Diesel Engine Power plant.

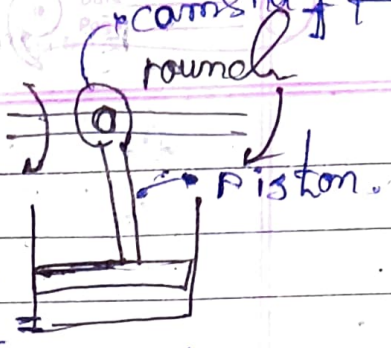
(D) – (G) · Set
Diesel Engine — Alternator.

Selection of site for Diesel power plant.

- This plant should be installed near the load center or At the load center
- Cost of the land should be less.
- for cooling purpose soft water should be avilabl
- If the plant is away from fuel mines ; should be required transportation facility.
- local condition should be such that future expantions of the plant should be possible
- There should be possibility for establishing new industries nearby.
- It should be away from dense populated area to avoid noisane and the trouble for local.

Elements of Diesel power plant.

(i) Diesel Engine.
(ii) Engine Air Entake system
iii Engine fuel system
iv Engine Exhust System
(v) Engine cooling system
(vi) Engine Lubricating system
vii Engine Starting system
viii AC or DC Generator.



Diesel Engine

Suction - when air is Enter into the cylinder

UP - Down 1 revolution

Compression

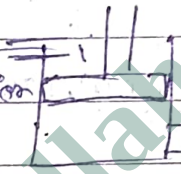
Expansion → combustion of gase produce expand gases

Exhaust

→ when air is compress it become hot.

rotate the shaft

2-Stroke Engine



power more ↑

oil consumption ↑

Efficency ↓

4-Stoke Engine

DN - (1) Suction

UP - (2) compression

DN - (3) Power (Expansion)

UP - (4) Exhaust.

2 revolution of crank Shaft.

Economic Generation.

~~Base load~~ The cost of determining per unit (Kwh) cost of production of electrical energy is known as Economic of power generation.

To determine cost of production.

- Cost of land.
- Depreciation cost
- Interest on capital & staff salary.

Cost of Estimation:-

Fixed cost - Cost which is independent to maximum demand and unit generation.

(a) Annual maintenance cost.
(b) High Rank official salary.
(c) capital cost of land.

Semi fixed cost - depend on maximum demand and independent on unit generation.

- Interest on capital
- Depreciation cost.

Running cost / operating cost.

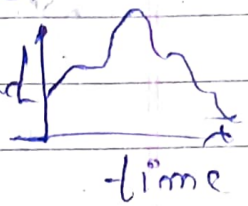
Running cost depends upon number of unit generation.

- Anual fuel cost.
- Clubricating oil cost
- Repair & maintenance cost.

Load factor - used to determine how much generating unit installed in power plant.

→ Also it tells which power system is suitible for load center.

$$\text{Load factor} = \frac{\text{Average load}}{\text{maximum demand}}$$



$$\text{Diversity factor} = \frac{\text{Sum of all ind. max. demand of consumer}}{\text{Max. demand on p.s}}$$

D.F > 1

$$\text{Demand factor} = \frac{\text{Maxm. demand}}{\text{connected load}}$$

Demand factor < 1.

$$\text{Utilization factor} = \frac{\text{Maxm. demand}}{\text{plant capacity}}$$

U.f < 1

$$\text{plant capacity factor} = \frac{\text{Average load}}{\text{plant capacity}}$$

P.C.f < 1

Reserve capacity = plant capacity - Maxdem

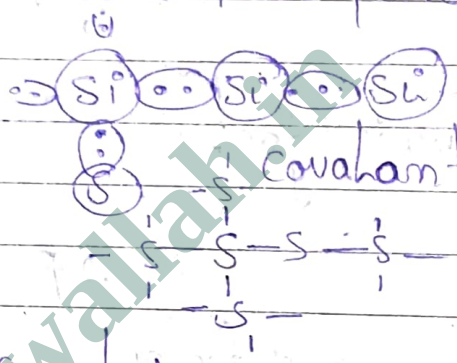
Photovoltic cell or solar cell

PN Junction

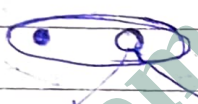
Electron → Hole.

Semiconductor :- Silicon → 14 → Better
Germanium → 32

When temperature is rise then some free Electron is develop.



Bond repair.

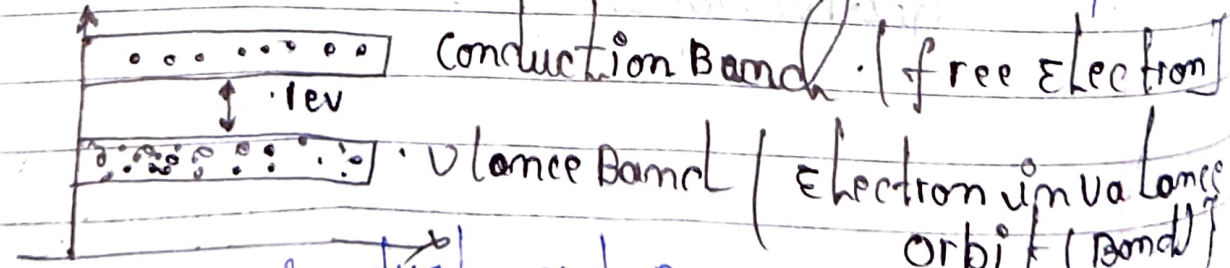


Hole → positive charge property

Hole - When bond is break the hole is create
↓ Vacancy of Electron.

Bond repair - Recombination of Electron - Hole pair.

Bond break - Generation of Electron Hole pair.



Semi conductor have low conductivity

free Electron ↑ Hole ↑

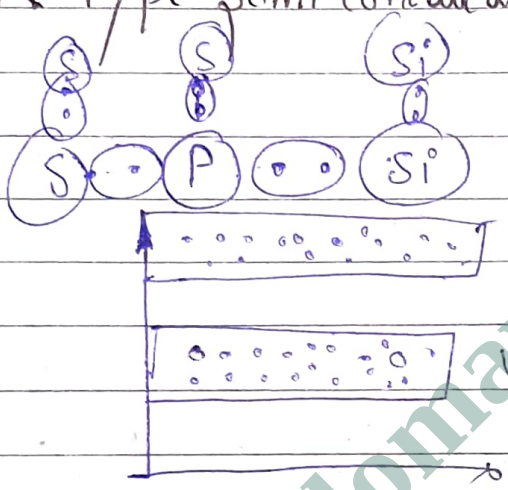
Al
P
As
Sb
Bi

Extrinsic Semi conductor.

pure → poor conductivity.

↳ Doping → better conductivity.

i) N-type Semi conductor. free Electron ↑ by the process of dopping due to doping of impurity.



impurity pentavalent → majority charge carrier

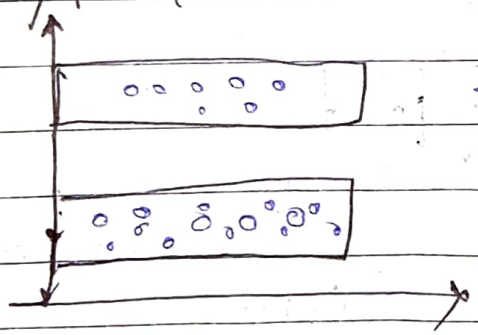
50 + 6

Hole → 6.

Sharing → 4 valancy

Trivalent → 3 share + 1 Hole.

(ii) P-type Semiconductor

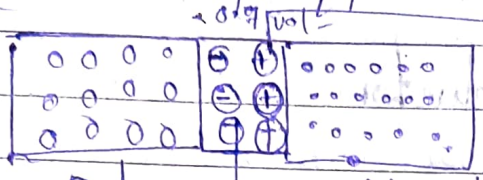


free Electro = 6

Hole → 50 + 6

majority charge conductor

(Conductor) n-type → free Electron
(Conductor) p-type → Hole.



Recombination start
Ion ↑
Recombination stop

→ forward Biasing - conduction.
→ Reverse Biasing - No conduction.

Photo cell → Light

photovoltaic cell: A cell that convert light Energy of sun into Electrical Energy.

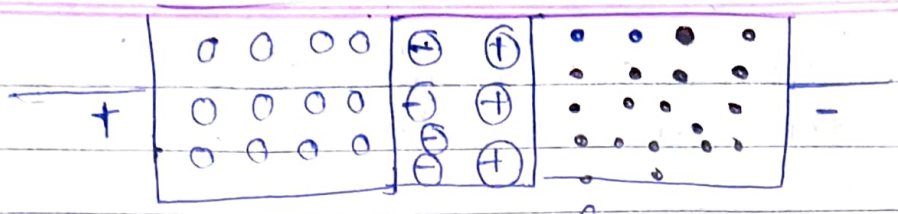
UV ray: the are invisible ~~wh~~ light which have high energy.

free Electron ↑

Photo-voltaic Effect.

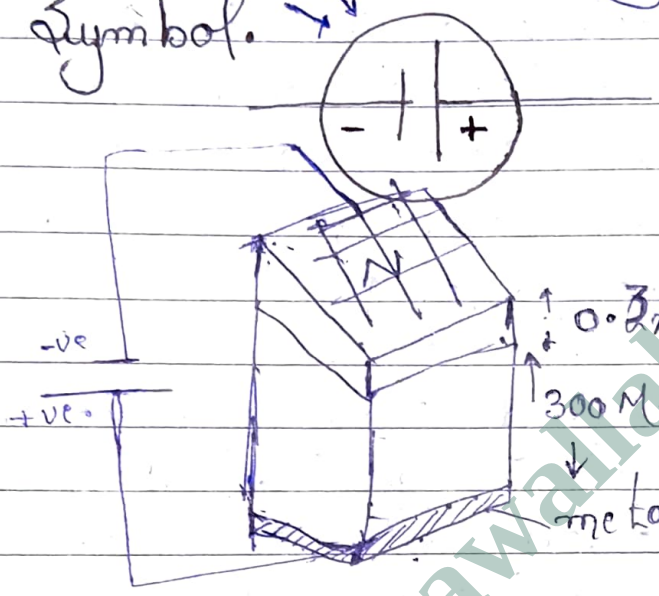
PN Junction
free Electron + Hole pair

$E = h\nu > E_{go}$ → 1.1eV



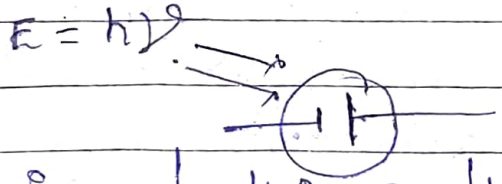
photovoltage. 0.5V - 0.6V.

Symbol.



Construction - It consist of a PN junction in which N- Region has small thickness (0.3 μm) and P-region has large thickness (300 μm) as shown.

Solar cell - It is a PN Junction which converts Solar Energy into Electrical Energy. It is also known as photovoltaic cell.



Here N-region is made thin so that light falling on the region reaches the depletion layer easily.

Two terminal are brought out from the P-region (+ve terminal) & N-region (-ve terminal)

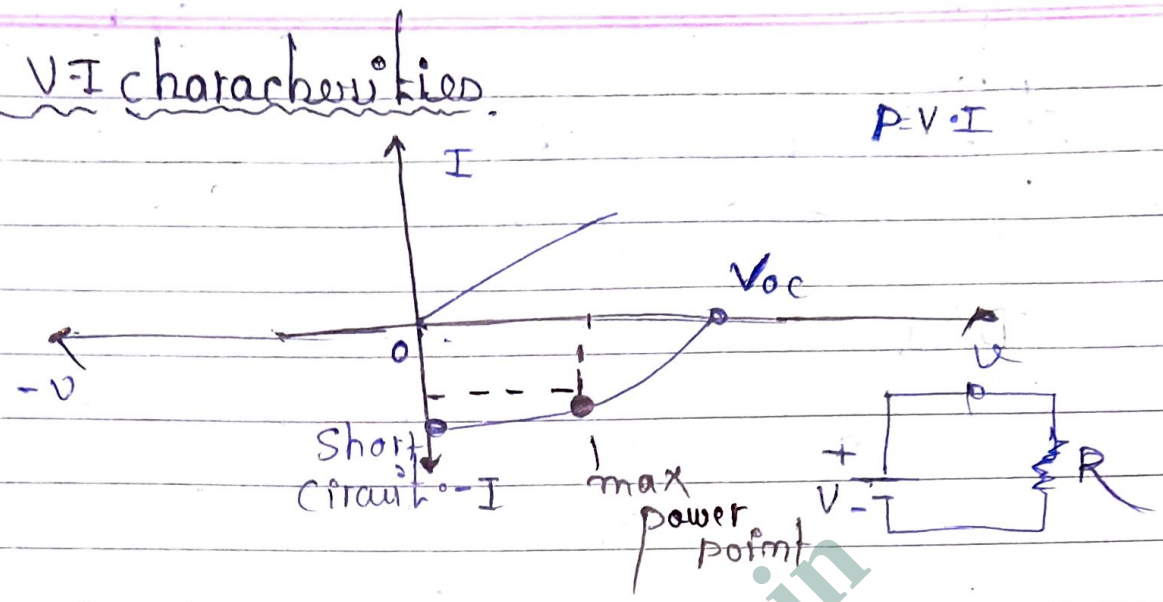
Here terminal from P-region is brought out by the help of metallic conductor, but terminal from N-region is brought out with the help of metallic fingure. So, that it can not stop the light falling to N-region which have to reach the depletion layer.

Working - when light (photons) having Energy more than forbidden Energy Gap ($h\nu > E_g$) fall on the N-region it reaches to the depelation layer due to which Electron-hole pairs are genetation at the junction. Here Electron moves towards N-region & Hole moves towards P-region due to junction field. Therefore Electron are collected at the N-side of the solar cells & Holes are collected the P-side of the solar cell which creates potential Difference (photo voltage) between the top & bottom metal Electrodes (or terminals).

when an external load is connected between the two terminal a Current (I) called photo current will flow.

Generally a Single Solar cell produce 0.5-0.6 V only.

V-I characheristics.



Materials used in Solar cell.

Semiconductor - Si, Ge. - 20 - 25%.

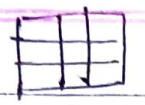
(i) Single Crystal silicon solar cell. - 14 - 15% less cost
(ii) Multiple Crystalline solar cell. - 4 - 8%.
(iii) Amorphous silicon (a-Si) Solar cell. - 2.2 - 28%
(iv) Gallium Arsenide cell. 18% less cost / costly.
(v) Copper Indium (Gallium) Diselenide (CIS) cell. 10% - 08% -
(vi) Cadmium Telluride (CdTe) cell.
(vii) Organic PV cell.

Solar module :-

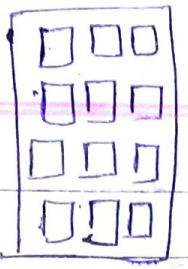
→ A bare single PV cell can not used for outdoor Energy generation because

(i) Out pout of single PV cell is very small.
(ii) It requires protection (capabulation) against dust

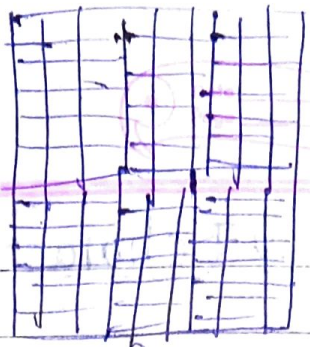
Solar modules is building block of PV System.



Single crystalline cell

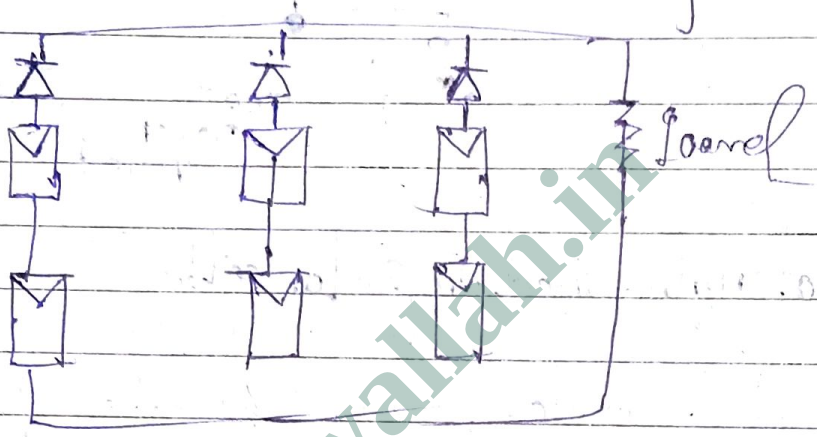


Module



Solar PV panel.

Diode → make uni directional flow.

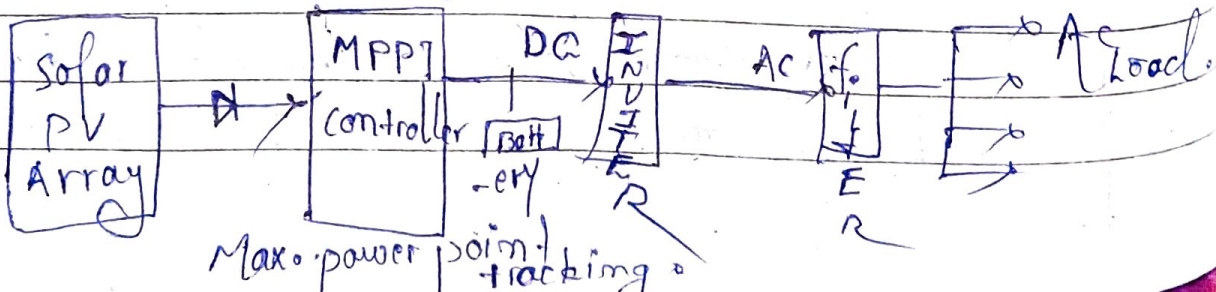


Solar PV Array:-

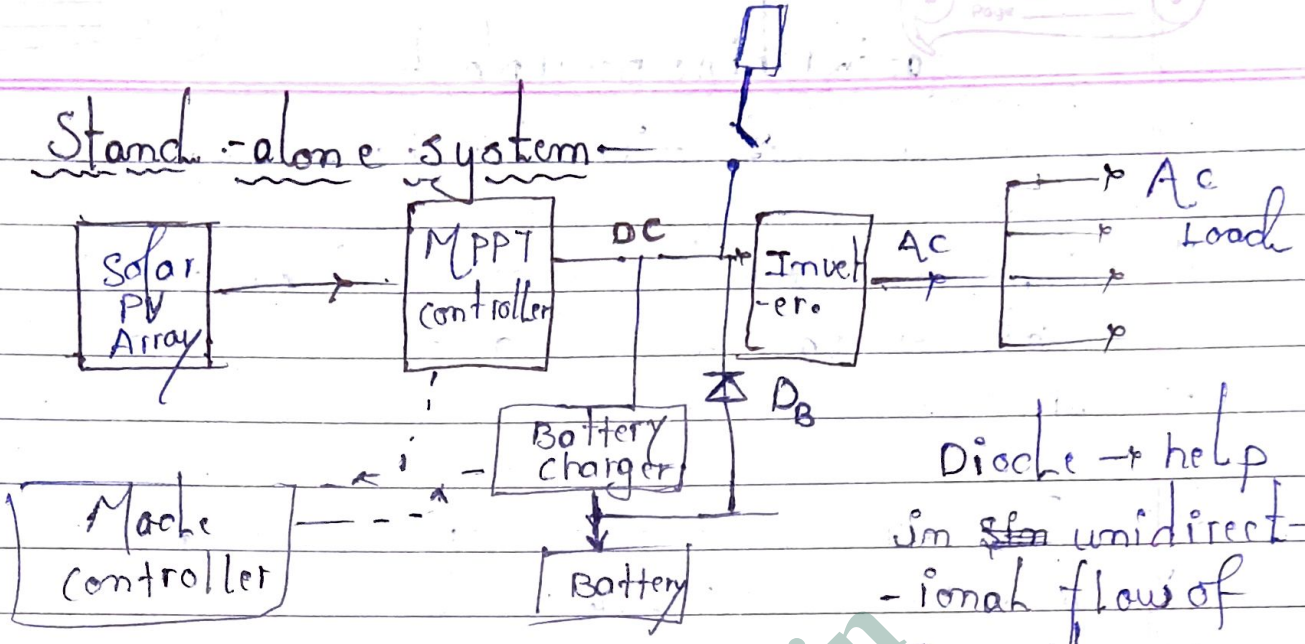
A large number of interconnected solar panels is known as solar PV array.

Classification of Solar PV system

(i) Central power station system.
(ii) Distributed system.
  (a) Stand alone system
  (b) Grid Interactive system.
  (c) Hybrid system consumer

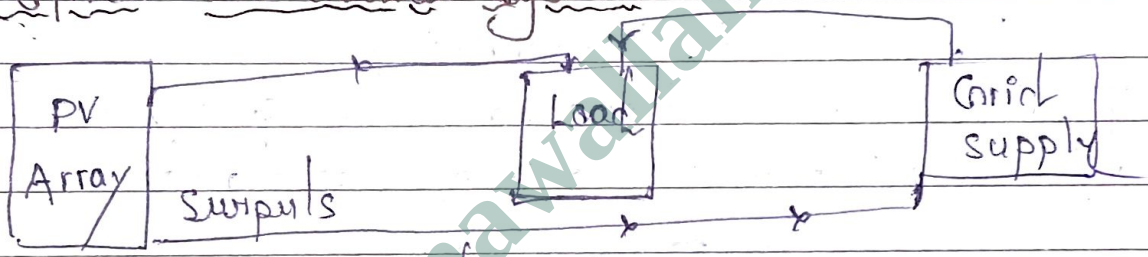


Stand-alone system

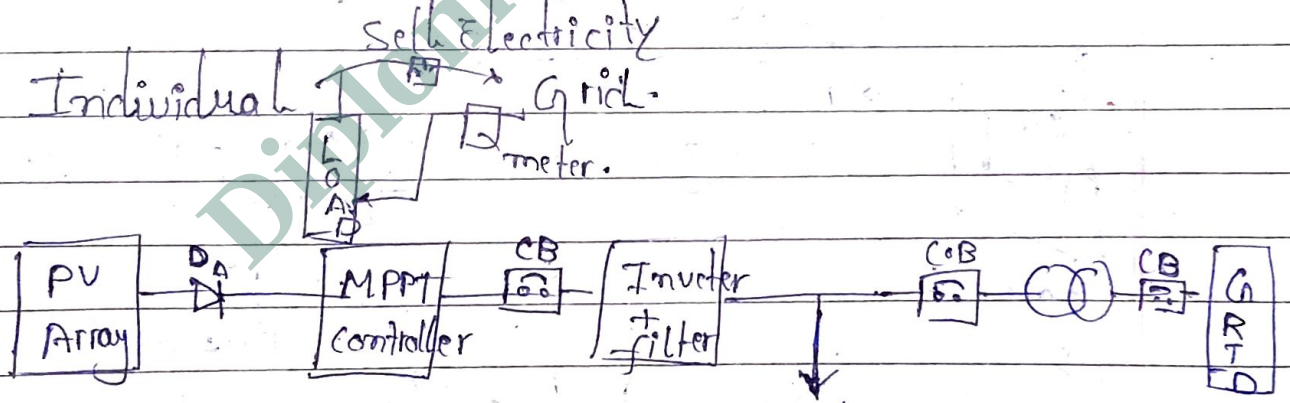


Diode → help in ~~the~~ unidirectional flow of current.

Grid Interactive system.



Individual



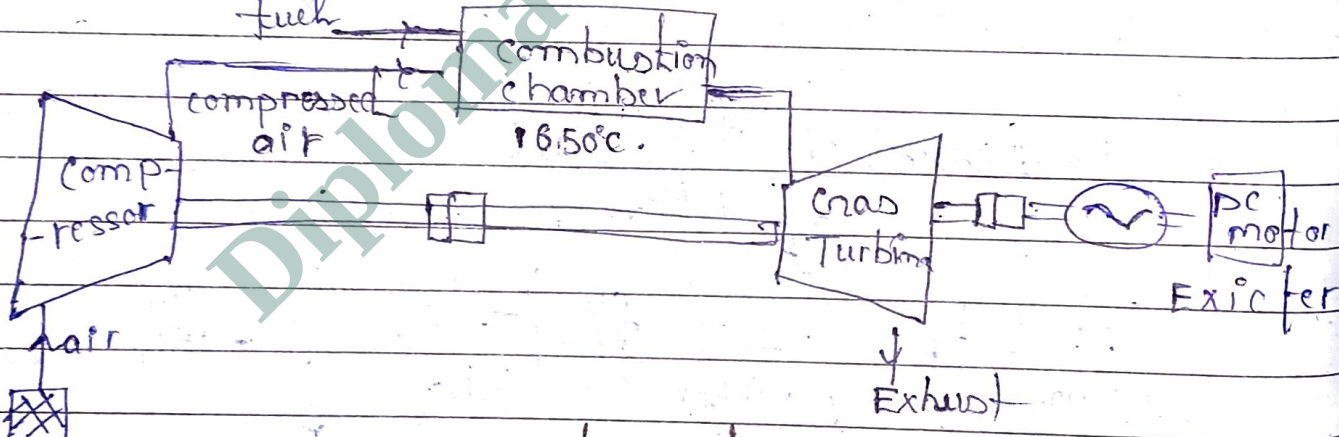
Gas turbine power plant

Intermediate fluid is not required.

Natural Gass (80% methane) have very high calorific value is used as fuel.

→ LPG

→ Gas turbin is used as prime mover.
→ Gas is directy expand in turbine
→ Working medium is Mixture of combustion product and air or heated air at a certain pressure and higher initial temperature.
→ Turbo compressor working medium to a high pressure.
→ It is the burn in the combustion chamber.



Aeroderivative:

Air craft Enginee.

Overall Efficiency of a Gas turbine power plant is limited since a large portion of power developed by turbine is used by compressor and limitation of temperature due to safety purpose.

Aeroderivative gas turbine based on aircraft Engine technology is widely used as gas-turbine.

Advantage—

- Simplicity of design and installation
- Less maintenance cost.
- High reliability
- Simple lubrication system
- Clean Exhaust.
- Compactness.
- Low intial cost.
- No standy losses.
- Requires less cooling water.

Disadvantages—

- Low net output as most of the power developed is used by compressor.
- Low overall Efficency.
- Noisy Operation.
- High Specific fuel consumption.
- Limited unit capacity.

pre-cooling of air to the compressor is required in summer (above 35°) to maintain number of oxygen quantity in air otherwise Oxygen Starvation may occur.

→ Generally temperature of combustion chamber is about 1650°c. therefore life of the combustion chamber is comparitively reduced.

→ External power supply is required for starting of compressor to start the power plant.

Applications –

→ In suppling peak load as this plant can be started quickly.
→ In starting auxiliaries in other power plant.
→ A large number of power pant are used as stand by power plant.
→ It is used in base load power plant.
* where fuel oil or natural gas are cheap & easily
* where there is scarcity of water and load is very low. (15 - 18)%.

→ 8000 MW in India.

Electric Supply System-

The conveyance of electric power from a power station to consumers' premises is known as Electric supply system.

An electric supply system consists of three principal-

→ the power station.
→ the transmission line
→ The distribution line system.

Electric power is produced at the power station which are located at favourable places, generally quit away from the consumers.
It is then transmitted over large distances to load centers with the help of conductor known as transmission line.
Finally, it is distributed to a large number of small and big consumers through distribution network.

Economical proposition- 3 phase, 3 wire ac system.
but distribution power done 3-phase, 4 wire A.C.

(i) DC or AC system (ii) Overhead or Underground system.

Various System of Power transmission

for transmission of electric power; 3-phase, 3-wire, ac system is universally adopted. However, other systems can be used for transmission under special circumstances.

D.C system.

(i) DC two wire.
(ii) D.C: two-wire with mid-point earthed.
(iii) DC three-wire.

	Same max. volt to Earth	Same Max. volt between conduc
Single phase A.C system.		
(i) Single-phase two-wire	1	1
(ii) Single-phase two-wire with mid-point earthed.		
(iii) Single-phase three-wire.	0.3125	1.25
Two phase A.C system.		
(i) Two-phase four-wire.	$2/\cos^2\phi$	$2\cos^2\phi$
(ii) Two-phase three wire.		
Three phase A.C System.		
(i) Three phase three wire		
(ii) Three phase four wire.		

Possible system transmission is difficult system

→ the cost of conductor is most important charge in system.

→ The volume of conductor material is minimum.

Comparison of Various system of Transmission.

The ratio of conductor material in any system compared with that in the corresponding 2-wire DC system.

Here, $\cos\phi$ is the load power factor in an A.C system.

Economic choice of Conductor size.

Therefore the determination of proper size of conductor for the line is of vital importance. The most Economical area of conductor is that for which the total annual cost of transmission line is minimum.

According to kelvin's Law - the total annual cost of transmission line can be divided broadly into two parts parts viz annual charge on capital outlay and annual cost of Energy wasted in the conductor.

(i) Annual charge on capital outlay - This is an account of interest and depreciation on the capital cost of complete installation of transmission line.

for an overhead line insulation cost is constant the conductor cost is proportional to the area of X-section and the cost of supports and their erection is partly constant and partaly proposstional

$$\text{Anual charge} = P_1 + P_2 a$$

Arc.

(ii) Annual cost of Energy wasted:- This is an account of Energy lost mainly in the conductor due to I^2R losses. Assuming a constant current in the conductor throughout the year, the Energy lost in conductor is proportional to resistance.

As resistance is inversely proportional to the area X-Section of the conductor,

Annual cost of Energy lost $= P_3/a$

Total annual cost $= (P_1 + P_2 a) + P_3/a$

the total annual cost is minimum if differentiation of C w.r.t a is zero.

$$\frac{dC}{da} = 0$$

$$\frac{d}{da}\left(P_1 + P_2 a + P_3/a\right) = 0$$

$$\Rightarrow P_2 - \frac{P_3}{a^2} = 0$$

$$\Rightarrow P_2 = P_3/a^2$$

$$\Rightarrow P_2 a = P_3/a$$

i.e, Variable part of annual charge = Annual cost of Energy wasted

Kelvin's law can also be stated in another way i.e, the most economical area of conductor is that for which the variable part the anual charge is equal to the cost of Energy losses per year.

Limitation of Kelvin Law:-

(i) It is not easy to estimate the energy loss in the line without actual load curves which are not available at the time of estimate.

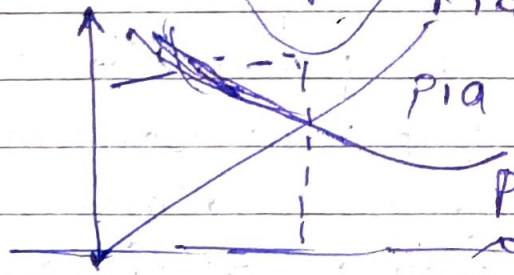
Economic choice of transmission voltage.

$$V = 5.5 \sqrt{0.62l + \frac{3P}{150}}$$

where, V = Line voltage in kV
P = maximum kW per phase to be delivered to single
l = distance of transmission line.

Kelvin's Law:-

Most Economical area of conductor → Annual interest and depreciation cost of conductor = Annual cost of energy wasted.



$$A = \sqrt{\frac{P_2}{P_1}}$$

Biomass power plant

Initial Biomass may be transformed by chemical Intermediate fuel such as methane producer Gas, Ethanol, charcoal etc.

Biomass —Transform→ More convenient Intermediate fuel (Methane, producer Gas, charcoal)

Photosynthesis:

$$xCO_2 + yH_2O + \text{light energy} \xrightarrow{\text{Photosynthesis}} O_2 + C_x(H_2O)_y$$

Carbohydrate

Advantage of Biomass Energy:-

- It is a renewable source.
- The Energy storage is an in-built feature of it
- It is an Indigenous source requiring little or no foreign Exchange.
- Forestry & Agricultural industries that supply feed/stock also provide substance Economic development opportunities in rural area.
- The pollutant emission from combustion of Biomass usually lower than those from fossil fuels.
- Commercial use of biomass may reduce or avoid the problem of waste disposal.

Disadvantage of Biomass Energy —

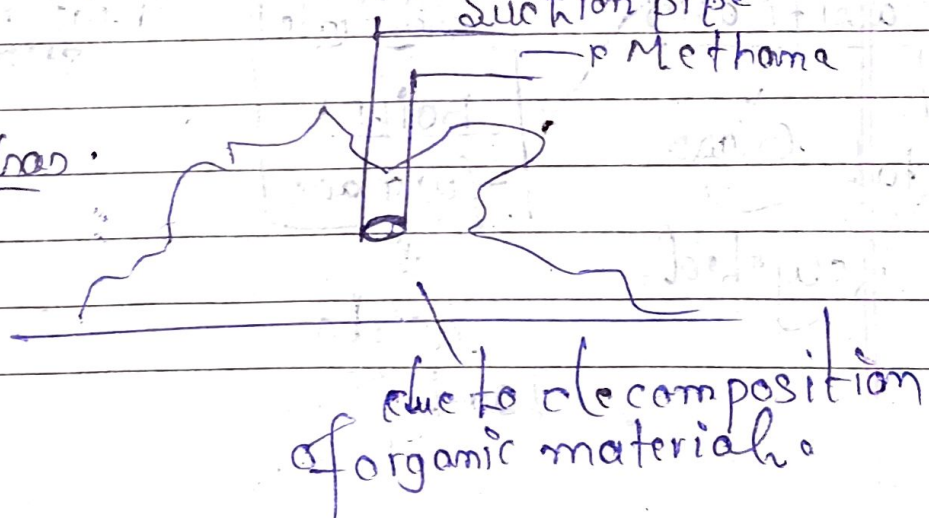
- It is dispersed and land intensive source.
- Generally it has low energy density.
- It is also above intensive. The cost of collective large quantities of Biomass for commerical application is high.
- Capacity of part is determine by the presence of Biomass hence it is not suitable for variable load.
- Not feasible to

MSW Incineration plant
↳ Municipal solich waste.

Urban Waste.
→ Municipal solich waste (MSW or Garbage).
* Incineration (Direct Burning)
* Land fill Gas (LFG) (50% methane).

Sewage (liquid waste).

Land fill Gas.

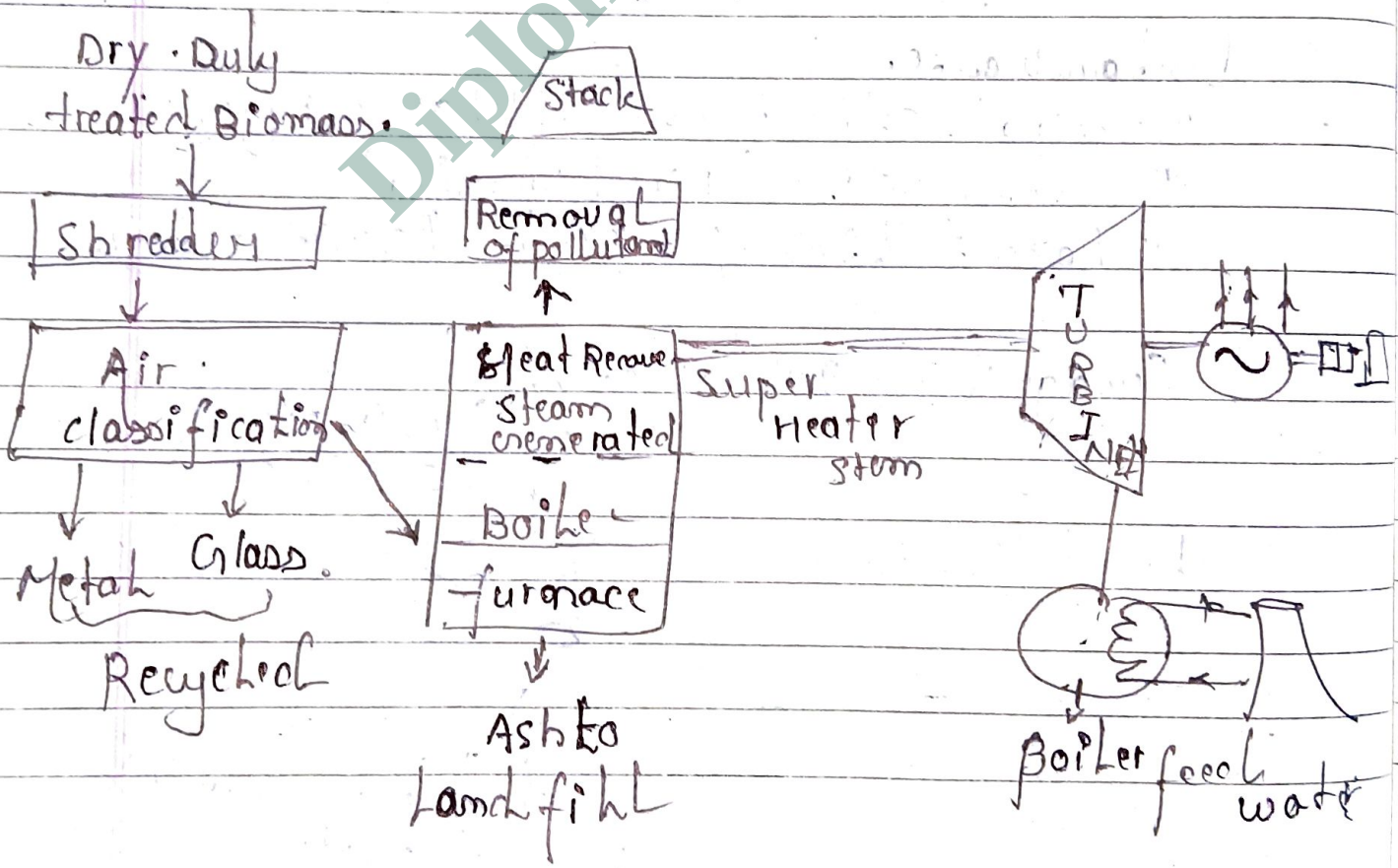


MSW: It is the solid waste generated by households, commerical, Industrial operation and some Industries.

General Data of MSW.

1. Paper & papper bord — 39.2%
2. food & yard waste — 21%
3. Glass — 6.2%
4. Metals — 7.6%
5. plastic waste — 9.1%
6. Wood — 7.1%
7. Others (including Hazardess) — 9.8%

Shredder mill: convert large biomass into small-smaller for further process.



During the process many harmful substances are produce

→ Derivative of sulphur
chlorine
fluorine
Nitrogen.

chlorinated Hydro carbon
< Heavy metal.

polychlorinated dibenzo-p-Dioxins (PCDD)
polychrominated dibenzofurans (PCDF)

Residual ash have high metal concentration.

→ calcium.
→ cadmium
→ lead
→ Aluminium

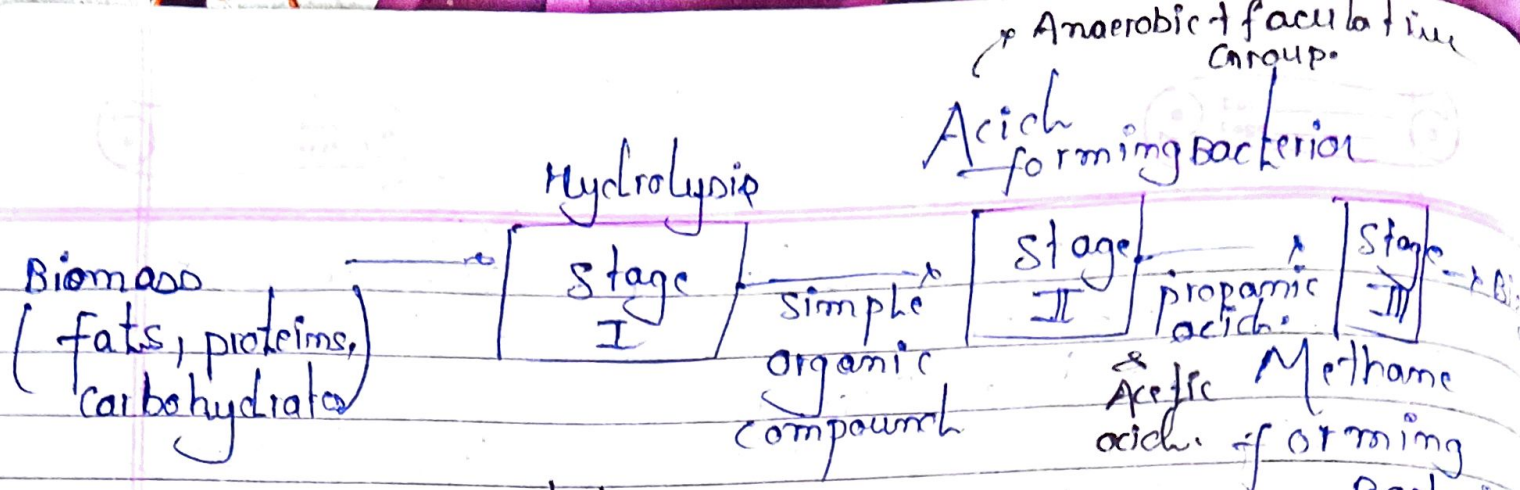
Leachates → causing ground water contamination

Biogas production from waste biomass.

Biomass

Decompose in Open Air → Aerobic Bacteria → [CO_2 + NH_3] No fuel

Wet Biomass (90-95 % water content) → Anaerobic Bacteria (fermentation) → Biogas. (Methane) (CH_4) + CO_2.



Advantage of Aemaerobic Digestion-

→ Discaricech materials are utilisech to get energy otherwise these materials may be wastech.

→ Normally, the waste material cambe ~~divid~~ dried & used as fuel, or it may be usechas fertilizer composting. Here anerobic cligestic gives fuel anch fultizers.

Biomass ⟶ composting ⟶ fertilizer.

→ Waste converted into less offensive anch stable slurry anch most of the clisease cause bacterica are kilech.

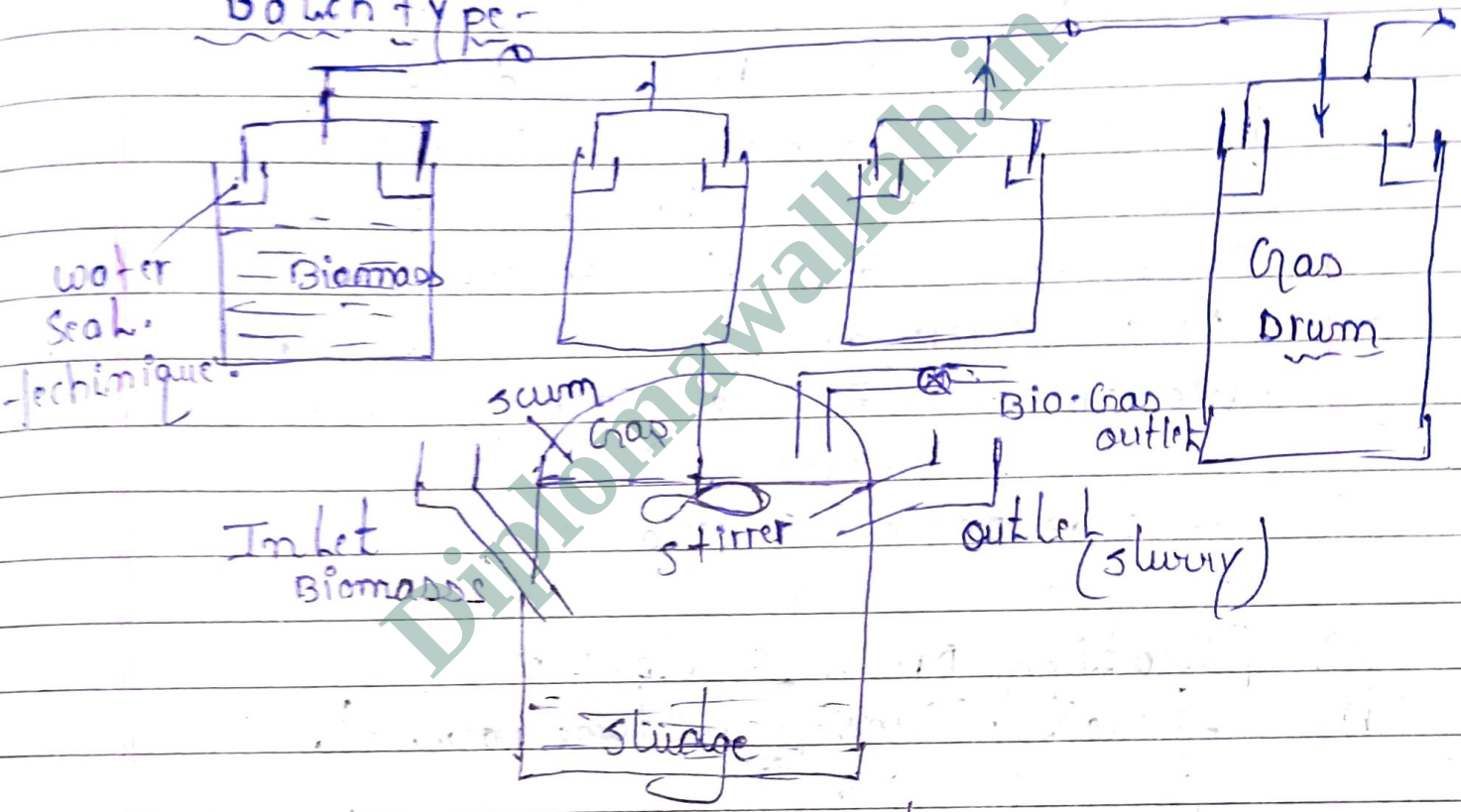
→ Mosquite & flies do not breed in digestech slurry

→ Since the system is enclosech, the odours are containech anch digestech slurry is odourless.

Classification of Biogas plants

(i) Batch type
(ii) Continuous type.
  (a) Floating Drum (constant pressure)
  (b) fixed - Dome (constant volume)

Batch type -

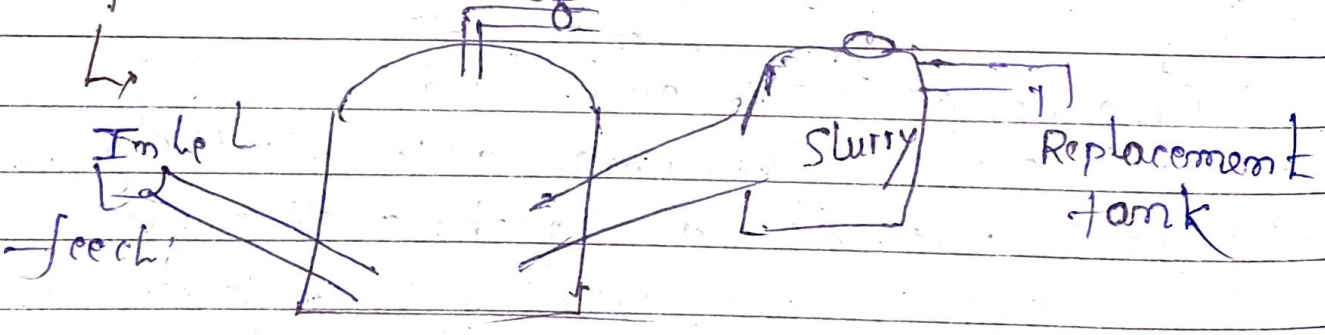


→ Charged at 50-60 day intervals.
→ It starts supply gas after 8-10 day..
→ It supplies biogas for about 40-50 days. till the process of digestion is completed.
→ A battery of digesters are charged and empty one by one in Synchronous manner.
→ Temp → 20-55°

Conclation.

(i) Temperature → 20° - 55°C
(ii) Pressure - 6cm - 10cm water column (1.2 bar). not to Exceed 40 - 50cm of water column.
(iii) Solid to mositure ratio in Biomass → 7 - 9%.
(iv) pH value → 6.5 to 7.5 is maintanied. methane forming Bacteria are sensitive to acidity.
(v) Feeding Rate - $\frac{1}{50}$ volume of the digester should be feed daily.
(vi) Carbon to nitrogen Ratio → 30:1 for maximum microbiological Activity.
(vii) Seeding of Biomass with Bacteria.
(viii) Mixing or stirring.
(ix) Retantion time - 30, 40 or 50 day. depending upon the region ☞
(x) Effect of toxic substance.

(a) Floating Drum (constant pressure)
(b) Fixed Dome (constant volume).



Biofuels

it is Renewable sources.

* fuel wood (Virgin wood)
  16-20 MJ/kg

(ii) charcoal - formed when they burn in absence in Air

(iii) fuel Pellets & Briquettes.

(iv) Bio fuke - Jatropha
- Karanj
- Peanuts

(v) Bio Ethanol.
↳ Sugar cane.

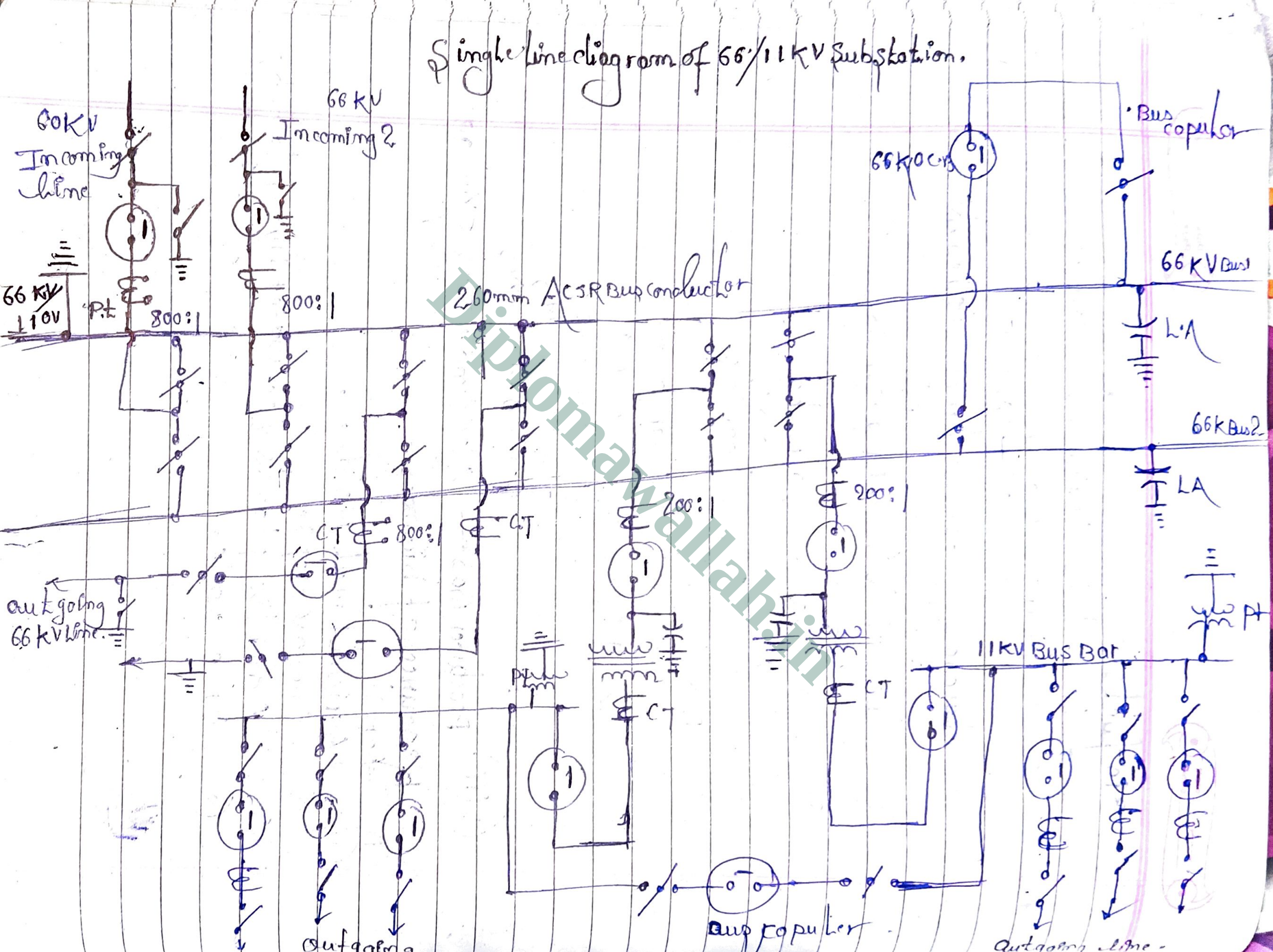
(vii) Biogas. 50-60% CH_4
30-40% CO_2
5-10% H_2
0.5-0.+ N_2

(viii) Producer Gas — Also know as Syn Gas.

Resources of biomass—

(i) forest
(ii) Agricultural Residues.
(iii) Energy crops.
(iv) Aquatic plants [eg. water Hyacinth]
(v) Urban waste.

Single line diagram of 66/11 KV Substation.



Single line diagram of 66/11kV substation.

(i) There are two 66kV incoming line marked 'incoming1' and 'incoming 2' connected to the bus bars such an arrangement of two incoming line is called double circuit. Each incoming line is capable of suppling load or any one line can be called upon the system. The rated sub-station load. Both these lines can be loaded simultaneously to share the sub station load or anyone line can be called upon to meet the Entire load. The double circuit arrangement increase the relability of the system. In case there is a breakdown of one incoming line, the continuity of supply can be maintained by the other line.

(ii) The sub-station has duplicate bus-bar system, one 'main bus bar and the other spare bus bar. The The incoming line can be connected either bus-bar with the help of a bus-coupler which consists of a circuit breaker and isolators. The advantage double bus bar system is that if repair is to be carried on one bus-bar, the supply need not be interrupted as the entire load can be transferred to the other bus.

(iii) There is an arrangement in the substation by which the same 66kV double circuit supply is going out ie. 66kV double circuit supply is passed through the sub-station. The out going 66kV double circuit line can be made to act as incoming line.

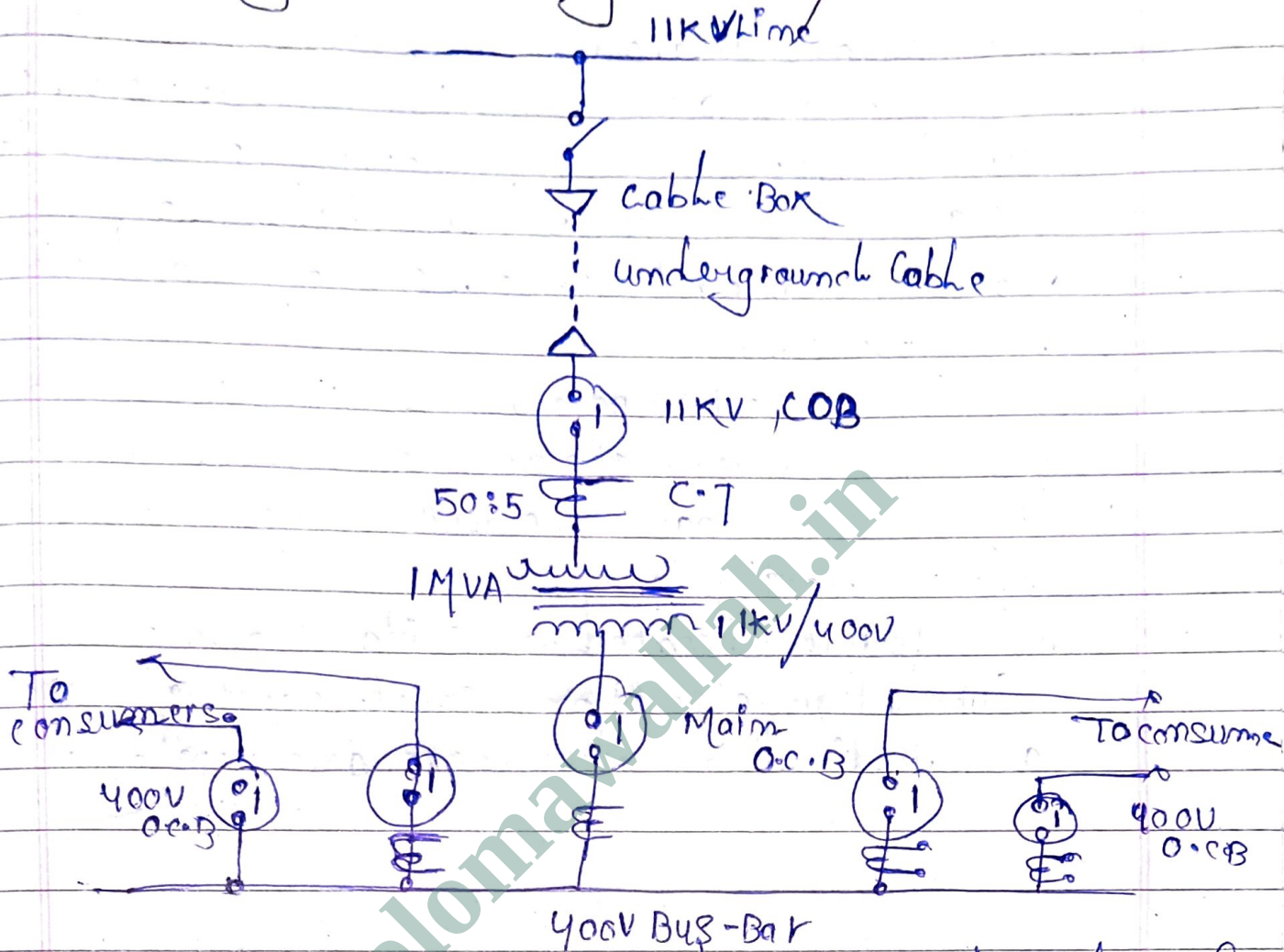
(iv) There is also an arrangement to step down the incoming 66KV supply to 11KV by two unit of 3-phase transformer each transformer suppling to a seperate bus bar. Generally one transformer supplies the Entire Sub-Station load while other transformer acts as a standby unit. If needs arises, both the transformer can called upon to share the substation load. The 11KV outgoing line feed to distribution Substation located near consumer localities.

(v) Both incoming and outgoing line are connected through circuit breaker having isolators on their either end. whenever repair is to carried away the line tower, the line is first switched off and the Earthed.

(vi) The potential transformer (P.T and current transformers (C.T) are suitably located for supply to metering and indicating instruments and relay circuits. The P.T is connected right on the point where the line is terminated. The CTs are connected at the terminals of each circuit breaker.

(vii) There are other auxiliary components in the substation such as capacitor bank for power factor improvement, Earth connections, local supply connection. D.C. supply connection etc, However, these have been omitted in the key diagram for the sake of simplicity.

Single line Diagram 11KV/400V.



(i) The 3-phase, 3-wire 11KV line is tapped and brought to the gang (group) operating switch installed near the Sub-Station. The G.O. switch consists of isolators connected in each phase of the 3-phase line.

(ii) From the G.O. switch, the 11KV line is brought to the indoor sub-station as underground cable. It is fed to the H.T. side of the transformer (11KV/400V) via the 11KV O.C.B. the transformer steps down the voltage 400V, 3 phase 4-wire.

(iii) The secondary of transformer supplies to the bus bar via the main O.C.B. From the bus bar 400V, 3 phase 4 wire supply is given to the various consumers 400V, O.C.B. The voltage between any two phase is 400V and between any phase and neutral is 230V.

The single phase residential load is connected between any one phase and neutral. 3-phase 400V motor load is connected across 3-phase line directly.

(iv) The CTs are located at suitable place in the substation circuit and supply for the metering and indicating instruments and relay circuits.

Electrical Grid.

Electrical grid is defined as network which interconnects the generation, transmission and distribution unit. It supplies the electrical power from Generating station unit to distribution unit.

The network by these high voltage lines is called the super grid.

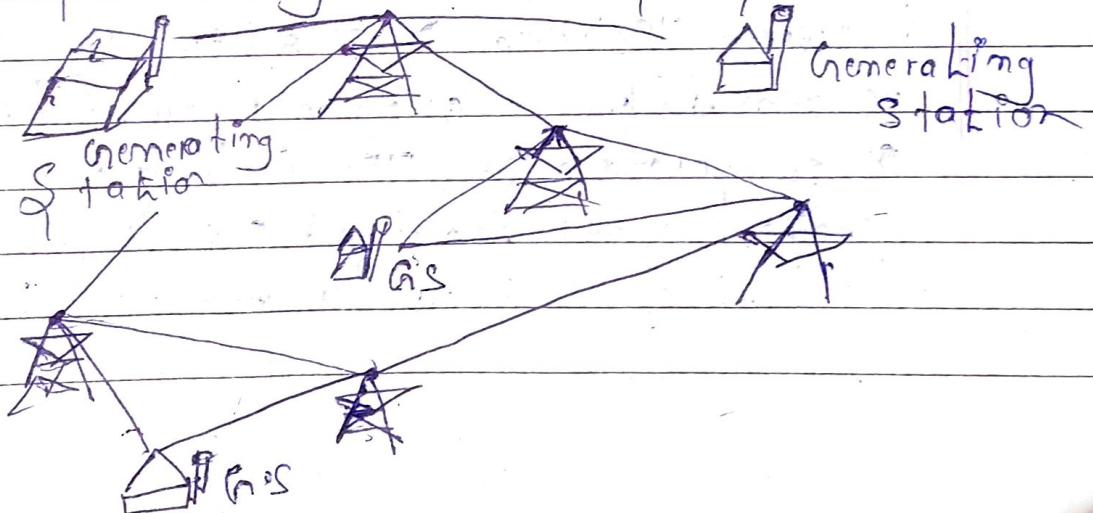
Types of Electrical Grid.

(1) Regional Grid - is formed by interconnecting the different transmission of a particular area through the transmission line.

(2) National grid - It is formed by interconnecting the different regional grid.

Reason for an Interconnection.

The inter connection of the grid provides the best use of power resource and ensure great security to supply. It make the system economical reliable. The generating stations are interconnected for reducing the reserve capacity in each are



If there is a sudden increase in load or loss in a zone, then it borrows from the adjacent interconnected area but for the interconnections of the network certain amount of generating capacity known as the spinning reserve is required.

The spinning reserve consists generator running to normal speed and ready to supply power instantaneously.

Types of Interconnections

The interconnection between network is mainly classified into type i.e. the HVAC Link and HVDC Link.

HVAC (High voltage A.C)

In HVAC Link the two AC systems are interconnected by an A.C link. For interconnecting the A.C system it is necessary that there should be sufficiently close frequency control on each of the two system.

For the 50Hz system, the frequency should lie between 48.5 Hz and 51.5 Hz. such an Interconnection is known as synchronous interconnection or synchronous tie. The AC link provides a rigid connection between two A.C system to be interconnected. But the AC interconnection has certain limitations.

Limitation of AC interconnection:—

01. The interconnection of the two AC systems is the synchronous tie. the frequency disturbance in one system are transferred to the other system.

02. The power swings in one system affect other system large power swing in one system may result in frequent tripping due to which major fault occures in system. the fault cause complete foiture of the whole interconnected system.

03 There is an increase in the fault level if an existing A.C system is connected with the other A.C system with an A.C tie line. This is because the additional parallel line reduces the Equivalent reactance of the interconnected system.

HVDC (High voltage Direct current).

The DC interconnection or DC-tie provides a loose coupling between the two AC system to be interconnected. The DC tie between two AC system is non-synchronous (Asynchronous). The DC interconnection has the certian advantage.

(1) The DC interconnection system is asynchrons thus the system which is to be interconnected is either of the same frequency or of the diff-erence frequency.

→ It also enables the system to operate independently and to maintain their standards frequency.

→ The HVDC links provide fast and reliable control of magnitude and direction of power flow by controlling the firing angle of converters. The rapid control of power flow increase limit of transient stability.

05 The power swings in the interconnected AC networks can be damped rapidly by modulating the power flow through the DC tie. Thus, the stability of the system is increased.

Black start-

A black start is the process of restoring an electrical power oak station or a part of an electric grid to operation without relying on external electric power transmission network to recover from a total or partial shutdown.

Normally, the electric power used with in the plant is provided from the station's own generators. If all of plant's main generator are shutdown, station service power is provided by drawing power from the grid through the plants transmission line.

To provide a black start, some plant have small diesel generators. normally called the black start diesel generators which can be used to start larger generators (of several megawatts capacity), which turn can be used to start larger generators.

Generating plants using steam turbines require station service power up to 10% of their capacity for boiler feed water pumps, boiler forced-draft combustion air blowers and for fuel ~~per~~ preparation It is uneconomical to provide such large standby capacity at each station.

So black-start power must be provided be over designated tie lines from another station. Often hydroelectric power plants are designated as black-start sources to restore network interconnect-ions.

A black start sequence.

01. A battery starts a small diesel generator installed in hydroelectric generating station.
02. The power from the diesel generator is used to bring the generating ~~sets~~ station into operation.
03. Key transmission lines between the station and other area are energized.
04. The power from the station is used to the Nuclear/ fossil-fuel fired base load plants
05. The power from the base load plant is used to restart all of the other power plants.
06. Power is finally re-applied to the general electricity distribution network and sent to the consumers.

Procurement of black start services (edit)

In the United kingdom the grid operator has commerical agreements in place with some generators to provide black start capacity.

Hybrid PV system

[Solar panel + Battery] + Inverters → Load (AC)

DC system.

When weather is back. The system is fail we added additional components for power generation.

Additional backup.

↳ on Grid PV system.

PV system + Non conventional Energy source

⇒ Hybrid PV system

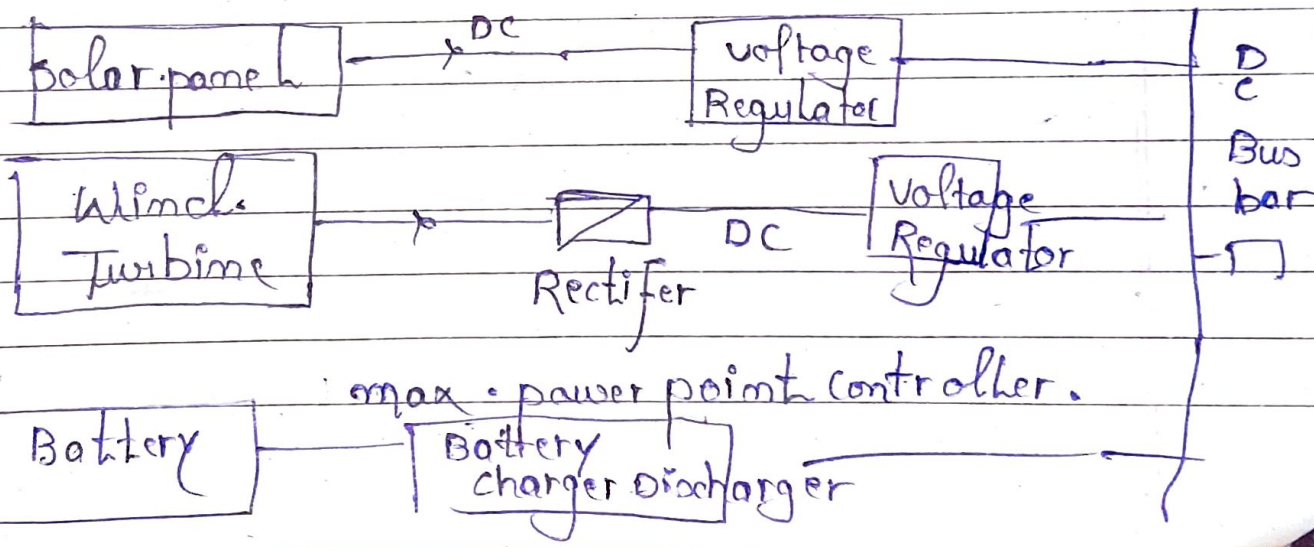
⇒ Efficency more

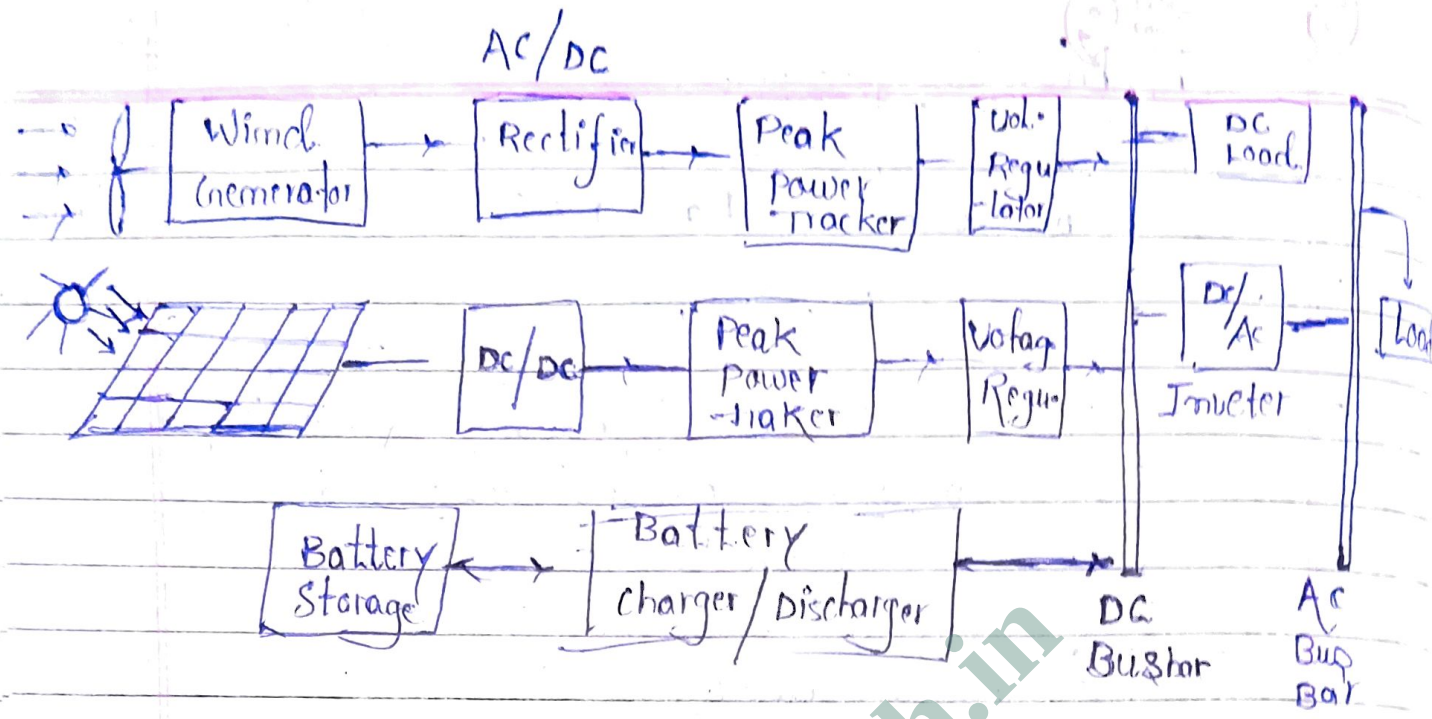
⇒ Reliable.

(i) PV - Diesel Hybrid system

(ii) PV - Wind Hybrid system.

(iii) PV - fuel cell Hybrid system, etc





Demand Side Management

The term demand side management is used to refer to a group of actions designed to efficiently manage a site's energy consumption with aim of cutting the cost incurred for the supply of Electrical Energy, from grid charges and general system charge including taxes.

The aim of these optimisations actions is to modify feature of Electricity consumption with reference to the overall consuption piture, consumption time profile, contractual supply parameter in order to achieve saving in Electricity charge.

Ensure a blance between energy consumption and the amount of power fed into the grids, grid managers, can now utilize generation and consumpti- -on systems that offer so-called "grids services" in return for payment, this increasing the cost for the Electrical system.

In order to engage in Demand Management, the first requirement is to carry out an in-depth analysis of onsite consuption. this clarifies the peculiarities of Each individual site and whether consumption habits can be optimised without resorting to additional instruements.

Whenever a change in habits is not feasible or simply not sufficient to achive the desired cost reduction the on-site instalation of the following can be evaluated:

* Batteries (BESS - battery storage systems)
* Renewable source systems (photovoltaic, wind.
* Cogeneration systems.

It will then be necessary to acquires an Energy management systems, which is dedicated computer system that will.

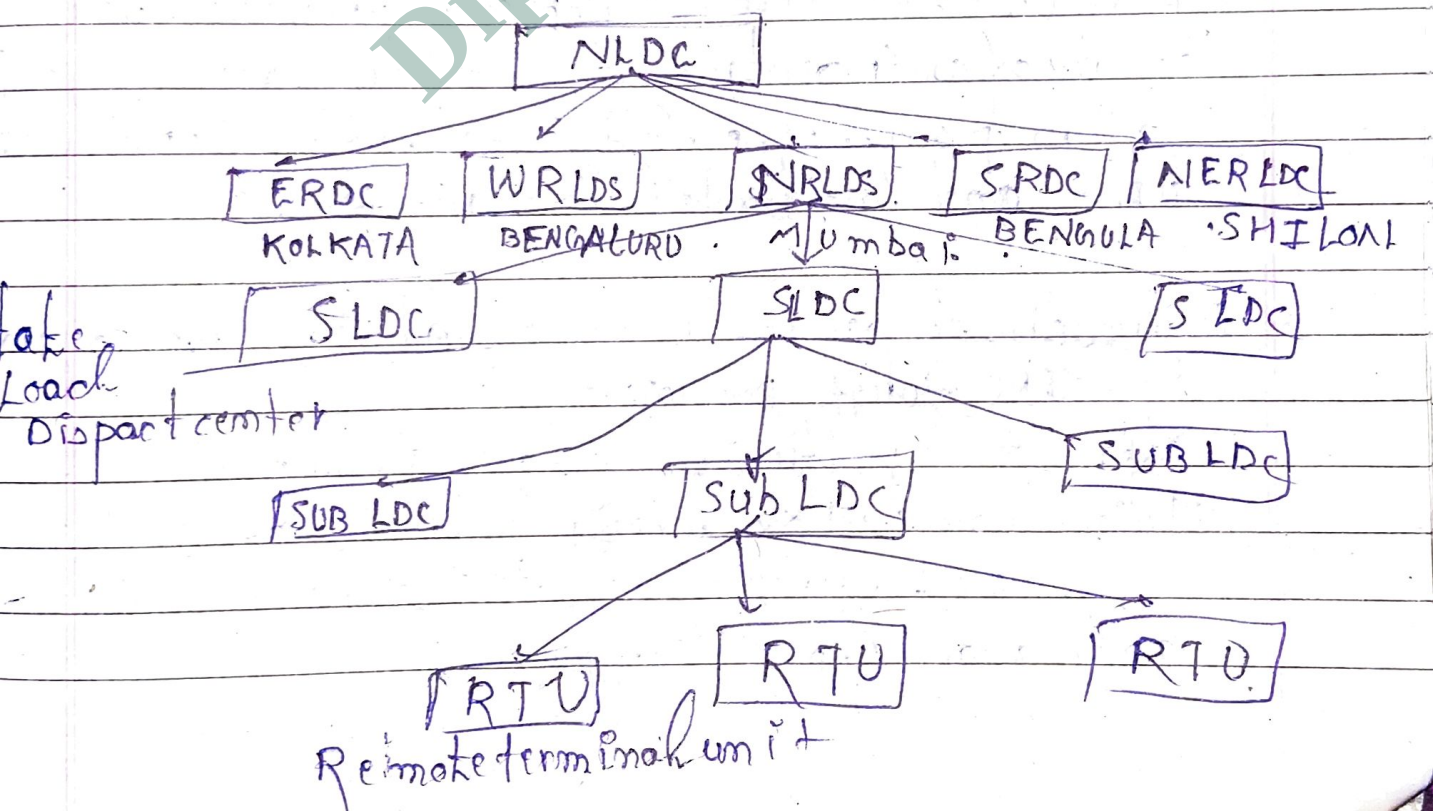
→ Monitor and check all the assets involved (consumption like, battery, production systems.
→ Optimise in real time the contribution of the batteries and production system to auto cost associated with in take from the grid and minimise battery aging.
→ Use the assets involved to supply serives to the grid.

Load Dispatch center.

Load dispatch center is an important link between generation and transmission, which co-ordinates the power requirements of consumers of electricity.

Objective of Load dispatch center.

- It monitors Grid operation.
- It keep account of quality of power supply transmitted through the regional grid.
- Load forecasting.
- It provide system security and islanding facility
- It performs scheduling of generating unit and transmission line.
- Energy distribution and load pattern studies.
- It exercise supervision and control over inter state transmission system.
- Communication and Scada management.



Equipment used in load dispatch center.

- Computer system
- Control Desk
- Annunciation panels.
- MIMIC DIAGRAM.
- COMMUNICATION.
- TELEMETRY Other equipment used in LDC Are.
  - (i) Diesel Generator set.
  - (ii) heating ventilation and Air-conditioning System
  - (iii) DC Battery Room
  - (iv) Harmonic free AC Supply
  - (v) UPS.

Duties and Responsibilities.

Distribution Companies.

BESCOM (HESCOM, MESCOM, GESCOM) is vested with the duty of distribution of power to consumers. In this process, the following supplementa duties and incidental to main function.

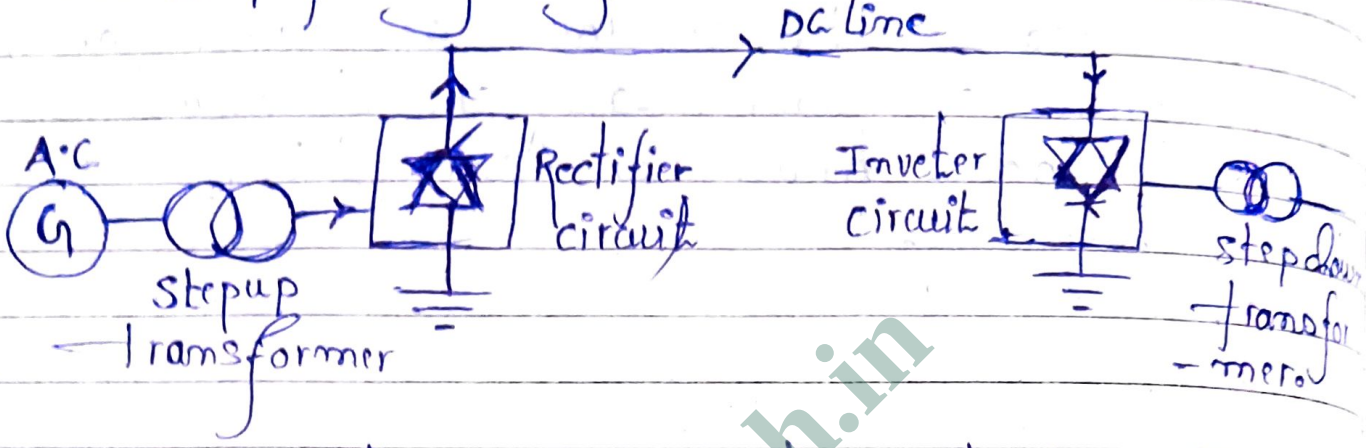
- Distribution of power to consumers at the rates approve by KERC Tariff Regulation.
- Supply at specified voltage and frequency.
- Maintenance 11 KV lines, distribution of transfo -rmers and equipments to Ensure reliable and quality power supply.

Unit office.

Operational & maintenance Unit is the primary link between the consumer and the Company. It is the lowest office in hierarchy, where consumer relationship is established. It is headed by an ~~Engi~~ Assistant Engineer or Junior Engineer.

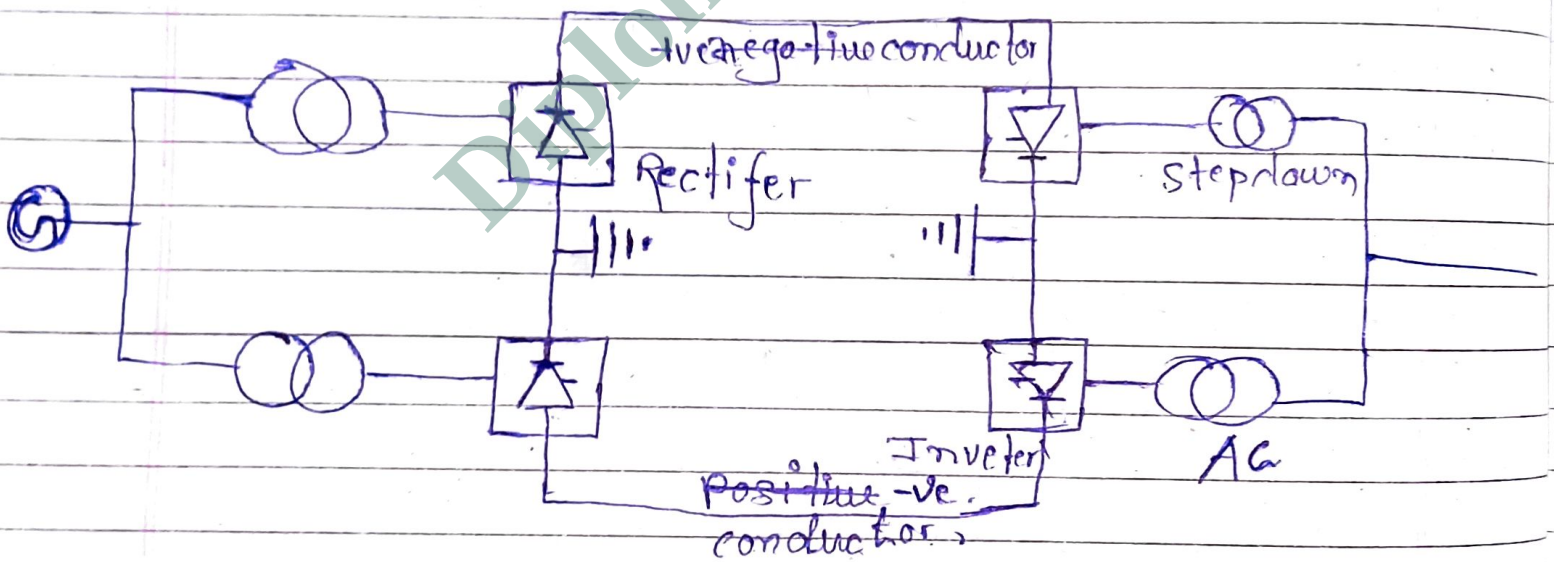
Types of HVDC Links

Monopolar links - and we transmit the D.C power by help of single negative conductor.



→ In this system we use single conductor that's why it is known as monopolar link

Bi-polar HVDC.

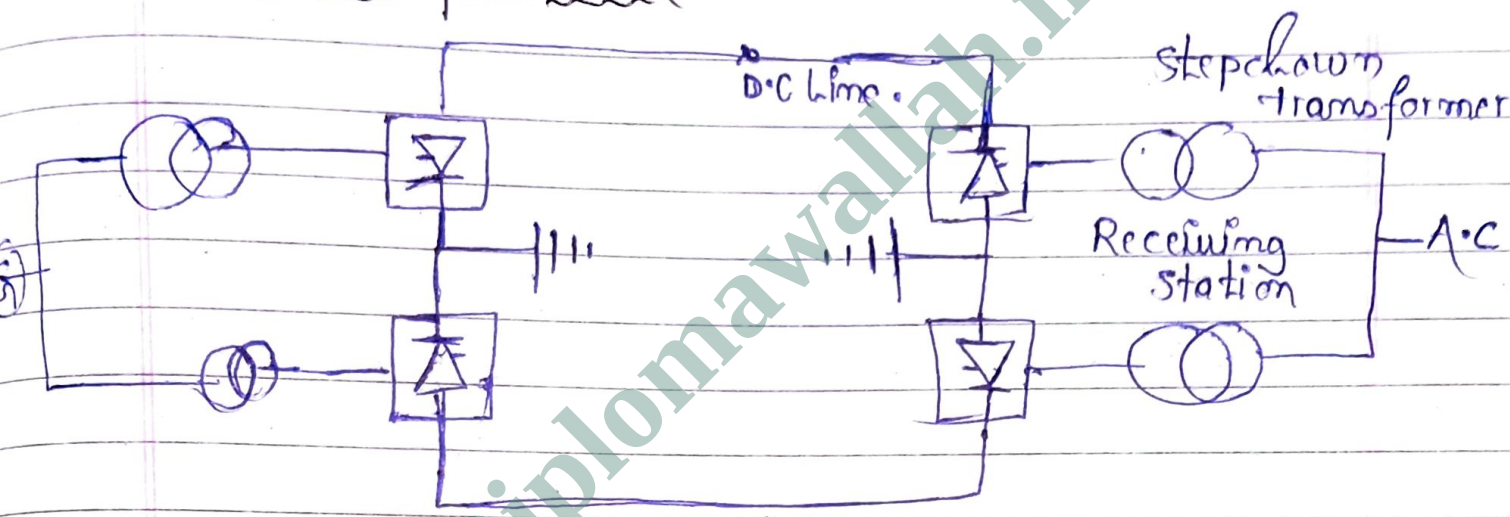


In bipolar link two type of conductor are used positive conductor negative conductor.

* two converters are placed at sending and receiving station.
# at generating station we increase the voltage of A.C and given to the converter-1

When fault occurs in any one conductor then earth work as returning path.

Homopolar link.



HVDC transmission line-

No skin effect:- The current density is uniform thaughtout the line conductor hence there is no skin effect in HVDC system.

Switch Gear & Switchyard.

A switching station that connects or disconnects plant from transmission line network.

"Set of facility outside the power plant through which power is supplied to transmission n/w at same voltage level."

Open area that contain switch gear element to connect or disconnect of generation and transmission side.

Switchgear - Collection of switching and safety devices that control protect and isolate power system.

Switchgear is located on both branch L.V side.

Components of switchgear.

Power conducting components
→ that make or break the flow of Electric power.
- L→ Circuit breaker
- L→ Isolator.
- → fuse.
- → lightning arrestor.

control system components
That monitor, control and protect power conducting components.
- L→ CT, PT
- L→ Realy
- L→ control pannel
- L→ Monitoring Equipment

Vital Function of switch gear.

→ Interrupt S.C overload fault current while maintaining service unaffected
→ Provide isolation of ckt from power supply
→ Enhanced system Relability
→ By allowing more that one sources to feed a load.

Switchyard

- Identification marks ←
  does not contain power transformer
- ## interference generating and transmission side by switching power of same voltage level

Substation.

Identification marks must contain Transformer
change voltage level and make power suitable for transmission and distribution.

** Highest voltage transmission

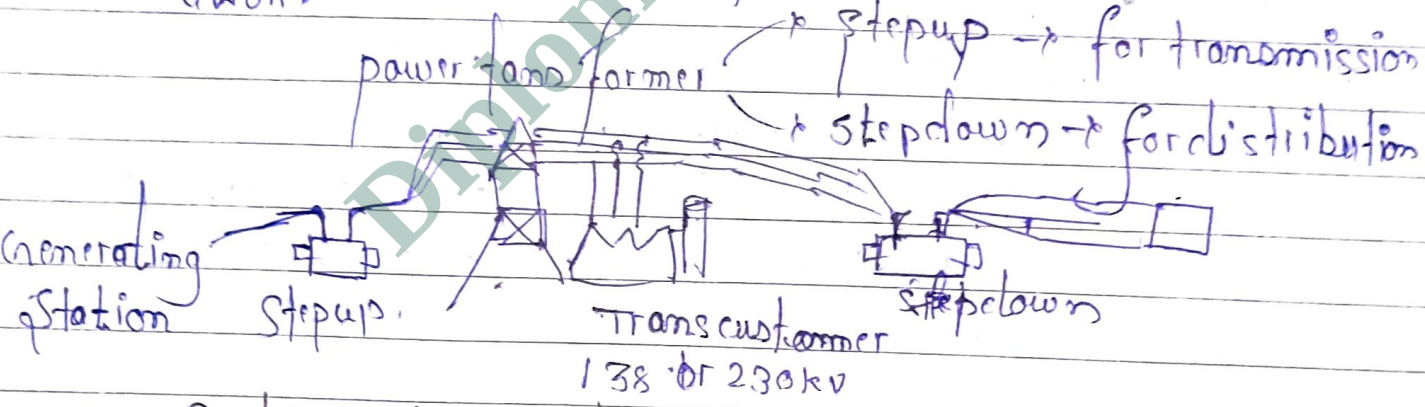
In India

AC = 765 KV
DC = 800 KV

Work
AC - 1150 KV

Substation.

* Electrical station that modifies electric power and make it suitable for transmission and Distribution.



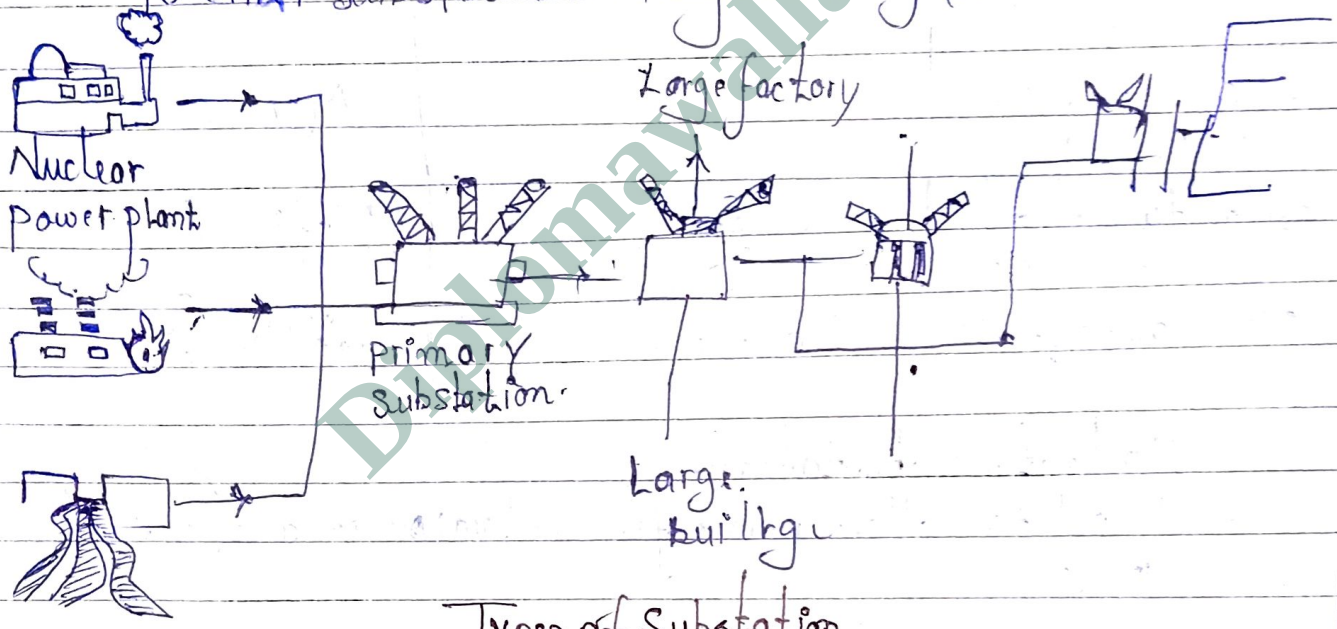
Rating of Substation

Substation are generally rated on the basis of (1) MVA capacity of transformer
(2) voltage level of incoming and outgoing line.

220 KV / 33 KV

function of Substation-

- Change the voltage level.
- Regulate voltage profile using compensation devices.
- Monitering V and I using PT and CT
- Act as switchyard - connector disconnector incoming and outgoing line.
- protect system against surges, lightning by using protective devices like - Surge arrestor, lightning Rod
- Send and receive communication signals from one to other substation or to generating station.



Types of Substation

On the basis of Construction
- Air - Insulated switchgear Substation
- Gas - insulated switchgear Substation

On the basis of function
- Transmission
- Distribution
- Converter
- collector
- Sub - Transmission

On the basic of Location
- Indoor
- outdoor

Fuel cell

On the basis of construction

Air-Insulated S.S.
→ use air to insulate conductor and switchgear equipments.

Gas-Insulated S.S.
→ use SF_6 (gas) to insulate conductor and switchgears
→ Space optimization.

On the basis of location.

Particular	Outdoor Substation	Indoor Sub. S.
1. Space requirement	more	less.
2. Time required for erection or future expansion	Less	More.
3.	Easy.	Difficult
4. fault location	Easier.	Difficult.

Collector substation—
→ Used to collect power from solar power and wind power.