FABRICATION OF SOLAR, WIND AND RAINWATER POWER GENERATION IN A SINGLE MACHINE

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Abstract

Renewable Energy is the energy that comes from natural resources such as sunlight, wind, rain, tides, waves and geothermal heat which are continually replenished. Hybrid power generation model mainly focuses on the renewable energy resources. These sources of energy can meet the world's demand without dismantling the stability of Earth. Hybrid power system model is mainly to meet the increasing energy demand through nonconventional energy sources. In our project a hybrid model Solar, Wind and Rain water has been planned to use to generate electricity. This configuration allows the three sources to supply the load separately or simultaneously depending on the availability of energy resources. The objectives of the present study are to convert the solar, wind and rain water into electricity and to optimize the energy requirement using these nonconventional energy resources. It reduces the environmental pollution using clean or environmental friendly technology and creates awareness among people regarding renewable energy resources.

Introduction

Wind energy is a source of renewable power which comes from air current flowing across the earth's surface. Wind turbines harvest this kinetic energy and convert it into usable power which can provide electricity for home, farm, school or business applications on small (residential), medium (community), or large (utility) scales. Wind energy is one of the fastest growing sources of new electricity generation in the world today. These growth trends can be linked to the multi-dimensional benefits associated with wind energy.

Green Power

The electricity produced from wind power is said to be "clean" because its generation produces no pollution or greenhouse gases. As both health and environmental concerns are on the rise, clean energy sources are a growing demand.

Sustainable

Wind is a renewable energy resource; it is inexhaustible and requires no "fuel" besides the wind that blows across the earth. This infinite energy supply is a security that many users view as a stable investment in our energy economy as well as in our children's' future.

Affordable

Wind power is a cost-competitive source of electricity, largely due to technological advancements, as well as economies of scale as more of these machines are manufactured and put online around the world.

Economic Development

As well as being affordable, wind power is a locally-produced source of electricity that enables communities to keep energy dollars in their economy. Job creation (manufacturing, service, construction, and operation) and tax base increase are other economic development benefits for communities utilizing wind energy.

Wind Electric

In wind electric systems, the rotor is coupled via a gearing or speed control system to a generator, which produces electricity. Wind power is used in large scale wind farms for national electrical grids as well as in small individual turbines for providing electricity to rural residences or grid-isolated locations. For small turbines the electricity generated can be used to charge batteries or used directly. Larger, more sophisticated wind energy converters are used to feed power into the grid. Small turbines intended for battery charging have a turbine diameter of between 0.5 –5 m and a power output of 0.5 – 2 kW. Installed costs vary between US$ 4 – 10 per watt. Medium sized turbines are used in small independent grids in hybrid with a diesel or PV generator. These turbines have diameters of between 5-30 m and a power output of 10- 250 kW. Large wind turbines are normally grid connected. This category includes diameters of 30-90 m and power outputs 0.5 – 3 MW. Total installed global capacity is 58,982 MW of which Europe accounts for 69% (2005). In the Eastern Africa region experience with wind generators has been isolated and largely driven by donors and missionaries. In Europe wind energy cost was estimated at $55.80/MWh, coal at $53.10/MWh and natural gas at $52.50/MWh.

Solar Energy

Solar energy is the energy obtained by capturing heat and light from the Sun. Energy from the Sun is referred to as solar energy. Technology has provided a number of ways to utilize this abundant resource. It is considered a green technology because it does not emit greenhouse gases. Solar energy is abundantly available and has been utilized since long both as electricity and as a source of heat. Solar technology can be broadly classified as Active Solar. Active solar techniques include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy. Active solar is directly consumed in activities such as drying clothes and warming of air. Passive Solar passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light-dispersing properties, and designing spaces that naturally circulate air.

Conversion of Solar Energy

The solar energy is the energy obtained by capturing heat and light from the Sun. The method of obtaining electricity from sunlight is referred to as the Photovoltaic method. This is achieved using a semiconductor material. The other form of obtaining solar energy is through thermal technologies, which give two forms of energy tapping methods. The first is solar concentration, which focuses solar energy to drive thermal turbines, The second method is heating and cooling systems used in solar water heating and air conditioning respectively. The process of converting solar energy into electricity so as to utilize its energy in day-to-day activities is given below − Absorption of energy carrying particles in Sun’s rays called photons. Photovoltaic conversion, inside the solar cells. Combination of current from several cells. This step is necessary since a single cell has a voltage of less than 0.5 V. Conversion of the resultant DC to AC.

Grid Integration

The overwhelming majority of electricity produced worldwide is used immediately since storage is usually more expensive and because traditional generators can adapt to demand. Both solar power and wind power are variable renewable energy, meaning that all available output must be taken whenever it is available by moving through transmission lines to *where it can be used now*. Since solar energy is not available at night, storing its energy is potentially an important issue particularly in off-grid and for future 100% renewable energy scenarios to have continuous electricity availability. Solar electricity is inherently variable and predictable by time of day, location, and seasons. In addition, solar is intermittent due to day/night cycles and unpredictable weather. How much of a special challenge solar power is in any given electric utility varies significantly. In a summer peak utility, solar is well matched to daytime cooling demands. In winter peak utilities, solar displaces other forms of generation, reducing their capacity factors. In an electricity system without grid energy storage, generation from stored fuels (coal, biomass, natural gas, nuclear) must go up and down in reaction to the rise and fall of solar electricity (see load following power plant). While hydroelectric and natural gas plants can quickly respond to changes in load, coal, biomass and nuclear plants usually take considerable time to respond to load and can only be scheduled to follow the predictable variation. Depending on local circumstances, beyond about 20–40% of total generation, grid-connected intermittent sources like solar tend to require investment in some combination of grid interconnections, energy storage or demand side management. Integrating large amounts of solar power with existing generation equipment has caused issues in some cases. For example, in Germany, California and Hawaii, electricity prices have been known to go negative when solar is generating a lot of power, displacing existing baseload generation contracts. Conventional hydroelectricity works very well in conjunction with solar power; water can be held back or released from a reservoir as required. Where a suitable river is not available, pumped-storage hydroelectricity uses solar power to pump water to a high reservoir on sunny days, then the energy is recovered at night and in bad weather by releasing water via a hydroelectric plant to a low reservoir where the cycle can begin again. This cycle can lose 20% of the energy to round trip inefficiencies, this plus the construction costs add to the expense of implementing high levels of solar power.

Literature Survey

Sensor less SynRG Based Variable Speed Wind Generator and Single-stage Solar PV Array Integrated Grid System with Maximum Power Extraction Capability

Deepu Vijay M et al presents a grid-integrated hybrid renewable energy sources-based system comprising a solar PV array and a wind energy conversion system (WECS). The WECS uses a position-sensor less synchronous reluctance generator (SynRG) for the electric power generation from the wind turbine (WT), wherein a sensor less field-oriented control (FOC) is made use of for the maximum power extraction (MPE). A second order flux estimation (SFE) method along with frequency-locked-loop (FLL) is utilized for the accurate flux estimation from the SynRG stator voltages and currents. A set of back-to-back connected three phase two leg voltage source converter (VSC) topology is selected for the grid integration of WECS. This system has a common DC-link where the solar PV array and the machine side VSC (MSC) of the wind generator, are directly connected. The power output from the solar PV array and WECS, is shared between the grid and the local loads. The maximum power generation from SynRG in the WECS, is achieved by operating the SynRG at the speed estimated by the MPE algorithm.

Existing System

To use individual power generation model consists of Rain water power, Solar PV and Wind energy.

Rain Water Power Generation

Rainwater harvesting is the accumulation and deposition of rainwater for reuse before it reaches the aquifer. In this technique, we channel the water falling on roof tops of buildings and homes, and open spaces to a storage tank through a filter. Excess water is directed to a well or pit through which water seeps in earth to increase water table.

Solar Power Generation

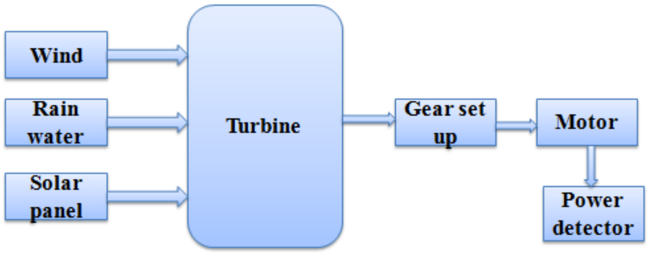
Solar power is converted into the electric power by a common principle called photo electric effect. The solar cell array or panel consists of an appropriate number of solar cell modules connected in series or parallel based on the required current and voltage. PV (Photo-voltaic) cells are made up from semiconductor structures as in the computer technologies.

Wind Energy Power Generation

The wind passes through the propeller and producing the circumferential force and axial thrust. This circumferential force is also known as torque, which drives the generator to produce the electrical power.

Methodology

In our present project planning to develop a hybrid power generation model consists of Rain water power, Solar PV and Wind energy, the process of working and installation as below



Solar PV Energy

Solar panels are the medium to convert solar energy into the electrical energy. Solar panels can convert the energy directly or heat the water with the induced energy. Photovoltaic is known as the process between radiation absorbed and the electricity induced. Solar power is converted into the electric power by a common principle called photo electric effect. The solar cell array or panel consists of an appropriate number of solar cell modules connected in series or parallel based on the required current and voltage. PV (Photo-voltaic) cells are made up from semiconductor structures as in the computer technologies. Sun rays are absorbed with this material and electrons are emitted from the atoms which activates a current. Storage batteries provide the backup power during cloudy weather to store the excess power or some portion of power from the solar arrays.This solar power generating system is used for domestic power consumption, meteorological stations and entertainment places like theatre, hotel, restaurant etc.

Results and Discussion

Spur gears have their teeth mounted on parallel axes, which makes them very useful when your goal is to transfer a motion from one shaft to another that is near and parallel. In addition to being very reliable, spur gears stand out because they produce no axial thrust, precisely due to the fact that the teeth are parallel to their axis. This means that ball bearings can be used for the gears' shafts. Calculations for spur gears and the steps you need to take to do it correctly, as well as the variables that you must consider: First, you need to define a series of concepts to perform the spur gear calculations:

The number of teeth (z).

This value is: $z = d/m$

Module (m). Ratio between the pitch circle in millimeters and the number of teeth. Anglo-Saxon countries use the "Diametral Pitch" instead, which is inversely proportional to the module. The value of the module is determined by calculating the material resistance in relation to the force to be transmitted and the gear ratio.

Two mating gears must have the same module: m = d/z Pitch Diameter (d) is the diameter of the pitch circle; its value is: d = m x z Outside Diameter (de) is the diameter of the outside circle; its value is: de =m (z + 2); de = d + 2m Root Diameter (df) is the diameter of the root circle; its value is: df = m (z – 2.5) **or** df = de – 2h Center Distance (dc) is the distance between the shafts of the gear and the pinion; its value is: dc = (D + d) / 2, where "D" corresponds to the pitch diameter of the gear and "d" to the pitch diameter of the pinion As for the tooth dimensions, we will need to know that: h = Toothdepth; h = 2,25 x m. Pc = Circular Pitch.

This is the length of the arc on the pitch circle composed of two homologous points of two consecutive teeth; Pc = πx m. B= Tooth thickness; B=10. m Standard modules are classified as follows: modules 1 through 4 vary by 0.25; modules 4 through 7 vary by 0.5; modules 7 through 12 vary by 1; and lastly, modules 12 through 20 vary by 2. When using inches instead of centimeters as a unit of length, in order to perform the calculations for spur gears we will need to define the 'diametral pitch', which is equivalent to the number of teeth per inch located along the pitch diameter.

The ratio between the diametral pitch and the module is *m*= 25.4/*Pt*.

In order to design straight-tooth gears you need to identify three concepts:

- The input speed of the pinion *np*
- The target output speed for the gear pair *NG*
- The power to be transmitted *P*

Once the type of material to be used to manufacture the gears has been chosen, you need to specify the type of driver and the driven machine as the over load factor *Ko*. The main factor will be what is called the expected load value. The proposed diametral pitch value (the nameplate power is *Pdi*=*KoP*) will have to be defined next.

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