

SCOPE OF SOLAR AND WIND ENERGY IN UTTARAKHAND

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ABSTRACT: The depleting fossil fuel reserves and environmental concerns are calling out for a safer and renewable source of energy. At present Uttarakhand is highly involved in the production of renewable energy through hydel and solar sources. Hydel power has its side effects of creating ecological disturbances while solar source, although abundantly available is costly to harvest. So it's time to start looking for a safer and cheaper renewable energy source i.e. Wind. Wind power promises a clean and free source of electricity that would reduce our dependence on imported fossil fuels and the output of greenhouse gases and other pollution. But wind too has its limitation that no electricity is produced when the wind is not blowing. Thus, it cannot be used as a dependable source of base load power. In the current article, the scope and challenges to the integration of wind and solar energy generation in Uttarakhand are being presented.

Keywords: Power generation, Solar power, Wind power, Hybrid Power, Potential

I. INTRODUCTION

India, a country with more than 1.25 billion population needs a lot of energy for basic daily requirements and this demand will keep on increasing with our booming population. But our fossil fuels are not going to last forever, which contributes almost 62.5 % of our energy requirement today. Therefore the need for renewable energy sources is on the rise. India, the second most

populous country is one of the fastest growing economy of the world and to maintain this tremendous rate of growth, a continuous supply of energy is required. India has become the third largest producer of electricity in the world and shares 4.8% of global electricity generation. The depletion of fossil fuels and ever increasing demand of energy calls for a much reliable and safer source of energy. At present we are producing 34,351 MW of energy through renewable source and this data is expected to rise to 175,000 MW till 2022[1].

Uttarakhand owing to its ecological and environmental conditions, becomes one of the most important locations to produce renewable energy. At present Uttarakhand is producing most of its renewable energy through hydropower plants which cause ecological imbalances and the area becomes more prone to earthquakes. So it's time to move towards safer and abundant sources - Solar and Wind to meet the demands of renewable energy. Moreover most of the villages are located at remote places so use of local available sources is more feasible and economical.[2].

In current article the scope and challenges of integrated sources of energy (Wind and Solar) and energy generation in Uttarakhand are being presented.

While Wind power promises a clean and free source of electricity, solar source, though costly to harness, is abundant once installed it run for years. Both of these sources would reduce our dependency on fossil fuels, most of which is imported. It

would also reduce greenhouse effect and pollution caused due to burning of fossil fuels.

II. WIND ENERGY

A. Locations for Wind Energy Generation

The adequate speed of the wind required to generate power through wind mills is around 12 kilometers per hour. Uttarakhand due to its low pressure belts provide adequate wind speed throughout the year. Windmills have long lives of about 20 years. They are energy efficient and economically feasible. A normal windmill achieves its break even in three to five months of operation.



Fig.1 Wind Farm

Windmills are mostly located on shorelines, hilltops, mountain gaps. They require about 0.1 square km land for each MW of energy produced. Most of this land can be used for other purposes like farming or forest land.

B. Scope of Wind Energy

Nowadays wind amplified rotor platforms (WARP) are available which operate at 15,000 feet and generate 27 times more electricity. A decade ago a survey was done by Centre for wind energy technology (CWET) to check the potential of wind energy in Bachhelikhal area. "We will be setting up 3 wind turbines with a capacity of 800 KW each at Bachhelikhal to produce 2.4 MW of wind energy," said the officials[3]. Any further action on this statement is still awaited.

Power produced by a wind turbine is given by [4]-[5].

$$P_m = 0.5 \pi \rho C_p (\lambda, \beta) R^2 v_w^3 \quad (1)$$

where R is the turbine radius, v_w is the wind speed, ρ is the air density, C_p is the power coefficient, λ is the tip speed ratio and β is the pitch angle. In this work β is set to zero.

The tip speed ratio is given by:

$$\lambda = \omega_r R / v_w \quad (2)$$

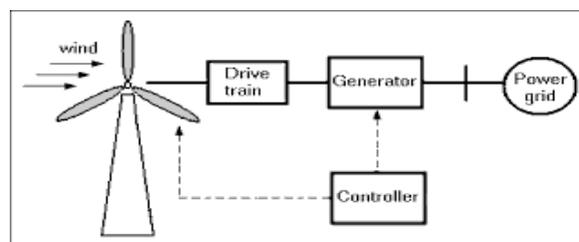


Fig.2 Block Diagram of Wind Power Generation

C. Challenges to Wind Energy

1. Wind Reliability: The god of wind is not very reliable and thus the speed of wind keeps varying throughout the day. In the cases of weather not supporting the wind, we have to go back to our conventional sources.
2. Location: There are only certain locations which favor the harnessing of wind power, thus considerable length of transmission lines is required to carry the energy from these locations to the location of use.
3. The transient behavior of fixed-speed wind farms can be improved by injecting large amounts of reactive power during the fault recovery. When integrated to the power system, large wind farms pose stability and control issues [6]

III.SOLAR ENERGY

A. Sites of Solar Energy Generation

The Sun, as we all know has always been and will always be as far as human existence is considered. Thus the energy harnessed from the sun is sustainable as well as renewable. It is the most abundant source of energy and is only limited by the technology to extract it. The solar power plants require little maintenance. Once the solar panels are installed at their maximum efficiency, only a small amount of maintenance is required each year.



Fig.3 Solar Panels

Solar power plants are silent power of energy. As the photovoltaic panels do not produce any noise while converting sunlight into electricity. Solar panel technology is continuously improving to increase the efficiency and lower the cost of production. Solar power plants also do not produce any harmful emissions while producing electricity. Uttarakhand being a hilly region has adequate amount of sunlight most of the day. And thus becomes a very favorable region for producing solar energy.

B. Scope of Solar Energy

Ministry of New and Renewable energy (MNRE), the government of India, has recently sanctioned a renewable energy project for Rajbhawan, Dehradun/Nainital under the special area demonstration program (SADP) scheme. The government has sanctioned Rs 74.84 lakhs as a financial assistance [3].

a) Rajbhawan, Dehradun

b) Rajbhawan, Nainital

c) Shri Badrinath Shrine

d) Shri Kedarnath Shrine

e) The Doon School, Dehradun

f) IMA, Dehradun. State Assembly Dehradun is some of the sites selected under SADP.

Simple PV output current:[5]

$$I = I_{ph} - I_0 \times \left(e^{\frac{q \times (V + I \times R_s)}{n \times k \times T}} - 1 \right) - \frac{V + I \times R_s}{R_p} \quad (2)$$

Where:

I_0 = Diode saturation current

q = Electron charge (1.6×10^{-19} C)

k = Boltzmann constant (1.38×10^{-23} J/K)

n = Ideality factor (from 1 to 2)

T = Temperature (°K)

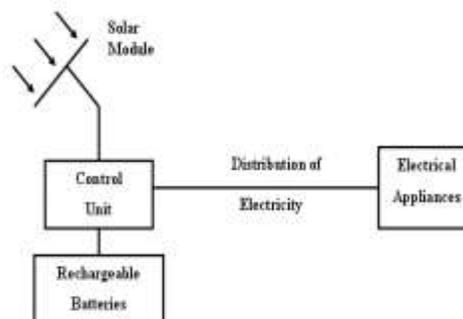


Fig.4 Block Diagram of Solar Power Generation

C. Challenges for Solar Energy

The only notable disadvantage to solar power is that sun doesn't shine 24 hours a day, when the sun is heavily shaded or during night, we will require energy from other source to meet the demand, that's when it calls for setting up of an integrated power plant.

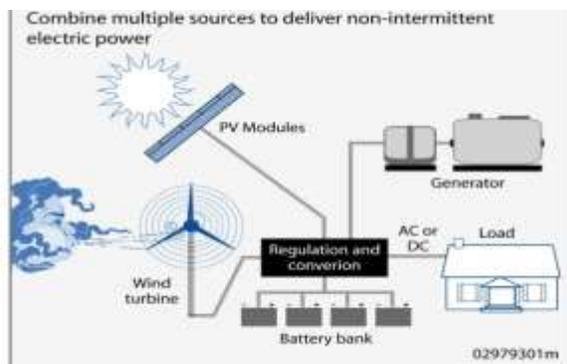


Fig.5 Hybrid Power Systems

IV. WIND - SOLAR Hybrid POWER PLANTS vs. ISOLATED POWER PLANTS

A latest study conducted by the Reiner Lemoine institute and solar proxies AG has found that solar and wind power generation are complementary to each other .

Thus the recent trend is to move towards an Hybrid power plant, where both wind and solar plants are installed in the same area. Thus, through this integrated plant, twice the amount of electricity is generated.

Also the shading of wind turbines causes only one to two percent losses in photovoltaic solar system.

These plants generate solar and wind power during complementary seasons and at different intervals and thus no grid expansion is required. The core part concluded from all these studies is:

Wind- Solar Hybrid Power Plants can be set up in areas where the wind and solar power generation complement each other. The locations where wind generation plants are set up, solar panels can be installed to supplement the supply during dry weather conditions. Similarly, wind can provide for energy during winters. As the wind speed and sunlight's intensity are both unreliable,

MPPT(maximum power point trackers) controllers are employed to track the peak power points.[6,7]

VI. CONCLUSION

As the seasonal profiles of wind and solar are complementary to each other, a combination of both performs better than either wind or solar systems alone. Wind turbine produces more energy during winters, while the solar power plants generate a lot more power in the summer. Thus a balance of supply is achieved and the grid remains stable throughout the year.

VII REFERENCES

- [1] National statistics 2015
- [2] Anuradha, A.S.Yadav, Amit Kumar, "Hybrid power systems : Solutions to Rural electrification" International Journal of reaseach in technology and management , May 2016
- [3]Uttarakhand Renewable Energy Development Agency (UREDA).
- [4] M. Pucci and M. Cirrincione, "Neural MPPT control of wind generators with induction machines without speed sensors," *IEEE Trans. Ind. Elec.*, vol. 58, no. 1, Jan. 2011, pp.37-47.
- [5] Jogendra Singh Thongam¹ and Mohand Ouhrouche," MPPT Control Methods in Wind Energy Conversion Systems".
- [6] Kumar Pushpak, Anuradha, Balram Kumar, .Agnivesh Ravi and Amit Abhishek, "Improving transient stability of wind farm using FACTS devices focused on STATCOM", International Journal of Engineering Applied Science and Technology.Vol.1 Issue 7.(published online May June 2016.
- [7] Dave Freeman," Introduction to Photovoltaic Systems Maximum Power

Point Tracking,” Texas Instruments, Application Report, SLVA446–November 2010.

[6] Hardik K Mehta , Dr. Vinod Kumar Yadav,” Wind-PV Hybrid System with MPPT Control”,International Journal For Advance Research In Engineering and Technology, Volume 2, Issue VII July 2014 ISSN 2320-6802.