International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 04 | Apr-2016 www.irjet.net p-ISSN: 2395-0072

A Review on Flying Electric Generator as an Alternate Source of Energy Harvester

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Abstract - *Flying electric generator are proposed to harness kinetic energy in powerful, persistent high altitude winds. At 1500ft (4600m) and above, tethered rotorcraft, with four or rotors mounted on each unit, could give individual output of up to 40MW. Flying Electric Generator (FEG is one of the recently found energy source. FEG is a lighter wind turbine that rotates about a horizontal axis in response to wind, generating electrical energy. This electrical energy is transferred down for immediate use, or to a set of batteries for later use, or to the power grid. Helium (an inert non-reactive lighter than air) sustains the Air Rotor which ascend to an altitude for best wind and its rotation also causes the Magnus effect. This provides additional lift, keeps the device stabilized, and keeps it positioned within a very controlled and restricted location. This is the latest technology in Energy sector and cheaper than other techniques and Eco friendly.*

Key Words: Global Positioning System, Wind Energy, Air Rotor, Jet Streams, Rotor Craft System, Magnus Effect.

1. INTRODUCTION

Flying electric generator is proposed to harness kinetic energy in powerful, persistent high altitude winds. At 1500ft (4600m) and above, tethered rotorcraft, with four or rotors mounted on each unit, could give individual output of up to 40MW. Flying Electric Generator (FEG) is one of the recently found energy source. FEG is a lighter wind turbine that rotates about a horizontal axis in response to wind, generating electrical energy. This electrical energy is transferred down for immediate use, or to a set of batteries for later use, or to the power grid. Helium (an inert non-reactive lighter than air) sustains the Air Rotor which ascend to an altitude for best wind and its rotation also causes the Magnus effect. This provides additional lift, keeps the device stabilized, and keeps it positioned within a very controlled and restricted location. This is the latest technology in Energy sector and cheaper than other techniques and Eco friendly.

2. CONCEPT FOR EXTRACTING HIGH ALTITUDE WIND ENERGY

The concepts for extracting energy from high altitude wind can be categorized according to the position of the electrical generator namely “flygen” concept and “groundgen” concept [4]. In the “flygen” concept, the propeller turbine on the flying device or the flow induced rotational motion of the complete device drives on-board generators from where the electrical energy is transmitted to the ground by a conductive tether A good example of this category is the balloon concept developed by Magenn Power Inc. namely Magenn Air Rotor System. In this concept, a balloon filled with helium stationary at a height of 200 m to 350 m altitude rotates around a horizontal axis connected to a generator. The electrical energy produced is transmitted to the ground by a conductive tether for consumption or to a set of batteries or to the power grid. The Magenn Air Rotor System rotation also generates the "Magnus effect" which provides additional lift, keeps the rotor system stabilized and positions it within a very controlled and restricted location [4]. Flygen concept takes advantage of this principle by mounting small turbines on a wing or an array of turbines on a multi-wing structure that itself acts like the tip of a traditional turbine blade. The FEG is filled with helium gas, which is inert and non-flammable. Helium is a light inert gas and the second most abundant element in the universe; see the followed Fig 1 of magenn air rotor system.

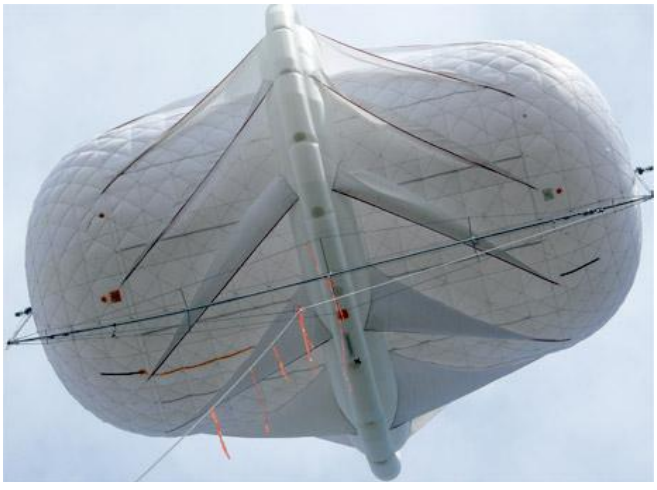

Fig -1: Magenn Air Rotor System

The advantages of the “flygen” concept is a continuous power production with simpler launch and retrieval of the flying device with the help of on-board generators working as motors to provide thrust and lift for flying away from and back to the ground station during

operation but the main challenges in this concept are to develop lightweight generators with high power density and flexible conducting tethers that can withstand high mechanical loads.

3. CONSTRUCTIONAL DATA

The FEG is constructed with Composite Fabrics used in Airships. The fabric will be either Dacron with an inner laminated coating of Mylar to reduce porosity and an exterior coating of Tedlar which will provide ultra-violet protection. Turbines connect to motor-generators which produce thrust during takeoff and generate power during crosswind flight. The first kind form of high altitude wind power is to construct transmission equipment at high.

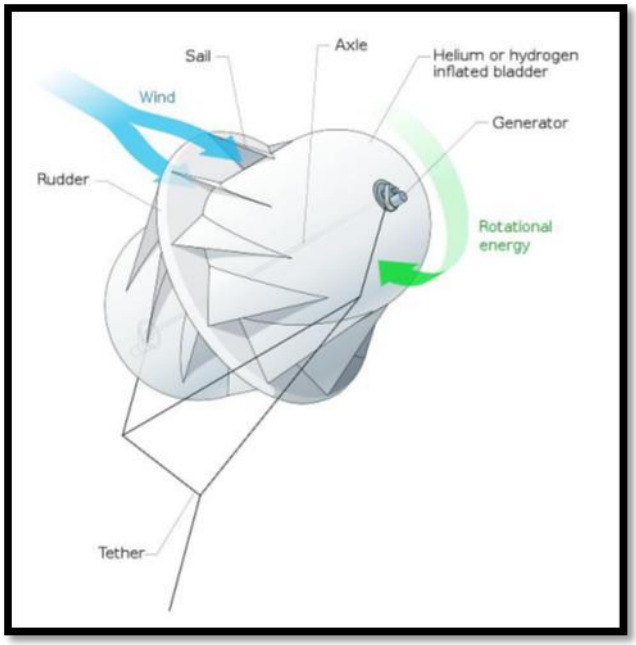

Fig -2: Construction of a FEG

This form will convert the wind energy to mechanical energy, and mechanical energy to electrical energy by the generator. The most practical and promising one of the high altitude wind power generation equipment was called tethered rotorcrafts system (TRC), as composition by the light weight aircraft with four rotors to connect the power station by cable.

4. THEORY & PRINCIPLE

The Turbine Filled with Helium is deployed with the help of a tether made from a Vectra and high-performance multifilament yarn spun from liquid crystal polymer, which is stronger than Steel with high Strength to Weight Ratio. The Flying Electric Generator (FEG) is an innovative lighter-than-air tethered device that rotates about a horizontal axis in response to wind, efficiently generating clean renewable electrical energy at a lower cost than all competing systems. This electrical energy is transferred down the tether to a transformer at a ground station and then transferred to the electricity power grid. Helium (an inert non-reactive lighter than air gas) sustains the Air Rotor which ascends to an altitude for best winds and its rotation also causes the Magnus effect. This provides additional lift, keeps the device stabilized, keeps it positioned within a very controlled and restricted location, and causes it to pull up overhead rather than drift downwind on its tether.

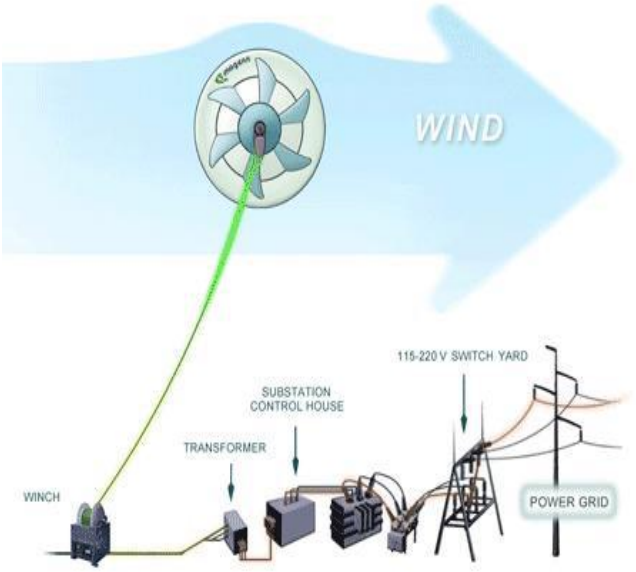

Fig -3: Power Generation

The Flying Electric Generator (FEG) is an innovative lighter-than-air tethered device that rotates about a horizontal axis in response to wind, efficiently generating clean renewable electrical energy at a lower cost than all competing systems. This electrical energy is transferred down the tether to a transformer at a ground station and then transferred to the electricity power grid. Helium (an inert non-reactive lighter than air gas) sustains the Air Rotor which ascends to an altitude for best winds and its rotation also causes the Magnus effect. This provides additional lift, keeps the device stabilized, keeps it positioned within a very controlled and restricted location, and causes it to pull up overhead rather than drift downwind on its tether.

The cylindrical FEG unit is filled with helium, which provides the lift necessary to keep it in the air, additional lift is provided by the Magnus effect, where a rotating object in the air can also generate lift for itself. This effect also enables the unit to stay in place, rather than constantly drift downwind. Once the wind passes over the unit, electricity is generated by rotation of the FEG unit, and it is then transferred by cables to the ground

into a transformer. All competing wind generators use bladed two-dimensional disk-like structures and rigid towers. The Flying Electric Generator is a closed three-dimensional structure (cylinder). It offers high torque, low starting speeds, and superior overall efficiency thanks to its ability to deploy higher.

5. THE ENERGY CONVERSION SYSTEM

The currently proposed new tethered craft consists of four identical rotors mounted in an airframe which flies in the powerful and persistent winds. The tether's insulated aluminum conductors bring power to ground, and are wound with strong Kevlar-family cords. The conductor weight is a critical compromise between power loss and heat generation. We propose employing aluminum conductors with tether transmission voltages of 15 kV and higher, because they are light weight for the energy transmitted .To minimize total per kWh system cost and reduce tether costs, the design allows higher per meter losses and higher conductor heating than does traditional utility power transmission [1]. When operating as an electrical power source, four or more rotors are inclined at an adjustable, controllable angle to the on-coming wind, shown in Fig 4. In general the rotors have their open faces at an angle of up to 50° to this wind. This disk incidence is reduced in various wind conditions to hold the power output at the rated value.

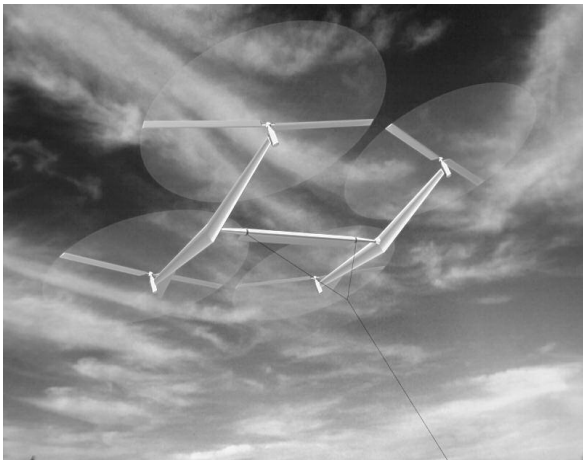

Fig -4: Four rotor demonstration craft

6. FLIGHT CONTROL

Very accurate control is needed to precisely maintain a desired position in the sky. GPS with gyroscopes is an ideal way to provide the reference data necessary to provide this control [1]. The Global Positioning System (GPS) consists of a constellation of 24 satellites that provide a continuous navigation capability to users at any location on (or near) Earth in all weather conditions.

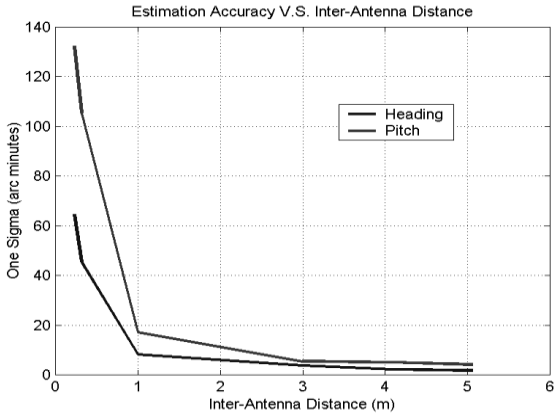

Chart -1: Relationship between the achievable GPS-derived heading and pitch accuracy

With this system, currently operating with 29 satellites real-time three dimensional position information with accuracies on the order of 5-10 m can be achieved; Main error sources for the system include signal propagation effects through the atmosphere, satellite orbit and timing errors, and GP (multipath). When used in differential mode, where measurement corrections are computed at a GPS reference station sited on a known location, accuracies can be improved quite easily to within a few meters (DGPS). Although generally used for positioning and navigation, GPS can also be used for platform attitude determination and control. If three or more GPS receivers and antennas are mounted on a platform, such as an FEG, the GPS carrier phase data can be used to directly estimate the roll, pitch, and heading of the platform in real-time at a rate of 1-20 Hz.

The attitude parameter accuracy is primarily a function of the signal multipath, and antenna separation. For the FEG, multipath could occur through the reflection of the signals off the structure itself. However, when antennas are separated by over 5 m on the FEG, attitude accuracy should be better than 0.25° with multipath present, which is well within the required attitude control specifications. Two other factors must be considered when using GPS for attitude determination and control on the FEG. One is the rigidity of the structure itself. Antennas with maximum separation increase the achievable accuracy, but function best with antennas located on a rigid frame. A second factor is system performance during significant FEG nose-up angles. These angles range from 0° when hovering up to 45° when generating. While hovering, some GPS satellites may be obscured since the FEG may block reception signals along the line-of-sight. Tests show that attitude parameters can still be estimated up to at least a 45° tilt, however, a gyroscope used as an auxiliary attitude sensor, augments GPS availability and reduces noise.

7. COSTS AND MATERIAL OF HIGH ALTITUDE WIND POWER

High altitude wind power technology is still facing the difficulties comes from the material technical, to reach the purpose of send the kite to the high altitude. The materials must use the ultra-light type, also to have the high strength, the feature of corrosion-resistant. The optional cable at same time needs to use the light materials, also need to has the feature with high strength and be resistant. Followed by the wind power generation growth of the stand-alone equipment, the stiffness of the blade is very important. The fatigue strength is a critical factor which will restrict the blades and design. Due to the current properties of the material cannot be completely satisfied the demand for the high altitude wind power generation device, the glass fiber composite performance have tended to limit. So therefore when to development the high-power high altitude wind power device and the better performance of rotor blade, to use the carbon fiber composite materials is imperative.

8. ADVANTAGES

Air turbines have numerous advantages, they are highly flexible deployment, have lower costs, have better efficiency than competing systems, and are more environmentally friendly. Wind farms can be placed closer to demand centers, reducing transmission line costs and transmission line loses. In terms of electrical energy output, the FEG System are less expensive than competing wind power systems (under 15c per kWh).air turbines can be placed close to wherever they are needed, Air turbines can operate at higher wind speeds than conventional wind turbines Conventional wind generators are only operable in wind speeds between 3 meters/sec and 28 meters/sec. Flying Electric Generator are operable between 1 meter/sec and in excess of 28 meters/sec.

Air turbines float high up in the air, up to 1000ft, thus capitalizing on higher wind speeds. Visual impact is also reduced, as air turbines are less visible than conventional wind turbines. Noise impact is also reduced due to the high altitude operation of the air turbine is less of an impact on the bird and bats population. Air turbines are softer objects, without any deadly solid blades. Air turbines are highly mobile, and can be moved easily. This is especially good for emergency disaster relief situations.

9. CONCLUSION

FEG technology will be applied off-grid and combined with diesel power for developing nations, island nations, farms, remote areas, cell towers, exploration equipment, oil and gas wells, mining sites, offshore drilling stations, and backup power & water pumps. FEG could also be used for on-grid applications for farms, factories, and remote communities. We know that Wind energy is a CLEAN Energy i.e. Pollution-free and eco-friendly. Also wind energy is a renewable energy. Our F.E.G is a hot-new mobile power generating system uses the wind energy in the effective manner so as to generate more electrical power. This system proves as better & more efficient power generating system than the present wind power systems. These kinds of newer technologies are necessary for compensating the increase in present world power consumption in effective manner. Let us use these kinds of cost & eco-friendly system for power generation

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BIOGRAPHIES

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