

## **EE3014 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS**

### **UNIT V - HYBRID RENEWABLE ENERGY SYSTEMS**

#### **5.1 - NEED FOR HYBRID SYSTEMS**

##### HYBRID RENEWABLE ENERGY SYSTEMS

###### Introduction

The renewable energy technologies include power generation from renewable energy sources, such as wind, PV(photovoltaic), MH (micro hydro), biomass, ocean wave, geothermal and tides. In general, the key reason for the deployment of the above energy systems are their benefits, such as supply security, reduced carbon emission, and improved power quality, reliability and employment opportunity to the local people. Since the RE resources are intermittent in nature therefore, hybrid combinations of two or more power generation technologies, along with storage can improve system performance. Hybrid Renewable Energy System (HRES) combines two or more renewable energy resources with some conventional source (diesel or petrol generator) along with storage, in order to fulfill the demand of an area.

###### Methodology

It is essential to have a well-defined and standardized frame work/steps taken for hybrid system based power generation for rural electrification. These steps are as follows:

###### **Demand Assessment:**

Using accurate load forecasting of remote villages, the load demand can be fetched.

During load survey, following factors may be considered:

- Demand for street lighting
- Number of houses, schools, health centers, commercial establishment and their energy requirement
- Number of small scale industries and their energy demand
- Miscellaneous demand

**Resource Assessment:**

Resource assessment can be done by calculating potential available in wind, MHP, solar, Biomass, Biogas, and other renewable energy resources using meteorological data available.



## **Demand is fulfilled by Hybrid renewable energy system.**

This can be done by combining one or more renewable energy sources with conventional energy sources. Some Hybrid renewable system configurations are as follows:

- PV/Wind/diesel generator HRES
- PV/wind/fuel cell HRES
- Wind/battery HRES
- Biomass/wind/diesel generator HRES
- PV/Wind/Biomass/fuel cell HRES

### **Need for Hybrid Systems**

As conventional fossil fuel energy sources diminish and the world's environmental concern about acid deposition and global warming increases, renewable energy sources (solar, wind, tidal, biomass and geothermal etc) are attracting more attention as alternative energy sources. These are all pollution free and one can say eco friendly. These are available at free of cost in India, there is severe power shortage and associated power quality problems. The quality of the grid supply in some places is characterized by large voltage and frequency fluctuations, scheduled and un-scheduled power cuts and load restrictions. Load shedding in many cities in India due to power shortage and faults is a major problem for which there is no immediate remedy in the near future since the gap between the power demand and supply is increasing every year.

In India wind and solar energy sources are available all over the year at free of cost whereas tidal and wave are coastal area. Geothermal is available at specific location. To meet the demand and for the sake of continuity of power supply, storing of energy is necessary. The term hybrid power system is used to describe any power system combine two or more energy conversion devices, or two or more fuels for the same device, that when integrated, overcome limitations inherent in either. Usually one of the energy sources is a conventional one (which necessarily does not depend on renewable energy resource) powered by a diesel engine, while the other(s) would be renewable viz. solar photovoltaic, wind or hydro. The design and structure of a hybrid energy

system obviously take into account the types of renewable energy sources available locally, and the consumption the system supports. For example, the hybrid energy system presented here is a small-scale system and the consumption of power takes place during nights.

The wind energy component will make a more significant contribution in the hybrid system than solar energy. Although the energy produced by wind during night can be used directly without storage. Battery is needed to store solar and wind energy produced during the



day. In addition to the technical considerations, cost benefit is a factor that has to be incorporated into the process of optimizing a hybrid energy system. In general, the use of wind energy is cheaper than that of solar energy. In areas where there is a limited wind source, a wind system has to be over-dimensioned in order to produce the required power, and these results in higher plant costs. It has been demonstrated that hybrid energy systems (renewable coupled with conventional energy source) can significantly reduce the total life cycle cost of a standalone power supplies in many off-grid situations. Numerous hybrid systems have been installed across the world, and expanding renewable energy industry has now developed reliable and cost competitive systems using a variety of technologies.

### Benefits of Hybrid Systems

Improved reliability a robust power supply and downtime minimization during power outages could be achieved by virtue of varying the power sources, which is vital indeed due to its ability to provide backup power. System failure or disruption of diesel supply to the community are factors leading to utilizing an alternate generating system encompassing renewable energy / diesel hybrid system as to encourage continuous and reliability power supply. Photovoltaic and wind energy system attributive to fewer moving parts, requiring less maintenance than diesel, thus reduces downtime during repairs or routine maintenance. In fact, renewable energy sources being original and free, is more securing than diesel thus, beneficial to facilities.

The ability of renewable energy working in tandem with diesel, contributes to high quality and dynamic electricity services for 24 hours / day even as in a conventional system, the hours / day. The cost of photovoltaic or wind power generation lies in the form of upfront capital expenditures whereby the operation and maintenance expenses are low. Therefore, the generating cost via photovoltaic or wind is marginally more than a conventional system with respect to the additional generating capacity, nevertheless promises customer satisfaction of a continuous electricity supply. Reduced emissions and noise pollution Diesel generation emits air / water pollution agents as well as loud noise, proving the essentiality of renewable energy or diesel retrofits application in power generation which adopts an

environmental-friendly technology. In fact, renewable energy system is also substantially quieter than diesel generators. Continuous power by incorporating diesel generator with renewable energy system, diesel generator is able to boost up the electricity supply during sudden increase in energy demand or when the batteries capacity decreases and thus, facilities face no supply interruption.

Reduced cost Renewable energy or diesel hybrid system act as the most cost-effective way of generating electricity with regards to savings on fuel consumption and lower



maintenance cost. For a conventional diesel system at remote area, the fuel and transportation cost is typically very high, as well as the service and spare parts cost which grossly excessive to rural community. Efficient use of energy Hybrid system promotes efficient use of power since renewable energy system could be configured to cope with base load whilst the peak load could be met via diesel generator

