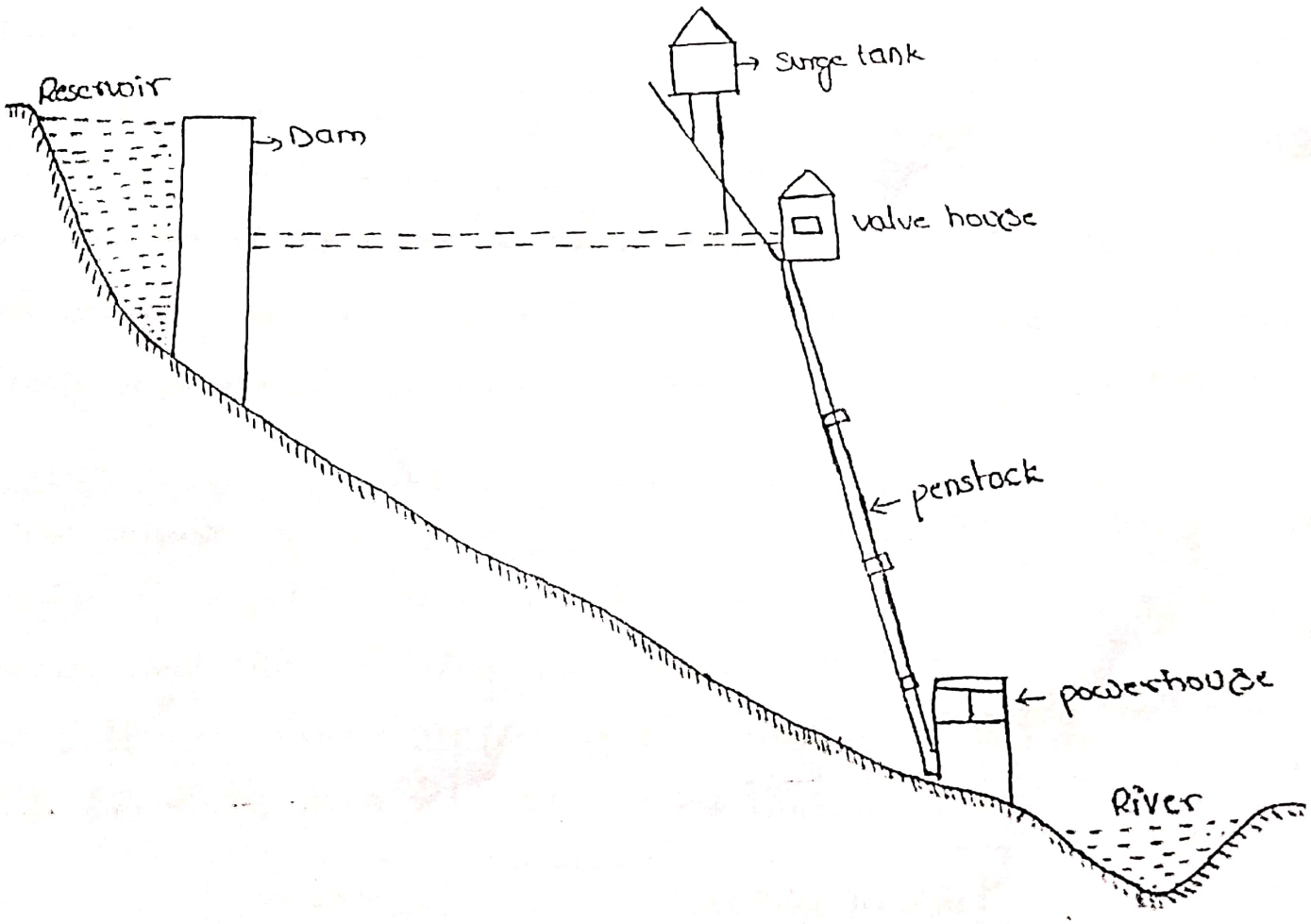
BEEE

UNIT - III

asics of power System:-

Layout and operation of Hydro, thermal, Nuclear Stations - Solar and wind generating Stations - Typical Ac power Supply Scheme - Elements of Transmission Line - Types of Distribution System: primary and Secondary Distribution Systems.

yout of a Hydro power Station (HPS):-



main Components :-

(i) Dam

(ii) Spill way iii) penstock iv) Surge house (v) Head works vi) prime-mover vii) Electrical equipment viii) Reservoir ix) Water turbine

A HPS Simply involes the Conversation of Hydraulic energy into electrical energy. The Schematic arrangement of HPS as Shown in above figure

(i) Dam :- A Dam is a barrier which Safe Stores water and Create water head. Dams are built of Concrete (or) Stone masonary, earth & rock-fill the Dam is also depends on the foundation Condition, Local material and Transportation available

(ii) Spill way Gate Valves :-

There are times when the river flow exceeds the Storage Capacity of the reservoir Such a Situation arises during heavy rain-fall in the Catchment area. Spill ways are Constructed of Concrete pairs piers of the dam.

Penstocks :- penstocks are open (or) closed Conduits which Carry water to the turbine. They are generally made of rein-forced Concrete or Steel

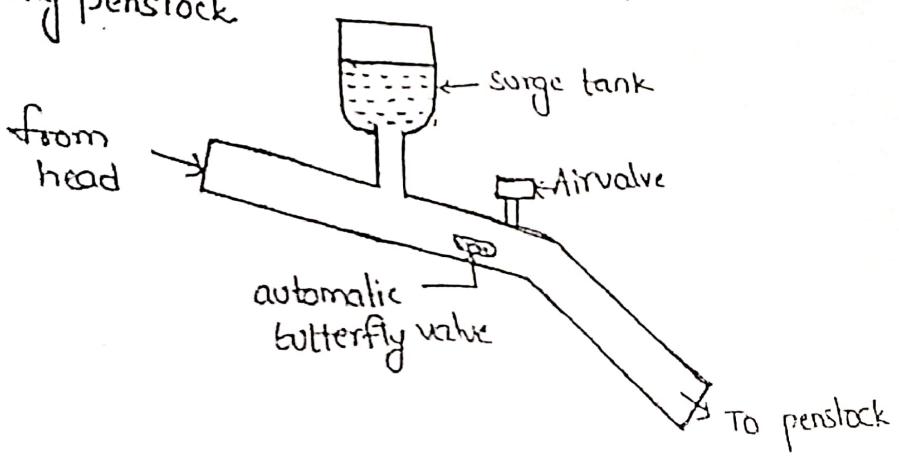
Concrete penstock are Suitable for Low head (< 30m)

Steel penstock are Suitable designed for any head.

Surge Tank :-

It is a Small reservoir (or) Tank (open at top)

These are Large Cylindrical tanks provided near the down Stream end of the Long penstock



function of Surge tank is to provide better regulation of flow of water on the load on the system fluctuates i.e, Store water when the load decreases Suddenly and Supplies extra water to the penstock. when Load increases Suddenly

→ Surge Tank Controls pressure variation resulting from rapid variation

Reservoir :-

→ It is a basic requirement of Hydro electric plant

→ It's purpose is to Store water which may utilized run the prime-mover to produce electric power.

→ It Stores water during the rainy Season and Supplies the Same during the dry Season.

Forebay :-

→ It is a enlarged body of water just upstream of the penstocks.

→ It Serves as a regulatory, reservoir Storing water tempararily. when Load on the plant is reduced to Supply extra water required. when Load increases Suddenly.

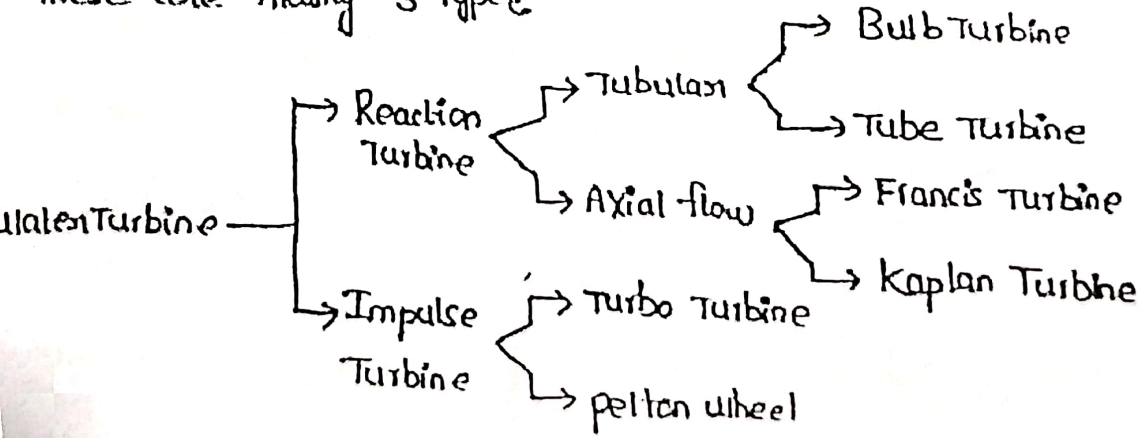
→ It is also known as "head pond".

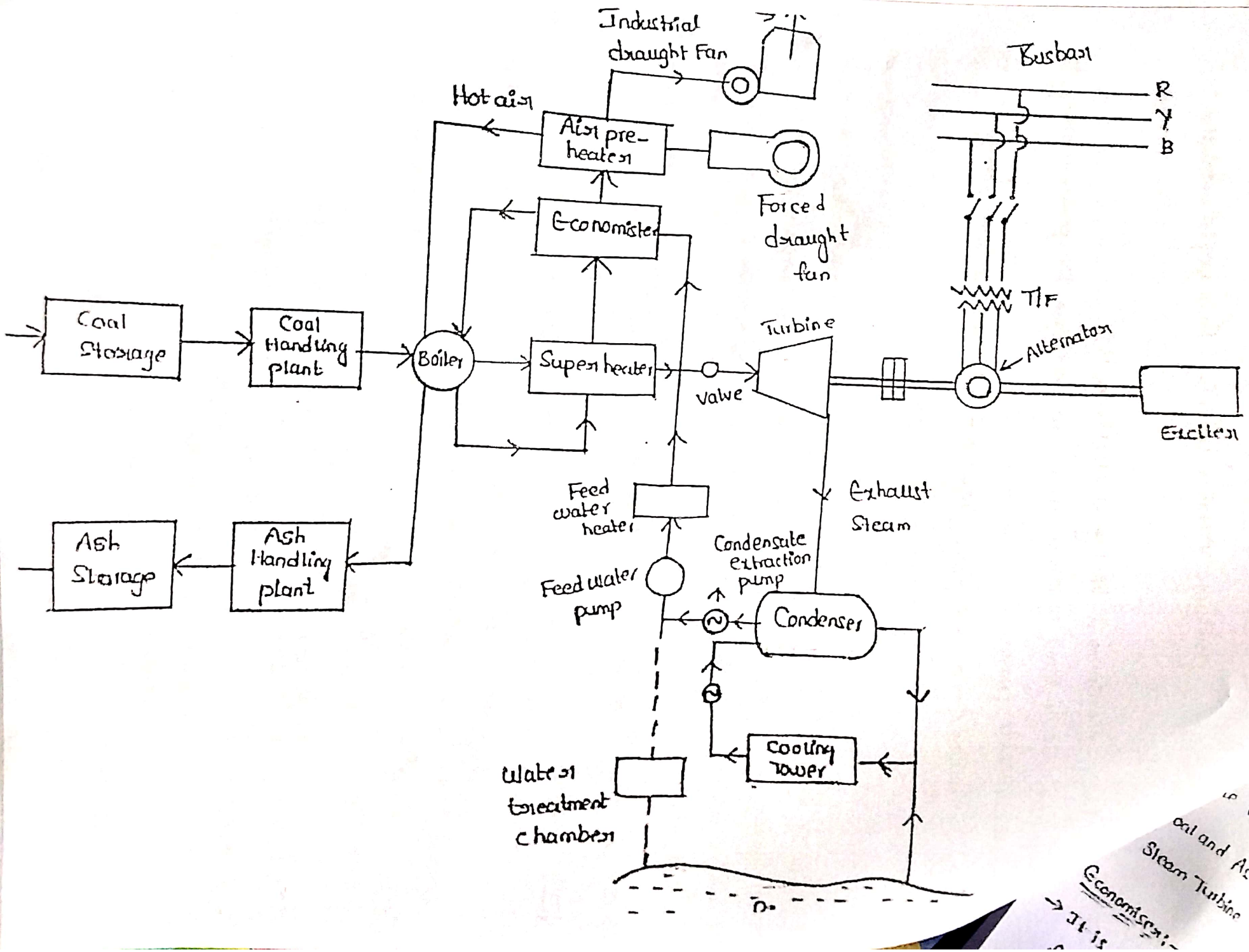
prime-movers :-

The purpose of this is to Convert K.E of water into Mechanical Energy

Electrical Equipment :- It includes (i) Alternator (ii) Transformer iii) Circuit breakers and other Switching and protective devices.

Water Turbine :- Convert the energy of falling water into mechanical energy These are mainly 3 Types




Industrial draught Fan
Hot air
Air pre-heater
Forced draught fan
Economiser
Busbar
R
Y
B
TF
Alternator
Exciter
Turbine
Coal Storage
Coal Handling plant
Boiler
Super heater
valve
Feed water heater
Exhaust Steam
Condensate extraction pump
Feed water pump
Condenser
Ash Storage
Ash Handling plant
Cooling Tower
Water treatment chamber

whole arrangement can be divided into the following stages

1) Coal and Ash handling arrangement 2) Steam Generating plant
3) Steam Turbine 4) Alternator 5) Feed water 6) Cooling arrangement

i) Economiser:-

→ It is essentially a feed water heater and derives heat from the flue gases for this purpose.

→ The feed water is fed to the economiser before supplying to the boiler.

→ It extracts a part of heat of flue gases to increase the feed water temperature

Air preheater:-

→ The air preheater extracts heat from flue gases and increases the temperature of air used for coal combustion.

→ preheating the air are increased thermal efficiency and increased steam capacity per square metre of boiler surface

Steam Turbine:-

The heat energy of steam when passing over the blades of turbine is converted into mechanical energy.

→ The steam is exhausted to condenser which condenses the exhausted steam by means of cold water circulation.

Alternator:-

→ It converts mechanical energy of turbine into electrical energy

→ The electrical o/p from the Alternator is delivered to the bus bar through T/F, CB and isolators.

→ The electrical

Feed Water:-

→ The feedwater on its way to the boiler is heated by water heater and economiser

→ This helps raising efficiency of the plant

Coal and Ash handling plant :-

→ The coal is transported to the power station by Road (or) Rail and is stored in Storage plant

→ From coal Storage plant, coal is delivered to the coal handling plant where it pulverised (i.e, crushed small pieces)

→ The pulverised coal is fed to the boiler by belt Conveyors.

→ The coal is burnt in the boiler and Ash produced after the complete Combustion of coal is removed to the Ash handling plant and then delivered to the ash Storage plant for dispasal.

→ The removal of the Ash from the boiler furnance is necessary for proper burning of Coal.

Steam Generating plant :-

This is Consists of a boiler for the production of Steam and other auxilia equipment for the utilization of flue gases

(i) Boiler :-

→ The purpose of the boiler is to Convert water into Steam at high tempera and pressure.

→ The flue gases from the boiler make their journey through Super heater economiser, air pre-heater and finally exhausted to Atmosphere throu the chimney.

(ii) Super heater :-

→ The Steam produced in the boiler is wet and is passed through Super heater where it is dried and Super heated by the flue gases on their way to chimney.

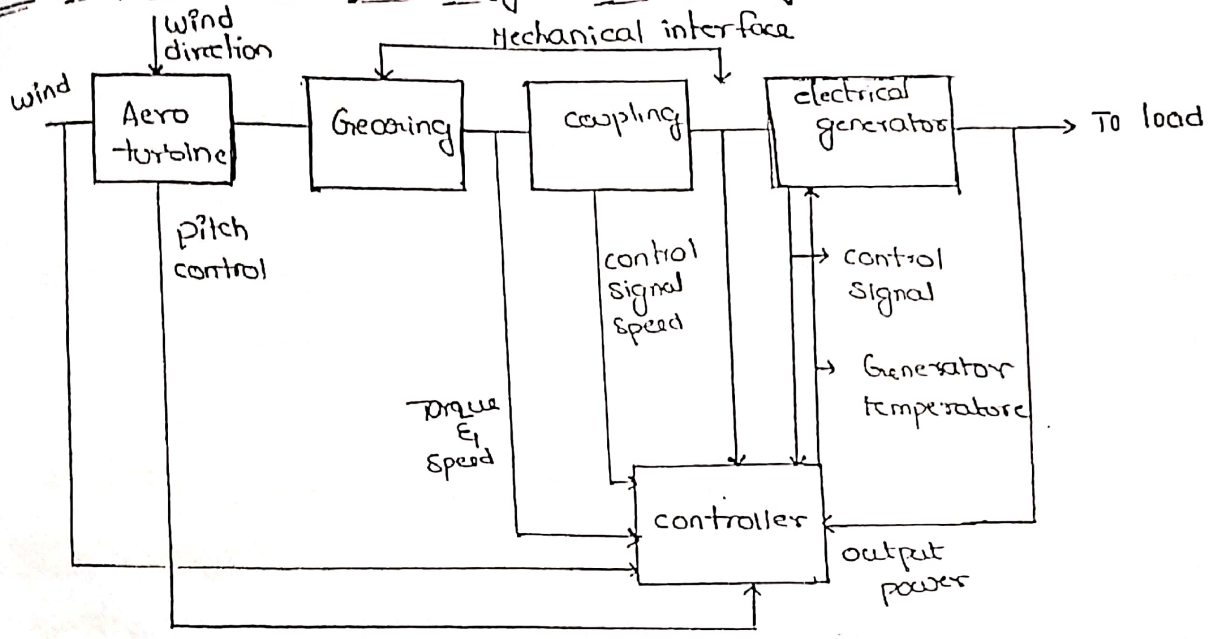
arrangement :-

& circulating water takes up the heat of the exhausted steam and itself becomes hot.

n case the availability of water from the source of the supply is not assured through the year, cooling towers are used

the cold water from the cooling tower is reused in the condenser.

asic Components of Wind energy Conversation System:-



ero Turbine :- which converts energy in moving air to rotary mechanical energy, They require pitch and yaw Control in Horizontal axis.

earing :- A mechanical Gear Consisting of a Stepup gear and Suitable Coupling to transmits the rotary mechanical energy to electrical energy.

w Control :-

The rotor can be fixed orientation with the Swept area perpendicular to the predominant wind direction Such m/c is Said to be Yaw fixed when wind direction changes

In Small m/c Yaw action is Controlled by tailvane In Layer m/c a Servo mechanism operated by wind direction Sensor Controls.

Controllers:-

→ It is used to Sense the wind Speed, direction, Shaft Speed, torques factors :- an appara Control ve a ranium

(or) more points

→ output power and Generators temperature as necessary and appropriate Con Signal for matching the electrical o/p to the wind energy input.

Generator:- Either Constant (or) variable Speed generators are possibility but variable Speed unit are very expensive.

Towers:- pole towers, Rein-forced Concrete towers, & Cross towers are used

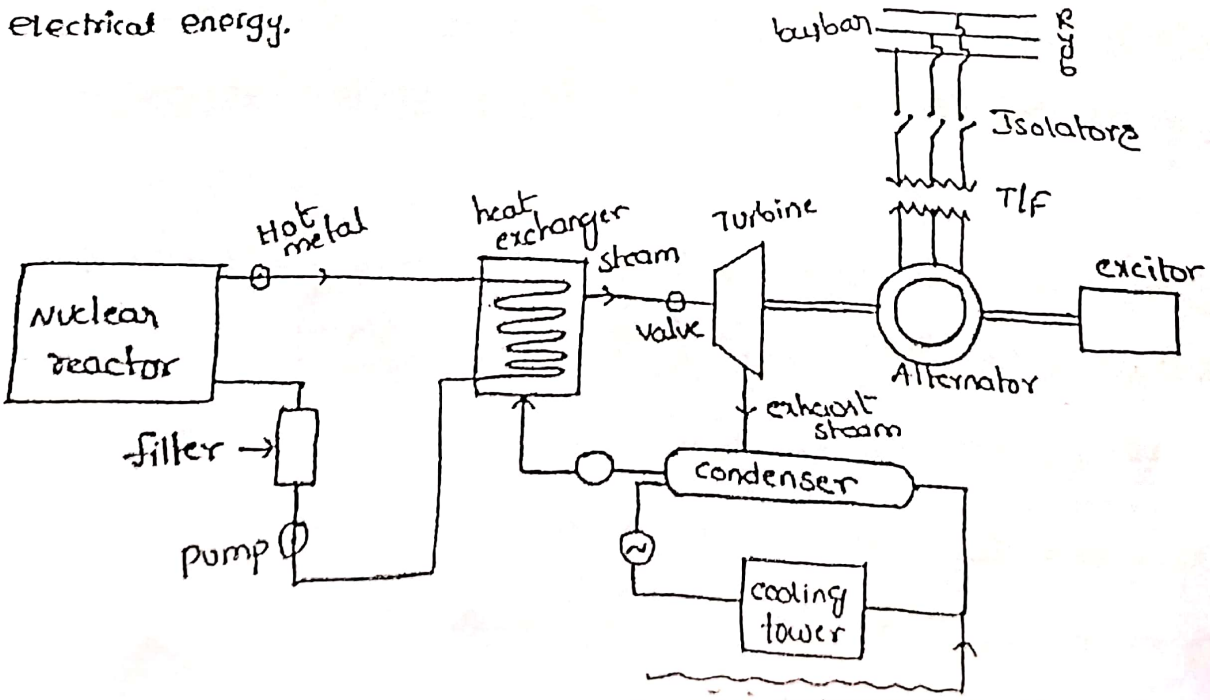
Layout of Nuclear power station:-

It is a Generating Station in which nuclear energy is Converted into electr energy is known as "Nuclear power station"

Operation:-

In Nuclear power Station, heavy elements Such as uranium (U^{235}) or Thorium (Th^{232}) are Subjected to nuclear fission in Special apparatus known a "Reactor". The heat energy thus released is utilized in raising Steam at high temp and pressure.

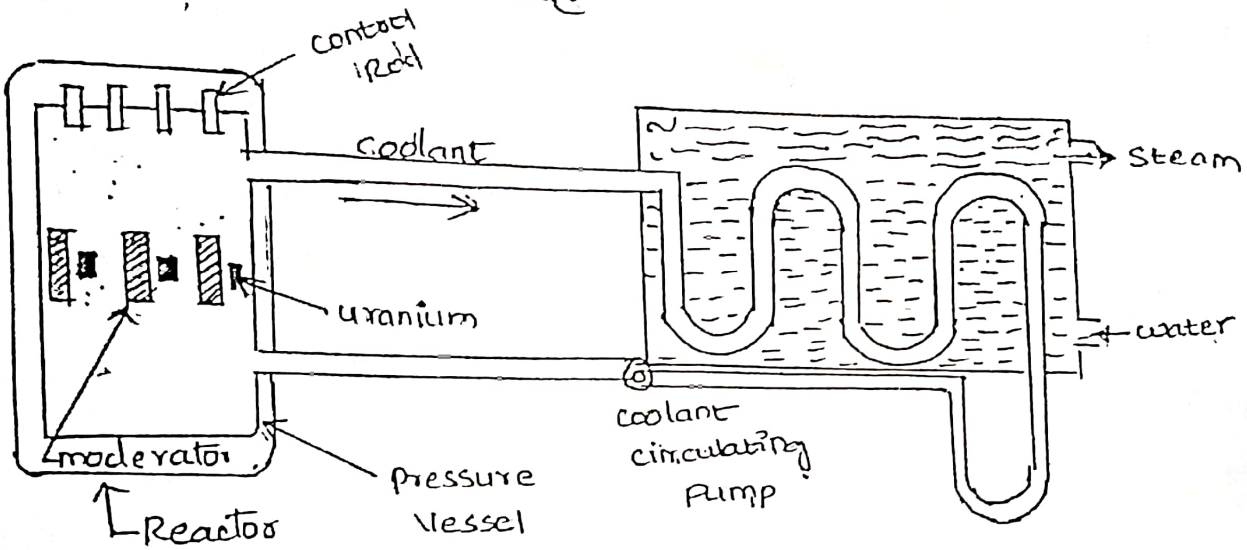
The Steam runs the Steam turbine which Converts Steam energy into mechar energy. The Turbine drives the Alternator which Converts mechanical energy into electrical energy.



Reactor :-

It an apparatus in which nuclear fuel (U^{235}) is subjected to nuclear fission. It control the chain reaction that starts once the fission is done.

It is a cylindrical steel pressure vessel and houses fuel rods of uranium, moderator and control rods.



Heat Exchanger :-

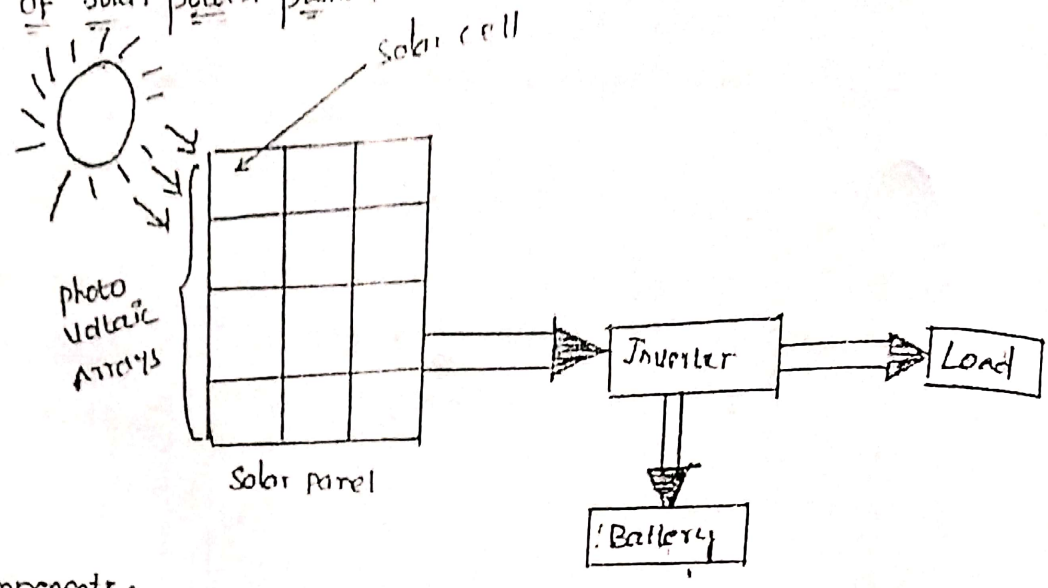
The coolant gives up heat to the heat exchanger which is utilized in orals the steam. After giving up heat the coolant, is again fed to the reactor.

Steam Turbine :-

The steam produced in the heat exchanger is led to the steam turbine through a valve.

The condenser the steam which is fed to the heat exchanger th feed water pump.

Layout of Solar power plant :-



main Components :-

1. Solar panel 2. Solar Cells 3. Battery 4. Inverter

- Solar panel :-

→ It is the heart of the Solar power plant

→ It consists of no. of Solar Cells

→ The energy produced by each Solar Cell is very Small

2. Solar Cells :-

→ It is energy Generating unit

→ It is the heart of the Solar power plant

3. Battery :-

→ Batteries are used to module the power back (or) Store

Inverter (Dc to Ac)

→ Solar panels produce " Direct Current "

→ By using Inverter Direct Current Can be Converted into Alternating Current to be Supplied to homes

Working of Solar power plant :-

> As Sunlight falls over a Solar Cell, a large no. of photons Strike the p-type region of Silicon.

tron and hole pairs will get separated after absorbing the energy of photon.

the electron travels from p-type region to n-type region due to the action of electric field at p-n junction

further the diode is reversed biased to increase the electric field. So the current starts flowing in the circuit for individual solar cell

→ Combine the current of all the solar cells of a solar panel to get a significant output.

Typical Ac power Supply System Scheme:-

the lines network between Generating Station and Consumers of electric power can be divided into two parts

→ Transmission System

→ Distribution System

The system categories such as primary transmission and secondary transmission. Similarly primary and distribution and secondary distribution. This is shown in the below image

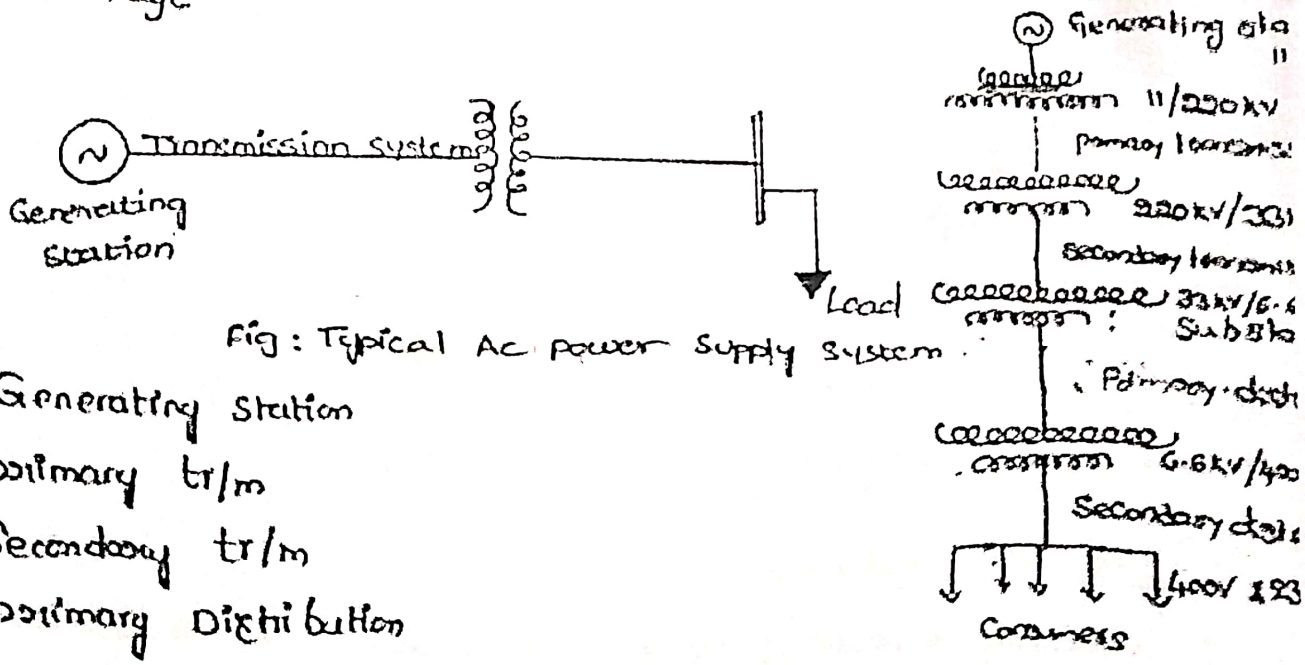


Fig: Typical Ac power supply system.

1. Generating Station
2. primary tr/m
3. Secondary tr/m
4. primary Distribution
5. Secondary Distribution

1. Generating Station:-

The place where electric power produced by parallel connected three phase alternator / generator is called Generating Station.

2. primary Transmission:- (132kV, 220kV, 400kV or more)

The electric supply is transmit to Load Center by three phase three wire overhead t/m System.

3. Secondary Transmission:- (132kV, 66kV or 33kV)

Area is far from City which have connected with generating Station by line is called Secondary Transmission.

4. primary Distribution:-

At a Substation the level of Secondary t/m Line voltage (132kV, 6 or 33kV) steduced to 11kV by step down Transformers.

5. Secondary Distribution:-

→ Electric power is given by to distribution Substation.

→ This Substation is Located by near by Consumer area Level of voltag steduced by Step down Transformer 440V by Stepdown Transformer.

Distribution System:-

It is a part of power System which distribution electrical power for Local use is known as "Distribution System".

Classification of Distribution System:-

A Distribution System be classified according to

(i) Nature of Current:-

According to Nature of Current, Distribution System may be classified as (a) D.C Distribution System

(b) A.C Distribution System.

these two A(a) - a- days, A Distribution System universally adopted
bution of electrical power on it is simple and more economical than direct
(D.C) method.

Type of Construction:-

According to type of construction distribution System may be classified as

(a) overhead System.
(b) underground System.

The overhead System is generally employed for distribution as it is 5 to 10 times cheaper than the equivalent underground System.

Scheme of Connection:-

According to Scheme of Connection the D.S may be classified as

(a) Radial D.S
(b) Ring main D.S
(c) Inter Connected D.S

Each Scheme has its own advantages and disadvantages

A.C Distribution:-

Now a days electrical energy is generated, Transmitted and distributed in the form of Alternating Current. one important reason for the wide Spread use of Alternating Current in preferance to direct Current is the fact that Alternating voltage Can be Conveniently changed in magnitude by means of a Transformer. High Transmission and distribution voltages have greatly reduced the Current in the Conductor and the resulting Line Losses.

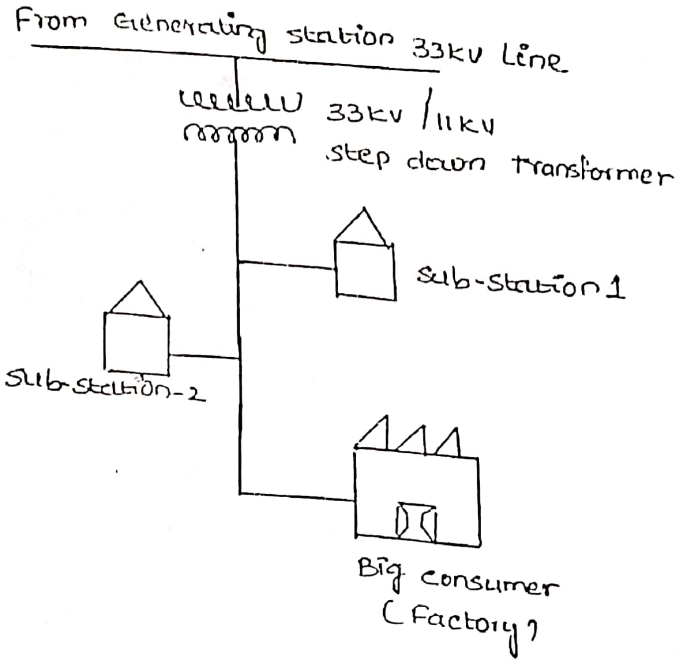
In General the a.c distribution System is the electrical System blw the Step down Substation fed by the Transmission System and Consumer's meters.

The A.C Distribution System can be Classified into

(a) primary D.S
(b) Secondary D.S

i) primary Distribution System :-

It is that part of a.c distribution system which operates at voltages some what higher than general utilisation and handles large blocks of electrical energy than over average Low voltage Consumers uses.



→ Electric power from the generating Station is transmissed at high voltag to Substation Located in (or) near the city.

→ At the Substation voltage is step down to 11kV with the help of Step-dow transformers.

→ power is Supplied to various Substation for distribution or big consumer at this voltage.

Secondary Distribution System:-

→ It is that part of a.c distribution System which includes the stan of voltages at which the ultimate Consumers utilises the electrical energ delivering to him.

Secondary distribution employs 400/230V, 3-phase, 4-wire System.

primary distribution delivers power to various S/S Substation, called "distribution Substation".

the substation are situated near the Consumer Localities and Contain Step down transformers.

the voltage is Stepped down to 400V and power is delivered by 3-ϕ, 4-wire ac Systems.

the voltage between any two phases is 400V and between any phase and neutral is 230

→ The Single phase domestic Loads are Connected between any phase and neutr where as 400V motor Loads are Connected across 3-phase Lines directly.