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Abstract – 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. In India wind and solar energy sources are available all over the year at free of cost so in this situation hybrid energy system can be a better option with sensor based solar tracker. This set up consist of a photo-voltaic solar –cell array ,a wind generator, Lead acid storage batteries ,an invertors unit to convert D.C power to A.C Power, Fuse , Junction box ,Sensor, LDR, D.C motor, variable resistor , PCB ,I.C(LM324,L293D), Wire. This paper describes an analysis of local PV-wind hybrid system for supply electricity for all (EFA).

***Keywords** - PV – Wind, sensor, Inverter, Battery, I.Cs, EFA*

I. INTRODUCTION

As convention 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. This led to rapid usage of stand-by petrol or diesel generator sets and conventional battery inverter sets in both urban and rural areas.

PHOTOVOLTALICS (PV):

Is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect? Photovoltaic power generation employs solar panels composed of a number of solar cells containing a photovoltaic material. Materials presently used for photovoltaic include mono crystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, and copper indium gallium selenide/sulphide. The best silicon PV modules now available commercially have an efficiency of over 18%, and it is expected that in about 10 yrs. Time module efficiencies may rise over 25%.

WIND POWER

It is the conversion of wind energy into a useful form of energy, such as using: wind turbines to make electricity, windmills for mechanical power, wind pumps for water pumping or drainage, or sails to propel ships. Wind is the movement of air across the surface of the Earth, from areas of high pressure to areas of low pressure. The surface of the Earth is heated unevenly by the Sun, depending on factors such as the angle of incidence of the sun's rays at the surface (which differs with latitude and time of day) and whether the land is open or covered with vegetation. Also, large bodies of water, such as the oceans, heat up and cool down slower than the land. The heat energy absorbed at the Earth's surface is transferred to the air directly above it and, as warmer air is less dense than cooler air, it rises above the cool air to form areas of high pressure and thus pressure differentials. The rotation of the Earth drags the atmosphere around with it causing turbulence. These effects combine to cause a constantly varying pattern of winds across the surface of the Earth.

II. TECHNICAL SPECIFICATION OF WIND TURBINES AND PV CELLS:

Solar cells are devices which convert solar energy directly into electricity, either directly via the photovoltaic effect, or indirectly by first converting the solar energy to heat or chemical energy. The most common form of solar cells are based on the photovoltaic (PV) effect in which light falling on a two layer semi-conductor device produces a photo voltage or potential difference between the layers. This voltage is capable of driving a current through an external circuit and thereby producing useful work. Solar cells consist of two types of material, often p-type silicon and n-type silicon. Light of certain wavelengths is able to ionize the atoms in the silicon and the internal field produced by the junction separates some of the positive charges ("holes") from the negative charges (electrons) within the photovoltaic device. The holes are swept into the positive or p-layer and the electrons are swept into the negative or n-layer. Although these opposite charges are attracted to each other, most of them can only recombine by passing through an external circuit outside the material because of the internal potential energy barrier. Therefore if a circuit is made power can be produced from the cells under illumination, since the free electrons have to pass through the load to recombine with the positive holes.

III. SYSTEM ANALYSIS:

3.1 LOCATION FOR PV- WIND HYBRID SYSTEM:

We know India is good wind speed country although the western and southern states have average wind density of 300 Watts/m^2. The solar radiation falling over India is about 5,000 trillion kWh / year. There are about 300 clear sunny days in a year in most parts of the country. The average insolation incident over India is about 5.5 kWh / sq. meter over a horizontal surface. Thus Solar PV is a very important power source for meeting rural electricity demand in hybrid mode. The PV –wind hybrid system suits to conditions where sun light & wind has seasonal shifts i.e.; in summer the day time is long & sun light is strong enough. While in winter the day are shorter and there are more clouds also

3.2 COMPONENTS OF SYSTEM:

In general, a local cost-efficient, safe, and durable PV- wind hybrid system is composed of the core part (PV modules & wind turbine); PV module mounting & wind turbine tower; DC- AC inverter, safe equipment electricity such as fuses & lighting arrestor, batteries, charge controller regulator & back up power resources for battery storage systems.

PHOTOVOLTALIC MODULES (PV) converts sun light into Direct current (D.C). Modules can be wired together to form a PV array that is wiring modules in services the available voltage is increased & by wiring in parallel, the variable current is increased.

A typical PV module measures about 0.5 square meters (about 1.5 by 3.5feet) and produces about 75 watts of DC electricity in full sun.

Power out put from PV array: For design of a PV system, we should know how much solar energy is received at the concern place. It is affected by sun position, could covering atmospheric affect, and the angle at which the collector is placed, called tilt angle ‘β’. Normally this angle is equal to the latitude of the concern place.

The related equation for

1. Isolation $‘i = I_o \{\cos\phi \cos\delta \cos\omega + \sin\phi \sin\delta\}$ kW/m2

Estimation of the radiation is listed below:-

2. $I_o = I_{sc}$ [1 + 0.033 cos (360N/365)] where I_{sc} solar constant. = **1.37 kW/m^2**
3. $H_o = \int_{\omega sr}^{\omega ss} ‘i \, dt$ ω_{sr} = hour angle when sun rising
   ω_{ss} = hour angle when sun setting
   = $(24/\pi)\, I_{sc}$ [1+ 0.033 cos (360N/365)] $\{\cos\phi \cos\delta \cos\omega + \sin\phi \sin\delta\}$ **kWh/m^2/day**
4. H_{oA} = energy falling on the concern place considering atmospheric effect
   = $K_T H_o$ **kWh/m^2/day** where K_T dearness index
5. $K_T = A1 + A_2 \sin(t) + A_3 \sin(2t) + A_4 \sin(3t) + A_5 \cos(t) + A_6 \cos(2t) + A_7 \cos(3t)$
   $t = (2\pi/365)(N-80)$ N= 1 for Jan 1^{st}
6. $A_i = ai1 + a_{i2} x + a_{i3} x^2 + a_{i4} w + a_{i5} w^2$
   Where x = (ϕ - 35)
   ϕ = Latitude in deg
   w = total perceptible water vapor in atoms gm/cm^2
7. H_t = energy falling on the tilt surface at the concern place
   = $R_D H_{oA}$ **kWh/m^2/day**
8. R_D = tilted factor
   For the sizing the PV panel is given by
   $W_{peak} = \{1/ h_{peak\}}$ [(Wh ((load) * No of no sun days / (η_b * no of discharging. Days)) + Wh_{load}(day) + Wh_{load}(night)/ η_b)]
   Where: η_b = battery efficiency
   hpeak = no of hours for which peak insolation falls on the PV cell.

WIND TURBINE:

It works the opposite of a fan .Instead of using electricity to make wind, like a fan , wind turbines have either two or three blades. These three bladed wind turbines are operated “upward”, with the blades facing into the wind. The two- bladed wind turbine is also another type of wind turbine. Single small turbines, below 50 kilowatts, are used for homes, telecommunication dishes or water pumping. The speed of wind is a random process; therefore it should be described in terms of statistical methods. The wind speed data were recorded near the ground surface. To upgrade wind speed data to a particular hub height, the following equation is commonly used [2]

$$\mathbf{v = v_i (H/H_i)^{\alpha}}$$

Where: v-wind speed at projected height, ***H***

V-wind speed at reference height, ***Hi***

α- Power-law exponent (- 1/7 for open land).

Let

m = Mass (in kg) of the air in the hypothetical cylinder which radius is equal to the vane length

v = the velocity of air in m/s.

So kinetic energy

$E = m u^2 / 2$

Power output $P_w = (v^2/2) \times dm/dt$

$= \rho \times (v^2/2) \times dQ/dt$

$= \rho \times (v^3/2) \times A$

Where:

Q = Au = volume of air

$\rho = 1.2$ (kg/m$^{3)}$ (at mean sea level)

$P_w = 0.6\ A\ u^3$

$p_a = P_w/A = 0.6u^3$ = power density (in W/m^2

$\boldsymbol{P_w}$ is the electrical power output of the turbine.

The available wind generator power output is a function of wind velocity **v**

$P_R (v^3 - v_{ci}^3)/(v_R^3 - v_{co}^3)$ for $v_R \geq v \geq v_{ci}$

$P_w = P_R$ for $v_{co} \geq v \geq v_R$

0 otherwise

DC- AC INVERTER changes low voltage direct current (DC) power , which is produced by the PV or wind turbine or stored in the battery into standard alternating current(A.C) house power that is 120 or 240 VAC, 50 or 60 hertz. The modern sine wave inverters supply uninterruptible power your system and i.e.; there are no black outs or brownouts. The inverters come in series from 250 watts to over 8,000 watts. Inverters can also provide a utility inter- tie between your system and the utility grid, allowing you to sell your excess energy to the utility for distribution by grid.

PV-MODULES MOUNTING & WIND TURBINE TOWER

Both are engineered to withstand the PV modules & wind turbine .The PV modules mounting can be ground mount that work either on roof tops or the ground, or pole mount for getting then up in the air. Both are angle adjustable. So that PV array will face the sun as near to perpendicular as possible.

SOLAR TRACKER:

This tracker actually based on sun light according to sun light sun rise in morning 7 pm.In east then after some times it moves in other direction then sun light are not affected in solar panel then panel efficiency are decreases then tracker are used rotate the solar panel by gear motor with respect to timer & power circuit and panel. This tracking system which will keep the solar panels aligned with the sun in order to maximize efficiency.

BATTERY BANK:

Calculation of the Capacity of the Battery Bank:

The energy generated by Hybrid system involving let say three source of energy like wind turbine and PV array for hour t,

$E_{G(t)}$ can be expressed as follows:

$$\mathbf{E_{G(t)} = E_{1(t)} + E_{2(t)} + E_{3(t)}}$$

Where: $E_{i(t)}$ - energy generated ith source

Since it is assumed that the battery charge efficiency is set equal to the round-trip efficiency and the discharge efficiency is set equal to 1, we considered two eases in expressing current energy stored in the batteries for hour t.

If the supplied energy from all energy sources exceeds that of the load demand at a time instant, the batteries will be charged with the round-trip efficiency:

$$E_{B(t)} = E_{B(t-1)} + \{E_{G(t)} - E_{L(t)}/\eta_{charging\ controller}\}.\eta_{Battery}$$

Where:

$\eta_{charging\ controller}$ - efficiency of charging controller,

$\eta_{Battery}$ - round-trip efficiency of the batteries,

$E_{B(t)}$ - energy stored in batteries in hour t,

$E_{B(t-1)}$ - energy stored in batteries in previous hour,

$E_{L(t)}$ - load demand in hour t.

When the load demand is greater than the available energy generated, the batteries will be discharged by the amount that is needed to cover the deficit. It can be expressed as follows:

$$E_{B(t)} = E_{B(t-1)} - \{E_{L(t)}/\eta_{charging\ controller} - E_{G(t)}\}$$

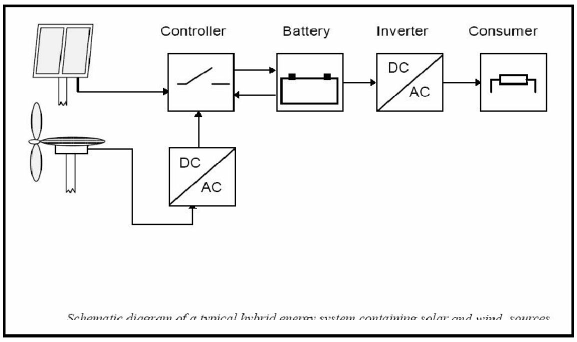
The energy stored in batteries at any hour t is subject to the following constraint:

$$E_{Bmax} \geq E_{B(t)} \geq E_{Bmin}$$

That means that batteries should not be over discharged or overcharged at any time. That protects batteries from being damaged.

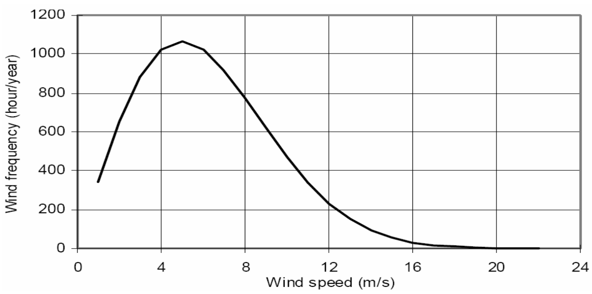
HYBRID SYSTEM:

Hybrid systems can be designed to maximize the use of renewable, resulting in a system with lower emissions than traditional fossil-fuelled technologies. A typical hybrid energy system consists of solar and wind energy sources. The principle of an open loop hybrid system of this type is shown in Figure above. The power produced by the wind generators is an AC voltage but have variable amplitude and frequency that can then be transformed into DC to charge the battery. The controller protects the battery from overcharging or deep discharging. As high voltages can be used to reduce system losses, an inverter is normally in traduced to transform the low DC voltage to an AC voltage of 230V of frequency 50 Hz



The system, whose block diagram is shown in Fig, above, consists of 12 photovoltaic (PV) panels, which can provide a total power of 900 W, and a wind generator that can produce a maximum power of 2200 W. The hybrid PV-wind generator system has been designed to supply continuous power of 1.5 Kw.

Protects wind generator from over speeding:-



IV. FUTURE WORK

The above discussion had shown that hybrid (solar tracker and wind) system can be better at every aspect, but a computer measurement & control bus will be added to the system computer controlled relay s will be added to allow all the major elements of the system through computer programs. The measured bus will be connected to all the major signals in the system and will allow for computerization data acquisition simultaneously of all the major signals in the system. Theses improvement will alloy for the study of more complex issues like power faults caused by sudden over voltages like lighting.

V. CONCLUSION

The use of solar and wind hybrid power generation is an especially vivid & relevant choice for power sources of & economic importance in a country. Hybrid combination of wind power, Solar power. The key elements of this test bed concept presented in this power are two or more renewable power sources can be connected to a power grid with complex electrical interaction.

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