CHAPTER – I

Introduction to energy source & its conversion.

* Energy : "The ability / capicity to do work.
  SI Unit : Joule (J) or kilojoule (kJ)
  Notation : E
* Power : "Rate of doing work or rate at which energy is converted from one form to other.
  SI Unit : Watt or J/sec.
  Notation : P.

* Various types of energy :
  → 1. Electrical Energy : It is the energy carried by moving elechon in an elechic conductor.
  Ex : Lightning. (Power plant convert chemical energy into elechicity)
  → 2. Chemical Energy : It results from chemical reaction's between atoms.
  Ex : Electrochemical cell or battery.
  → 3. Mechanical Energy : It is energy that results from movement of an object. Mechanical energy is sum of K.E and P.E. An object possesing mechanical energy has both K.E & P.E.
  Ex. Car moving up a mountain has both K.E & P.E.
  → 4. Thermal Energy : Heat energy reflets temp. difference between two systems.
  Ex. Cup of hot Tea has thermal energy.
  → 5. Nudear Energy : It is energy resulting from changes in atomic nuclei or nuclear reaction.
  Ex. Nudear fusion, Nuclear fission.
  → 6. Gravitational Energy : Energy associated with gravity involves attraction between two

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objects based on their mass.
Ex. Gravitational energy holds atmosphere to Earth.

→ 7. Electromagnetic energy: It is form of energy from light or electromagnetic waves.
Ex. X-rays, Gamma, Radio etc.

* Grades of energy:

1. High-Grade energy:
Electrical and chemical are high grade energy because energy is concentrated in a small space. Even a small amount of electrical and chemical energy can do great amount of work.
Molecules that stores these forms of energy are highly ordered & compact, thus Consider as high grade energy.
High-grade energy like electricity is better used for high grade applications like melting metals rather than simply heating of water.

2. Low-Grade Energy:
Heat is low grade energy. Heat can still be used to do work, but it rapidly dissipates. The molecules, in which kind of energy is stored (air & water) are more randomly distributed than molecules of carbon in a coal. This disordered state of dissipated energy are classified as low-grade energy. Its efficiency ranges from 28% - 40% depending on system.

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* Thermal Energy power plant :

→ I (1) Thermal energy / heat energy is produced when rise in temperature causes atoms to move faster and collide with each other.

(2) Energy that comes from temperature of heated substance is called thermal energy.

(3) Heat energy is other name for thermal energy.

→ Principle & working :-

II Diagram : Refer ppt.

(1) In this power plant, heat is evolved by burning of fuel in combuction chamber, where steam is ~~gtreo~~ generated from water in boiler. This high pressure steam is passed through steam turbine which impinges on turbine blade causing expansion and reduces pressure.

(2) Thus it rotates turbine shaft which is coupled with generator & generates electric power. Then this steam is passed through condenser where it is condenced by changing phase from vapour to liquid.

(3) This condensates are pumped back to boiler and water is taken from dam/ river and the cyde is repeated.

III List of components and function :

(1) feed pump : The function of feed pump is to increase pressure of condensate water up to boiler pressure on expense of work done on pump

(2) Combuction chamber: Burning of (coal or oil) fuel.

(3) Boiler: Boiler is closed metallic vessel in water is heated beyond its boiling point temperature in order to convert water into steam.

(4) Turbine: Expansion of steam and generate electric power with help of generator.

(5) Condenser: condenser is basically heat exchanger in which heat is transfered (rejected) from exhaust steam from turbine to cooling water due to which exhaust steam will be condensed into liquid called condensate.

(6) Cooling Tower: Due to heat transfer from exhaust steam from turbine to cooling water, cold water becomes hot, This hot water will be sent to cooling tower where hot water will be cooled, in order to recirculate it to condenser.

(7) Generator: Mechanical work (W_T) which is produced by turbine will be converted into electrical work by generator.

IV Advantages, Disadvantages Application } Refer ppt

* Hydro power energy :

→ I Hydropower or hydroelectric power is a renewable source of energy that generates power by using dam or diversion structure to alter natural flow of a river or other body of water.

Hydropower relies on endless, constantly recharging system of water cycle to produce electricity, using fuel water that is not reduced or eliminated in process.

There are many types of hydropower facilities though they are powered by kinetic energy of flowing water as it moves downstream.

Hydro power utilizes turbines and generators to convert that kinetic energy into electricity, which is then fed into electrical grid to power homes, businesses and industries.

II Classification :-

High head : (Water head above 300 m)

Medium head : (water head from 30 - 300 m)

Low head : (water head from 3 - 30 m)

III Diagram : Refer ppt.

IV Principle & working :

Principle :

i) Hydro electric is often considered as a renewable energy source.

(2) A renewable energy source is one that is not depleted (used up) in production of energy. Through hydropower, energy in falling water is converted into electricity without "using up" water.

(3) An impoundment is simply a dam that holds water in reservoir. water is released when needed through pen stock, to drive the turbine.

(4) Flowing water causes turbine to rotate, converting waters kinetic energy into mechanical energy. Mechanical energy produced by turbine is converted into electric energy using turbine power.

V Components :

(1) Reservoir / Dam : The dam is constructed on a large river to ensure sufficient water storage and dam forms large reservoir behind it. The head of water level (height) determines potential energy stored in it.

(2) Control Gate : Amount of water released in pen stock can be controlled by control gate.

(3) Pen stock : The potential energy of water is converted into kinetic energy as it flows down through penstock due to gravity.

(4) Hydraulic / water turbine : Flow of water from penstock is taken into water turbine. Turbine is mechanically coupled to an electric generator. Kinetic energy of water drives

turbine & consequently generator gets driven
(5) Generator : A generator is mounted in power house & is mechanically coupled to turbine shaft. when turbine blades are rotated it drives generator. Electricity is generated which is then stepped up with help of a transformer for transmission purp
(6) Surge Tank : A surge tank is a small reservoir or tank which is open at top and is fitted between reservoir & powerhouse. water lever in surge tank rises or falls to reduce pressure swings in penstock.
(7) Step up transformer : It converts A.C into high voltage current suitable for transmission.

V Advantage,
Disadvantage,
Application.

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* Nuclear Energy :

Nuclear energy is energy in nucleus or core of an atom. Atoms are tiny units that make up all matter in universe, & energy is what holds nucleus together. There is a huge amount of energy in atom's dense nucleus.

II Nuclear energy can be used to create electricity but it must first be released from atom. In process of nuclear fission, atoms are split to release energy.

A nuclear reactor or power plant is a series of machine that can control nuclear fission to produce electricity.

The fuel that nuclear reactors use (U-235) to produce nuclear fission is pellets of element uranium.

In a nuclear reactor, atoms of uranium are force to break apart. As they split atoms release tiny particles called fission products. Fission product cause other uranium atoms to split, starting a chain reaction. Energy released from this chain reaction creates heat.

III Diagram : Refer ppt.

Draw both, nuclear P.P & Reactor dia.

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IV Components :

(1) Nuclear reactor :

(1) Nuclear reactor is a special appratus used to perform nuclear fission and is covered by a protective shield. Splitting up of nuclei of heavy atoms is called nuclear fission, during which huge amount of energy is released.

(2) Nuclear fission is done by bombording slow moving neutrons on nuclei of heavy element. As the nuclei break up it releases energy as well as more neutrons which further cause fission of neighboring atoms. Hence it is a chain reaction and it must be controlled, otherwise it may result in explosion. A nuclear reactor consists of fuel rods, control rods, & moderator. A fuel rod contains small round fuel pallets.

(3) Control rods are of cadmium which absorbs neutrons. They are inserted into reactor & can be moved in or out to control reaction. Moderator can be graphite rod or coolant itself. Moderator slows down neutrons before they bombard on fuel rod.

~~(a) fuel rod~~ :

(a) Nuclear fuel : Normally used nuclear fuel is uranium.

(b) Fuel rod : Fuel rods hold nuclear fuel in a power plant.

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(c) Neutron source: A source of neutron is required to initiate fission for first time. A mixture of beryllium with plutonium is commonly used as source of neutron.

(d) Control rod: They are used to control chain reaction. They are absorders of neutrons commonly used control rods are made up of cadmium or boron.

(e) Moderotor: This are used to slow down fast neutrons. It reduces 2 Mev to an average velocity of 0.025 eV. Ordinary or heavy water are used as moderator.

(f) Neutron reflector: To prevent leakage of neutron to large extent. In pressurized heavy water reactor (PHWR), moderator itself acts as reflector.

(g) shielding: To protect from harmful radiations, reactor is sorrounded by a concrete wall of thickness about 2 - 2.5 m

(2) Heat Exchanger:

(1) In heat exchanger primary coolant transfers heat to secondary coolant (water) Thus water from secondary loop is converted to steam.

(2) The primary and secondary systems are closed loop, and they are never allowed to mixup with each other. Thus heat exchanger helps in keeping secondary system free from radioactive stuff.

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(3) Steam Turbine :

(1) Generated steam is passed through a steam turbine, which runs due to presence of steam. As steam is passed through turbine blades, pressure of steam gradually decreases & it expands in volume.

(2) Stem turbine is coupled with alternator through rotating shaft.

(4) Alternator :

(1) Steam turbine rotates shaft of alternato thus generating electrical energy.

(2) Electrical output of alternator is delivered to step up transformer to transfer it over distances.

(5) Condenser :

(1) Steam coming out of turbine, after it has done its work is converted back into water in condenser.

(2) steam is cooled by passing it through third cold water loop.

V Advantage
Disadvantage
Application
} Refer ppt.

Names of nuclear P.P in India.