Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 11, November-2023

Wind Energy and Development of Educational Model of Wind Plant

Samyak Jain
M Tech Power System (Std)
Department of Electrical Engineering
National Institute of Technology
Hamirpur

Guide
Dr. Sudheer Kumar Jain
Sr Manager (Training)
Centre for Research and Industrial Staff performance
(CRISP)
Bhopal

INTRODUCTION

There is reduction in availability of coal form mines and cost of electricity is getting increase day by day. We must look after its alternate sources. If we can use electrical energy produced by natural sources then we can come can join movement of make in India. There are several technologies that converting renewable energy sources like solar radiation, wind energy, biomass energy, etc. into useful energy.

Known sources of electrical energy are following;

1. Thermal Plant
2. Hydro plant
3. Atomic energy plant
4. Wind energy plant
5. Solar Energy plant

Wind Energy is one among them, which converts renewable energy sources into useful form of electrical energy. There are many people who are also working on other renewable energy technologies and there are many installations for energy generation which uses different types of renewable energy sources.
Here our focus is on Wind energy.
In case of Wind plant using energy conversion principle with dynamo technology, the wind rotating energy is converted into electrical energy directly,

Similar sources in form of renewal energies are as follows;

- Solar Energy
- Biomass Energy
- Hydro Energy
- Geothermal Energy

The Renewable energy sources which are natural energy sources are continuously produced by natural processes and forces occurring in our environment. These renewable energy sources include Solar radiation, Wind flow, Biomass, Water flow (Hydro), etc. these sources are available intermittently in cycles and can be harnessed during any number of cycles. For instance, solar radiation energy is available in cycle of 24 hours of day-night cycle. Any amount of solar energy can be harnessed without affecting the availability of solar energy for the next day, and therefore, it is termed renewable energy source. Similarly, wind energy (movement of wind) and hydro energy (falling pressure of water) are renewable energy sources, can be harnessed in any amount and con not be depleted.

ENERGY CONVERSION FROM WIND FLOW TO TURBINE ROTATION.

This is simple action following principle of Energy conversion from mechanical rotation to Electric generation. Here Wind flow rotates the turbine blades ,which resulted in generation of Electricity.

DETAILS AND COMPONENTS OF HYBRID WIND SOLAR ENERGY SYSTEMS

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 11, November-2023

The function of a Hybrid Wind Solar system is to supply reliable electricity to the appliances when required or in case of large PV power plants to supply electricity to the grid. With this system we can get uninterrupted Electricity generation in day and night. This type of Hybrid system is useful for petrol pump, Malls, Hospitals etc.
Turbine of wind plant or Solar PV module produce electricity only when wind flow or sunlight shines on modules and for night time applications, electricity energy storage in the form of batteries may be required if there is no other supply. Batteries are also used when the demand of electricity by appliances is more than the generation of electricity in day time. In some cases, the Wind turbine and PV modules supply electricity directly to the existing electricity grid in which the use of batteries can be avoided. Also, the electricity produced by Wind generator or PV modules either different level AC or DC in nature while most of our appliances are AC in nature, and therefore, inversion of DC into AC is required before making use of Hybrid Wind Solar PV electricity. Therefore, in all, as per above discussion, for the generation of solar PV electricity and reliable supply of electricity to the appliances, not only PV modules are required, but also, several other components are required. The other components included the following:

1. Battery: For storing electrical energy for night time application and for time when demand of electricity is more than the generation of electricity. Batteries are not required in grid-connected PV systems.
2. Inverter: For converting DC electricity to AC electricity, the DC electricity may either come from PV modules or it can come from batteries.
3. Charge controller: For protecting the batteries from overcharge and over-discharge conditions which reduce the life of batteries.
4. Maximum power point tracker (MPPT): For extracting maximum available power from solar PV module under given solar radiation input. Many times, charge controller or inverter (in case of grid connection) performs the function of charge controller and MPPT.
   PV modules together with other components that are put connected with PV modules to supply reliable energy to appliances is referred collectively as ‘solar PV system’. A solar PV system can be of several types (discussed in detail in Chapter 10) depending on the way the energy is generated and used. Broadly, PV system is divided in three categories:

1. Standalone solar. PV systems,
2. Grid-connected solar PV system, and
3. Hybrid solar PV system.

Standalone PV systems: These systems are self-sufficient in themselves. They do not depend on any other source of energy to supply electricity to planned appliances or load. The example of standalone solar PV systems include a solar lantern, a solar PV home lighting system, a solar PV water pumping system, etc. Since the standalone solar PV system do not depend on any other energy sources, they invariably use means to store energy, typically in the form of batteries. And since batteries are used, it is important to use to protect electronics. Also, for conversion of DC electricity from PV modules and from battery, inverter will have to be used. A typical standalone solar PV system and the flow of energy in the system (denoted by arrows) are shown in Figure.

WIND SYSTEM

1. Turbine
2. AC Generator
3. Electrical Control
4. PLC & SCADA
5. Transmission of Power

Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 11, November-2023

We have Grid-connected Wind Solar Hybrid systems: As the name suggests, a grid-connected Wind solar hybrid system is connected with nearby available electricity grid. In this way, the generated electricity is feed into the grid. No battery storage is used in this case. But conversion of DC electricity generated by solar PV modules into AC electricity is required before feeding to the grid. A typical arrangement of grid-connected solar PV systems is shown in Figure. This type of PV system configuration is used in India for large scale (MW level) solar PV power plants. Electricity grid voltage and frequency are well defined and, therefore, the PV electricity can be fed to electricity grid only after proper power conditioning, i.e., converting PV generated electricity solar PV system, the inverter not only performs the function of DC to AC conversion but also performs the function of grid synchronization which is related to bringing generated PV energy to appropriate voltage and frequency level. Use of PLC system in ON grid will make it more useful.

ADVANTAGES OF WIND SOLAR HYBRID SYSTEMS

The Hybrid Wind solar PV technology also has many advantages. Few of them are as follows:

- Good availability of solar radiation during day- Solar cell uses solar radiation energy as input, which is a renewable energy source. Solar radiation energy is available in huge quantity as it is abundant. We will not run in the shortage of solar radiation energy in future. On the other hand, the world is already facing the shortage of fossil fuels-based energy sources. In the night Wind Power is available
- Pollution free- The conversion of Wind flow or solar radiation energy into electrical energy does not emit any polluting products and, therefore, it does not cause damage to the environment like the smoke from use of diesel, petrol and coal does.
- Maintenance- In case of Wind there is maintenance requirement. However, there is very less maintenance in it. Colony electricians can take care for in case of electrical fault. Cleaning of PV modules can be taken care by users at their own.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 11, November-2023

- Negligible losses-In case of Wind Energy /solar radiation, energy is available everywhere, the Wind/solar PV electricity can be generated anywhere in decentralized manner in small quantities as per the need, unlike the coal-based power plant where electricity can be generated only in centralized manner in large quantities. Decentralized electricity generation results in less losses occurring due to transmission of electricity.

MODEL OF WIND PLANT

We can develop educational model of Wind Plant in the open area of Institute to orient students and trainees, Main Parts of Model of Wind Plant are

1. Wind Turbine blades .as per analysis of Wind flow
2. TMT Rods for Base grouting to fit M.S. Pipe
3. M S Pipe -Diameter 12 cm, length - 20 feet
4. M S Pipe-1/2*1/2 inch
5. Nylon Rod
6. Plate / Pipe for fins, 4 cm width * 4 mm thickness and 1 and ½ meter length - 4 No.
7. Parabolic Buckets -60 cm diameter
8. AC Generator- 500 watt, 36 volt AC, 3 phase 0.2 Volt per rotation, Max 36 Volt
9. Electronic PCB Amplifier- gain -5
10. AC to DC Converter 0-10 V DC
11. AC Drive- 10 v dc to 230 v0lt AC
12. Lamp- 230-volt AC – 3 No.
13. M S Plate for Base grouting to fit M.S. Pipe
14. Cement Concrete and Material for Base grouting to fit M.S. Pipe
15. Binding wire

Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 11, November-2023

Educational Model of Wind Plant

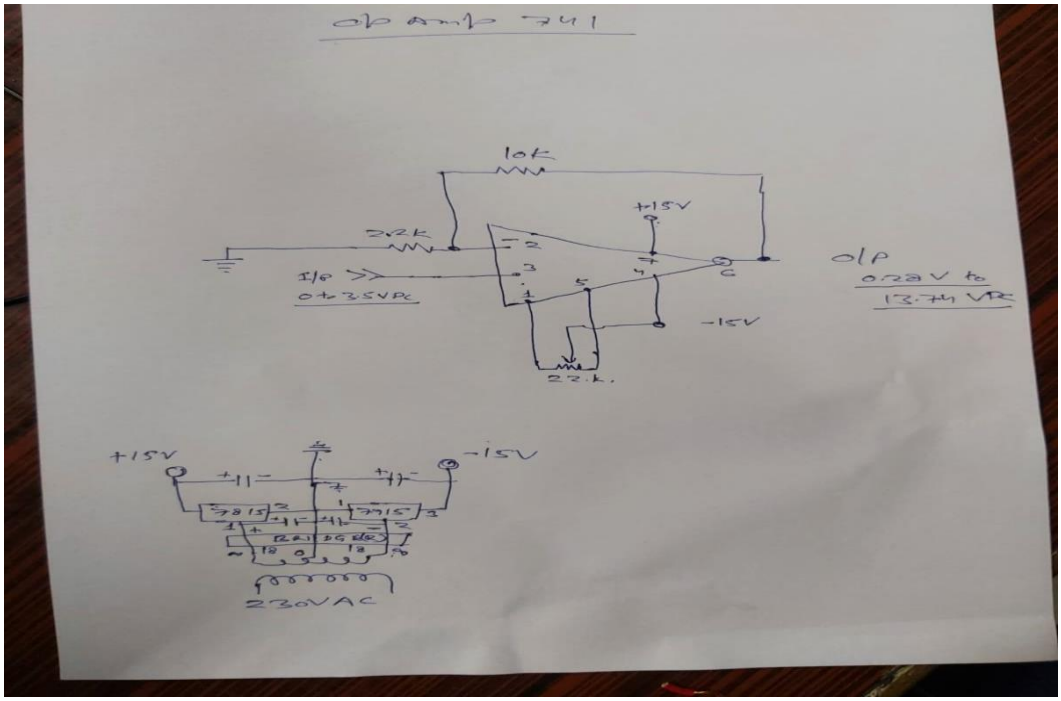
IJERTV12IS110079

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 12 Issue 11, November-2023

This model is rotating naturally with available wind flow at appx 5 RPM, with good wind at 10-12 RPM. Its AC generator placed at top, produce approximately 0.5 VAC. Output is 3 phase AC. There are 3 LEDs placed, and they are glowing.
To make visibility of light through LED is low in sun light. So we further worked and developed Electrical & Electronic Circuit to glow 230 V Ac Lamps 3 No.

1. 3 Phase AC to DC Conversion- circuit- It has 6 diodes which , converts 0.5 v AV to 0.5 v DC
2. Amplifier Circuit- 0.5 to 5 VDC
3. AC Drive 10 VDC=230 VAC

With this electrical arrangement, we are getting Lamp, 230 V AC-3 no. Glowing.
Amplifier Circuit



CONCLUSION

Educational model developed here gives an orientation to the students in practically ‘Understand, Design, Assemble, Hands on practice and Observe’ principles. Institutes can grant in to the students of Rs 50000/-. Student can get an exposure to Energy conversion, Turbines, Dynamo, AC Generation, Electronic Amplification, AC Drive etc.
Few exercises are developed to record observations.
People can save energy by using Hybrid Wind and Solar PV Installation. They not only use it for their own but in parallel they can sell it indirectly to electricity board. For wind there are Turbine, AC Generator, and converters. While for Solar system there are 3 important components; Solar PV modules, Power conditioning unit and battery. Their operation and maintenance are easy. People can think of using it. It is like small factory in their premises. Users can opt for ÓFF grid ‘or ‘ÓN grid’ system. On grid system provides best utility by allowing use of solar energy produces even, when you are not at home and on holidays.

REFERENCES:

1. Solar Energy by Dr. Solanki.IIT Mumbai
2. Solar PV Suryamitra by SCGJ NSDC Delhi
3. Industrial Automation, April 2018
4. O & M -Mechanical Technician -Q 1502
5. O & M -Electrical & Instrument Technician -Q 1503
6. Solar PV Installation- CRISP Bhopal
7. www.luminiousindia.com
8. www.enfsolar.com