EE3014-POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS
UNIT1-INTRODUCTION

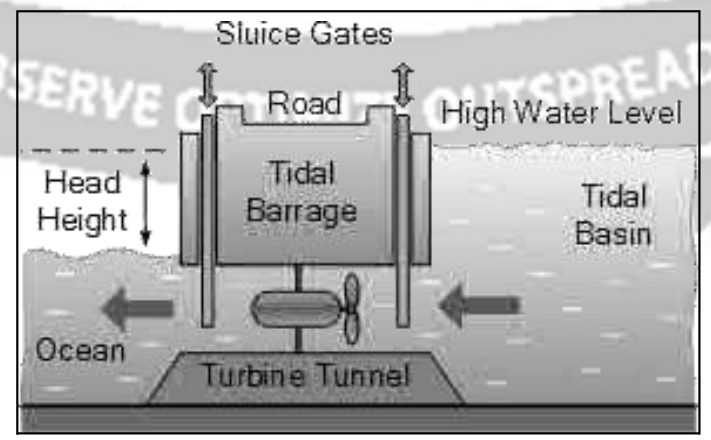
1.4 QUALITATIVE STUDY OF DIFFERENT RENEWABLE ENERGY RESOURCES: OCEAN, BIOMASS, FUEL CELL.

Ocean Power

Tidal Energy Generation

Tidal energy, just like hydro energy transforms water in motion into a clean energy. The motion of the tidal water, driven by the pull of gravity, contains large amounts of kinetic energy in the form of strong tidal currents called tidal streams. The daily ebbing and flowing, back and forth of the oceans tides along a coastline and into and out of small inlets, bays or coastal basins, is little different to the water flowing down a river or stream. The movement of the sea water is harnessed in a similar way using waterwheels and turbines to that used to generate hydro electricity. But because the sea water can flow in both directions in a tidal energy system, it can generate power when the water is flowing in and also when it is ebbing out. Therefore, tidal generators are designed to produce power when the rotor blades are turning in either direction. However, the costs of reversible electrical generators are more expensive than single direction generators.

Different Types of Tidal Energy Systems



Tidal Barrage

Tidal Barrage:

A Tidal Barrage is a type of tidal power generation that involves the construction of a fairly low dam wall, known as a ―barrage‖ and hence its name, across the entrance of a tidal inlet or basin creating a tidal reservoir. This dam has a number of underwater tunnels cut into its width allowing sea water to flow through them in a controllable way using ―sluice gates‖. Fixed within the tunnels are huge water turbine generators that spin as the water rushes past them generating tidal electricity. Tidal barrages generate electricity using the difference in the vertical height between the incoming high tides and the outgoing low tides. As the tide ebbs and flows, sea water is allowed to flow in or out of the reservoir through a one way underwater tunnel system. This flow of tidal water back and forth causes the water turbine generators located within the tunnels to rotate producing tidal energy with special generators used to produce electricity on both the incoming and the outgoing tides.

Tidal Stream

TIDAL STREAM

A Tidal Stream Generation system reduces some of the environmental effects of tidal barrages by using turbine generators under the surface of the water. Major tidal flows and ocean currents, like the Gulf Stream, can be exploited to extract its tidal energy using underwater rotors and turbines. Tidal stream generation is very similar in principal to wind power generation, except this time water currents flow across turbines

rotor blades which rotates the turbine, much like how wind currents turn the blades for wind power turbines. In fact, tidal stream generation areas on the sea bed can look just like underwater wind farms. Tidal streams are formed by the horizontal fast flowing volumes of water caused by the ebb and flow of the tide as the profile of the sea bed causes the water to speed up as it approaches the shoreline.

Advantages and disadvantages of Tidal Energy

Advantages

- Tidal energy is a renewable energy resource because the energy it produces isfree and clean as no fuel is needed and no waste bi-products are produced.
- Tidal energy has the potential to produce a great deal of free and green energy.
- Tidal energy is not expensive to operate and maintain compared to other forms ofrenewable energies.
- Low visual impact as the tidal turbines are mainly if not totally submergedbeneath the water.
- Low noise pollution as any sound generated is transmitted through the water.
- Tidal barrages provide protection against flooding and land damage.
- Large tidal reservoirs have multiple uses and can create recreational lakes andareas where before there were none.

Disadvantages of Tidal Energy

- Tidal energy is not always a constant energy source as it depends on the strength and flow of the tides which themselves are affected by the gravitational effects of the moon and the sun.
- Tidal Energy requires a suitable site, where the tides and tidal streams are consistently strong.
- Must be able to withstand forces of nature resulting in high capital, construction and maintenance costs.
- High power distribution costs to send the generated power from the

submerged devices to the land using long underwater cables.

- Danger to fish and other sea-life as they get stuck in the barrage or sucked through the tidal turbine blades.

Wave energy

Waves are caused by the wind blowing over the surface of the ocean. In many areas of the world, the wind blows with enough consistency and force to provide continuous waves along the shoreline. Ocean waves contain tremendous energy potential. Wave power devices extract energy from the surface motion of ocean waves or from pressure fluctuations below the surface. Wave power varies considerably in different parts of the world. While an abundance of wave energy is available, it cannot be fully harnessed everywhere for a variety of reasons, such as other competing uses of the ocean (i.e. shipping, commercial fishing, naval operations)or environmental concerns in sensitive areas. Therefore, it is important to consider how much resource is recoverable in a given region.

Ocean thermal energy conversion (OTLC)

Closed-Cycle of OTLC

Closed-cycle systems use fluids with a low boiling point, such as ammonia, to rotate a turbine to generate electricity. Warm surface seawater is pumped through a heat exchanger, where the low-boiling-point fluid is vaporized. The expanding vapor turns the turbo-generator. Cold deep seawater—which is pumped through a second heat exchanger—then condenses the vapor back into a liquid that is then recycled through the system.

Open-Cycle of OTLC

Open-cycle systems use the tropical oceans' warm surface water to make electricity. When warm seawater is placed in a low-pressure container, it boils. The expanding steam drives

a low-pressure turbine attached to an electrical generator. The steam, which has left its salt behind in the low-pressure container, is almost pure, fresh water. It is condensed back into a liquid by exposure to cold temperatures from deep-ocean water.

Hybrid OTLC

Hybrid systems combine the features of closed- and open-cycle systems. In a hybrid system, warm seawater enters a vacuum chamber, where it is flash-evaporated into steam, similar to the open-cycle evaporation process. The steam vaporizes a low-boiling-point fluid (ina closed-cycle loop) that drives a turbine to produce electricity.

Complementary Technologies

OTEC has potential benefits beyond power production. For example, spent cold seawater from an OTEC plant can chill fresh water in a heat exchanger or flow directly into a cooling system. OTEC technology also supports chilled-soil agriculture. When cold seawater flows through underground pipes, it chills the surrounding soil. The temperature difference between

plant roots in the cool soil and plant leaves in the warm air allows many plants that evolved intemperate climates to be grown in the subtropics.

Biomass power plants

The most common types of boilers are hot water boilers and steam boilers. Wood chips, residues and other types of biomass are used in the boilers, in the same way as coal, natural gas and oil. Fuel is stored in a bunker for further transport to the boiler. In the boiler, water is heated to high temperature under pressure. Steam from the boiler powers the turbine, which is connected to the generator. Steam has passed through the turbine, heats area heat ing water, which is distributed through the area heating network's piping. Co-firing biomass with coal (replacing a portion of coal with biomass) is an effective method of using biomass for energy purposes and to reduce CO_2 emissions. Coal plants can be made suitable to replace part of the coal by biomass or even to convert fully to biomass – turning a coal plant into a 100% renewable energy plant.

Biomass used for electricity generation

Forest products: Woody biomass from multi-functional forests constitutes the majorityof today's biomass. Pellets and briquettes are manufactured by compressing by-products fromthe forestry industry, such as sawdust, bark or small diameter wood. They are easy to transport and therefore suitable for export.

Waste, by-products and residues: Residues include manure, sewage, sludge and other degradable waste. Liquid biomass waste, such as manure, household waste and sewage plant residues, can be digested to biogas.

Energy crops: Energy crops are not used on a large scale for electricity or heat production today. As demand for sustainable biomass increases over time, such energy crops may play a more important role in the future. Examples include woody short rotation forestry/crops such as eucalyptus, poplar and willow. But also herbaceous (grassy) energy crops such as miscanthus can be used. Especially with the use of energy crops, it is important to ensure these plantations are established and managed in a

sustainable manner.

Fuel cell

Fuel cell is a device that uses hydrogen (or hydrogen-rich fuel) and oxygen to create electricity by an electrochemical process. A single fuel cell consists of an electrolyte sandwiched between two thin electrodes (a porous anode and cathode). Hydrogen, or a hydrogen-rich fuel, is fed to the anode where a catalyst separates hydrogen's negatively charged electrons from positively charged ions (protons). At the cathode, oxygen combines with electrons and, in some cases, with species such as protons or water, resulting in water or hydroxide ions, respectively.

The electrons from the anode side of the cell cannot pass through the membrane to the positively charged cathode; they must travel around it via an electrical circuit to reach the other side of the cell. This movement of electrons is an electrical current. The amount of power produced by afuel cell depends upon several factors, such as fuel cell type, cell size, the temperature at whichit operates, and the pressure at which the gases are supplied to the cell.