.

(1). fossil fuel - gas, coal, oil, natural gas, nucle sources. The conversion can be by chemical reactions (combustion, or fission to generate hea with scientific approach and control.

$$\text{Average demand/day} = \frac{4400 \times 10^3}{24} = 1,83,333\,kW.$$

$$\text{station capacity} = (75 \times 10^3) \times 4 = 300 \times 10^3\,kW.$$

$$\therefore \text{Plant capacity factor} = \frac{1,83,333}{300 \times 10^3} \times 100 = 61.1\%.$$

(iii) $$\text{Heat required/day} = \underline{\text{Plant heat rate} \times \text{Unit per day}}$$

$$= (2860) \times (4400 \times 10^3)\ \text{kcal}$$

$$\text{fuel required/day} = \frac{2860 \times 4400 \times 10^3}{10000}$$

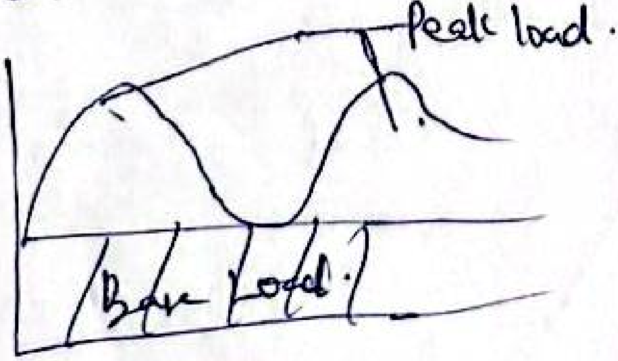
$$= 1258.4 \times 10^3\ \text{kg}.$$

$$= 1258.4\ \text{Tons}.$$

Base load and Peak load in Power Station.

① Base: The unvarying load which occurs almost the whole day on the station.

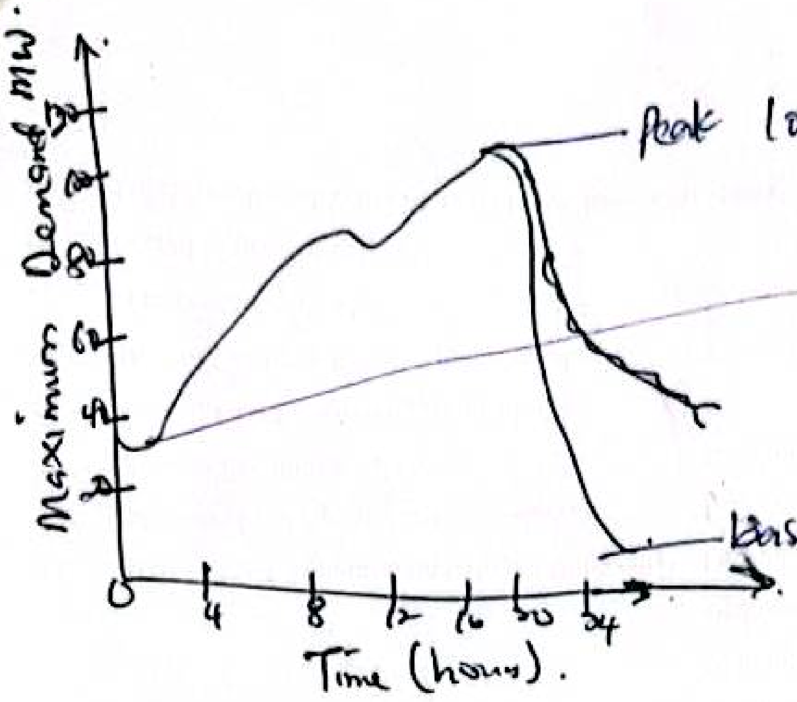
② Peak load. The various peak demand over and above the base load of station..



More effecient plant for base load and less effecient for peak load.

No hard and fast rule for selection.

1) Load Curve. LOAD Characteristics. 1



Average load determine the energy consumption over the day

Peak load is with the considerations of standby capacity

Base, medium / intermediate / peak.
steady

<u>Diversity factor</u>: This is the sum of individual maximum demands on the consumers divided by the maximum load on the system. if it $= 1$ – the ~~whole~~ total generated power will be at use at the same time. (It is expensive and not desirable).

Higher diversity factor can be obtained by good management

: Load factor $= \dfrac{\text{average load}}{\text{maximum (peak) load}}$ = less than unity.

Demand factor $= \dfrac{\text{Maximum demand}}{\text{Connected load}}$.

...age load/Demand. ②

$$\text{Daily average load} = \frac{\text{KWh supply in a day}}{24}$$

$$\text{Monthly} = \frac{\text{KWh supply in a month}}{24 \times 30}$$

$$\text{Yearly} = \frac{\text{KWh supply in a year}}{24 \times 365}$$

$$\text{Diversity factor} = \frac{\text{Sum of individual maximum demand}}{\text{Maximum demand of power station}}$$

Concidence factor = Inverse of D.f.

$$\text{Capacity (or plant) factor} = \frac{\text{Average demand}}{\text{Rated capacity of the plant}}$$

$$\text{Capacity factor} = \frac{\text{Maximum demand}}{\text{Rated capacity}} \times \text{load factor}$$

Example. Q1

There are 3 consumers of electricity having different load requirements at different time. Consumer 1 has a maximum demand of 5KW at 6p.m. and a demand of 3KW at 7pm and a daily load factor of 20%. Consumer 2 has a maximum demand of 5KW at 11am, a load of 2KW at 7pm and an average load of 1200W. Consumer 3 has an average ~~d.f~~ load of 1KW and maximum demand ~~of~~ is 3KW at 7p.m. Determine (a) the D.f (b) the L.f and average load of each consumer and (c) the average load and load factor of the combined load.

Solution.

Consumer 1.	MD 5kW at 6p.m	3kW at 7pm	Lf 20%
2	MD 5kW at 11am.	2kW at 7p.m	Average Load 1.2kW
3.	MD 3kW at 7pm.		Average load 1kW

Maximum demand of the system is ~~8kW~~ 8kW at 7p.m

Sum of the individual maximum demand $= 5+5+3 = 13kW$

Diversity factor (Df) $= \frac{13}{8} = 1.625$

Consumer 1 Average Load $0.2 \times 5 = 1kW$, $Lf = 20\%$.

Consumer 2 Average Load 1.2kW, $Lf = \frac{1.2}{5} \times \frac{100}{1} = 24\%$.

Consumer 3. Average load 1kW, $Lf = \frac{1}{3} \times 100 = 33.3\%$.

Combined average Load $= 1+1.2+1 = 3.2kW$.

Combined average Load factor $= \frac{3.2}{8} \times 100 = 40\%$.

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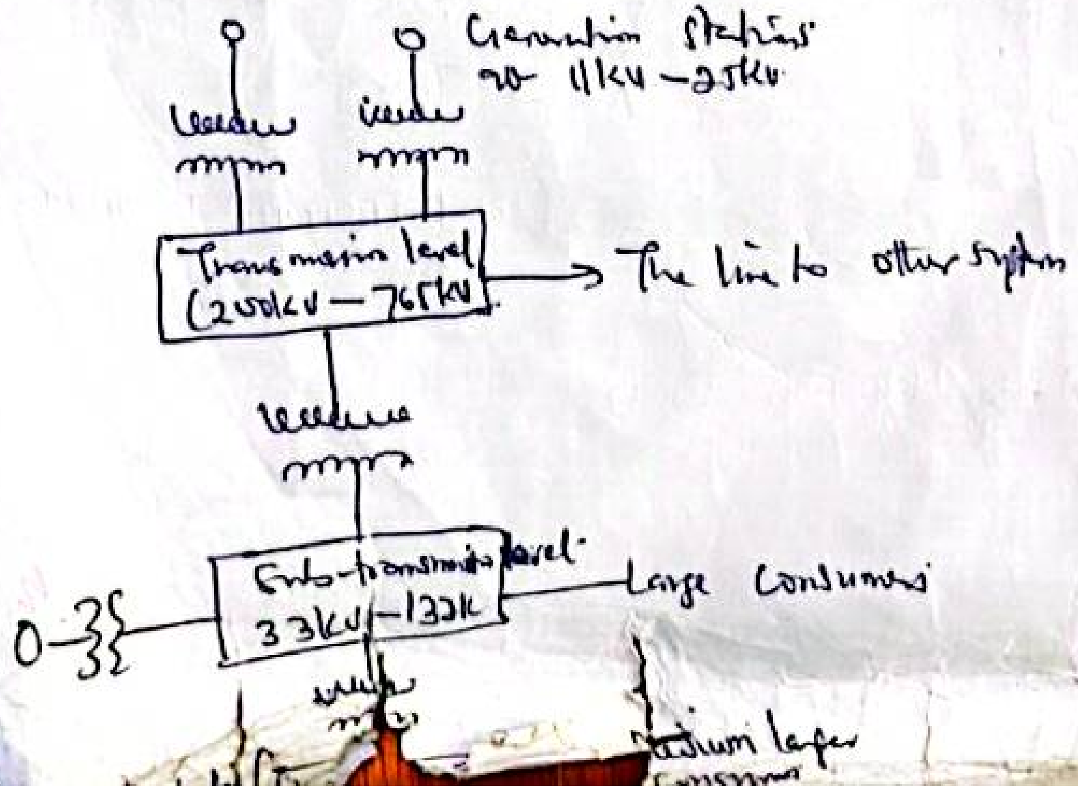
Introduction.

Energy is the fourth necessity of life after food, clothing and shelter. We need power for day to day activities and technology growth. Generation & Conversion in small scale can be managed by ... but bulk generation involved reasonable reliability, control and efficient operation.

Electrical power system is a branch of Electrical Engineering where we study in depth for its design, operation maintenance and analysis.

Structure of Power system

Generating stations, transmission lines and distribution system are the main components of an electric power system. Generating stations and a distribution ~~stations~~ systems are connected through transmission lines, which also connect one power system (grid area) to another (grid, area)



~~ual~~.

Maximum demand on a power station is 100 MW. If the annual load factor is 40%, calculate the total energy generated in a year. (3)

Solution.

Energy generated/year = Max demand × Hours in a year.

$$= (100 \times 10^3) \times (0.4) \times (24 \times 365)\,\text{kWh}.$$

$$= \boxed{3504 \times 10^5\,\text{kWh}}$$

3504×10^5

② A generating station has a connected load of 43 MW and a maximum demand of 20 MW; the unit generated being 61.5×10^6 per annum. Calculate ① the demand factor and ⑪ Load factor.

Solution ① Demand factor $= \dfrac{\text{Maximum demand}}{\text{Connected load}} = \dfrac{20}{43}$

$= 0.465$

⑪ Average load $= \dfrac{\text{Unit generated/annum}}{\text{Hours of a year}} = \dfrac{61.5 \times 10^6}{8760} = 7020\,\text{kW}.$

∴ Load factor $= \dfrac{\text{Average demand}}{\text{Max Demand}} = \dfrac{7020}{20 \times 10^3} = 0.351$ or 35.1%.

③ A power station has a maximum demand of 15000 kW. The annual load factor is 50% and plant capacity factor is 40%. Determine the reserve capacity of the plant.

lution.

Energy generated/annum = Max demand × L.f × Hours of a year.

$= (15000) \times (0.5) \times (8750)$ ~~kWh~~ kWh.

$= 65.7 \times 10^6$ kWh.

Plant capacity factor $= \dfrac{\text{Units/Gen/annum}}{\text{Plant capacity} \times \text{Hours in a year}}$.

Plant capacity ~~factor~~ $= \dfrac{65.7 \times 10}{0.4 \times 8760} = 18,750$ kW.

Reserved Capacity = Plant Capacity − Max Demand.

$= 18,750 - 1,50000 = 3750$ kW.

④. A power station has a daily load cycle as follows 260MW for 6hrs, 200MW for 8hrs, 160MW for 4hours 100MW for 6hrs. If the power station is equipped with 4 set of 75MW each, Calculate ⓘ Daily load factor ⓘⓘ Plant capacity factor ⓘⓘⓘ daily requirement if the calorific value of oil used were 10000 kcal/kg and the average heat rate of station were 2860 kcal/kWh.

Solution.

Max. demand on the Station is 260×10^3 kW.

Unit supplied/day $= 10^3 (260 \times 6 + 200 \times 8 + 160 \times 4 + 100 \times 6)$

$= 4400 \times 10^3$ kWh.

ⓘ Daily load factor $= \dfrac{4400 \times 10^3}{260 \times 10^3 \times 24} \times 100 = 70.5\%$.

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... heat energy produced is used to boil water ...
The heat energy contain in the steam is converted into mechanical energy by using turbine (motion). The ... of the shaft of the turbine (turning) turns the rot... of the generator (Alternator) that is coupled with the shafts. This lead to emf induction (faraday law).

Assignment (Group Term Paper).

1. Hydro-station.
2. Thermal Station — nuclear. / Gas.
3. Solar — Stand alone. / Hybrid
4. Tidal
5. Wind.
6.
7.
8.