

EOE-081
NON-CONVENTIONAL ENERGY
RESOURCES

UNIT-1

Syllabus

Introduction

- Various non-conventional energy resources- Introduction, availability, classification, relative, merits and demerits.

Solar Cells:

- Theory of solar cells. solar cell materials, solar cell array, solar cell power plant, limitations.

Introduction

Conventional energy sources

- Conventional energy sources are:
 - (a) Fossil fuel energy
 - (b) Hydraulic energy
 - (c) Nuclear energy

Non-Conventional Energy Sources

- The sources of energy which are being produced continuously in nature and are inexhaustible are called renewable sources of energy (or) non-conventional energy.
- Some of these sources are:
 - (a) Wind energy
 - (b) Tidal energy
 - (c) Solar energy

Wind energy

- Winds are caused because of two factors.
 1. The absorption of solar energy on the earth's surface and in the atmosphere.
 2. The rotation of the earth about its axis and its motion around the Sun.
- A wind mill converts the kinetic energy of moving air into Mechanical
- energy that can be either used directly to run the Machine or to run the generator to produce electricity.

Tidal energy

- Tides are generated primarily by the gravitational attraction between the earth and the Moon. They arise twice a day in Mid-Ocean. The tidal range is only a Meter.
- Basically in a tidal power station water at high tide is first trapped in a artificial basin and then allowed to escape at low tide. The escaping water is used to drive water turbines, which in turn drive electrical generators.

Solar energy

- Brief history of solar energy (or) Importance of solar energy:
- Energy from the sun is called solar energy. The Sun's energy comes
- from nuclear fusion reaction that take place deep in the Sun. Hydrogen
- nucleus fuse into helium nucleus. The energy from these reactions flow out
- from the sun and escape into space.

Bio- Energy

- Bio Mass means organic matter and Photo Chemical approach to harness solar energy means harnessing of solar energy by photo synthesis.
- Solar energy is stored in the form of chemical energy. Hence solar energy → Photosynthesis → Bio Mass->energy generation.

Tidal Energy

- Tide is periodic rise and fall of the water level of the sea.
- Tides occur due to the attraction of seawater by the moon. These tides can be used to produce electrical power which is known as tidal power.
- A dam is constructed in such a way that a basin gets separated from the sea and a difference in the water level is obtained between the basin and sea. The constructed basin is filled during high tide and emptied during low tide passing through sluices and turbine respectively.
- The Potential energy of the water stored in the basin is used to drive the turbine which in turn generates electricity as it is directly coupled to an alternator.

Advantages of Tidal Power Plants

- Exploitation of tidal energy will in no case make demand for large area of valuable land because they are on bays.
- It is free from pollution as it does not use any fuel.
- It is much superior to hydro-power plant as it is totally independent of rain which always fluctuates year to year. Therefore, there is certainty of power supply as the tide cycle is very definite.
- As in every form of water power, this will also not produce any unhealthy waste like gases, ash, atomic refuse which entails heavy removal costs.

- Tidal Power is superior to conventional hydro power as the hydro plants are known for their large seasonal and yearly fluctuations in the output of energy because they are entirely dependent upon the nature's cycle of rainfall, which is not the case with tidal as monthly certain power is assured. The tides are totally independent on nature's cycle of rainfall.
- Another notable advantage of tidal power is that it has a unique capacity to meet the peak power demand effectively when it works in combination with thermal or hydroelectric system.
- It can provide better recreational facilities to visitors and holiday makers, in addition to the possibility of fish farming in the tidal basins.

Disadvantages

- These Power plants can be developed only if natural sites are available.
- As the sites are available on the bay which will be always far away from the load centers. The power generated must be transported to long distances. This increases the transportation cost.
- The supply of power is not continuous as it depends upon the timing of tides.
- The capital cost of the plant (Rs.5000/kw) is considerably large compared with conventional-power plants (hydro, thermal)
- Sedimentation and siltation of the basins are some of the added problems with tidal power plants.
- The navigation is obstructed.

Fuel Cells

- Fuel Cells are efficient and quiet, operate on a variety of hydrocarbon fuels, and produces almost no objectionable emissions.
- The recent infusion of power cost from fossil fuels may convert this promising device into a major source of electric power generation.

Advantages of Fuel Cells

- The fuel cell converts its fuel directly to electric power. Pollutant levels range from 1/10 to 1/50,000 of those produced by a fossil fuel power plant as there is no combustion.
- As it does not make noise. It can be readily accepted in residential areas.
- The fuel cell takes little time to go into operation.
- It would be an ideal reserve power source with in large conventional power plants to handle peak or emergency loads.
- There is no efficiency penalty for part load operation. Efficiency remains constant from 100% to 25 % of rated load.

- There is no maximum or minimum size for a fuel cell power plant. Individual fuel cells are joined to form stacks.
- The land requirement is considerably less compared with conventional power plants.
- Possibly the greatest advantage of the fuel cell is its high operating efficiency. Present-day fuel cell efficiency is 38% and it is expected to reach to 60% before the end of this century.
- A wide variety of fuels can be used with the fuel cell. Although presently limited to using substances that produce pure H₂ rich gas, the cell may one day be able to operate on fuels derived from low grade shale oils or highly sulfur coals.

Availability of Conventional Energy Resources

- The maintenance charges are low as there are no moving parts and outages are also less.
- Fuel cells have an overload capacity of 50 to 100% for a short duration.
- The weight and volume of the fuel cell is considerably low compared to other energy sources.
- In H₂-O₂ cell, the reaction product is water which is portable.
- No cooling water is needed so it can be located at any desired place.

Solar Cells

- Solar cells , the basic unit block of a solar photovoltaic systems , comprises of two or more especially prepared layers of semiconductor materials processed with an additive that causes the device to become photosensitive.
- When photons strike the surface the surface of the solar cell ,electron hole pairs are released , generating a flow of electricity.
- Thus, a solar cell is a transducer which converts the solar radiation directly into electricity.

Theory of Solar Cells

- Solar cells are composed of mostly 95% of silicon(Si) semiconductor material .
- It consists of a thin slice of crystal p-type silicon into a very thin layer of n-type material is diffused