

# Generation of Electrical Power by Using Magenn Air Rotor System

Mithun Gajbhiye\*, Jagruti Raut, Sonu Tagwan, Ankit Wadekar, Prof. Sandeep Mude

Department of Electrical Engineering, KDK College of Engineering, Nagpur, Maharashtra, India

## ABSTRACT

In the last decade, several research groups and companies around the world have been developing a new class of wind generators, aimed at harnessing the energy of winds blowing at high elevation above the ground. Most of the energy which flows around the planet as wind isn't near the ground, or even above the ocean, its way up in the sky where some research suggests constant winds could meet the world's energy needs and cut the cost of power on that bases an Magenn Air Rotor System(MARS) is design with a rotor supported in the air without a tower, thus benefiting from more mechanical and aerodynamic options, the higher velocity and persistence of wind at high altitudes, while avoiding the expense of tower construction, or the need for yaw mechanism Magenn Air Rotor System(MARS) are devices that effectively extract energy from the air flow, more specifically kinetic energy, and convert it to electricity. Wind is the manifestation of the kinetic energy present in the atmosphere. An electrical generator is mounted on the magenn air rotor & transferring generated power back to earth through the cable.

**Keywords:** Magenn, Aerodynamic, Magnus, Air Rotor , Magenn Air Rotor System

## I. INTRODUCTION

In the fast growing world of technology & science, renewable source of energy is one of the most crucial parts that can be used effectively for gaining energy. The use of various renewable courses like wind, solar energy, and tidal energy can prove boon to mankind. So the use of airborne wind energy for generation of energy by using suitable eco-friendly technique is magenn air rotor system.

A Magenn Air Rotor System is a design concept for a wind turbine generator that is supported in the air without a tower. For supporting the wind collection elements, two types are considered the primary options, both of which are tethered to the ground: aerodynamic systems that rely on wind for support (i.e. kite- or wing-based), and aerostat systems that rely, at least in part, on buoyancy.

Generally, airborne wind energy systems may operate in low (250ft/76m) or high (2,000ft/610m) altitudes. Their advantage is in tapping higher-speed winds without

requirements for airborne slip rings or yaw mechanisms, and without the expense of tower transportation and construction.

Magenn Air Rotor System (MARS) can be positioned at higher altitudes to take advantage of wind speeds that generally increase with altitude, as surface friction diminishes. With each doubling of the wind speed the amounts of theoretical energy or power density increases roughly eight times.

An airborne wind turbine (Magenn Air Rotor System) technology innovation started during 1970's, its effective evolution was during 2008-2009. In the year 2010, MARS technology innovations recorded a remarkable growth of 35%, compared to 14% in the previous year. However, the growth phase has declined in 2011 and 2012. Nevertheless, in the following years, there are possibilities of some more interesting innovations.

The airborne wind turbine technology can be categorized under four major types based on their design concept:

- Kite type
- Balloon type (Magenn Air Rotor System)
- Kyttoon type (Combined Kite & Balloon)
- Tethered auto gyro type



**Figure 1 :** Overview of Magenn Air Rotor System

A Magenn Air Rotor System is design with a rotor supported in the air without a tower, thus benefiting from more mechanical and aerodynamic options, the higher velocity and persistence of wind at high altitudes, while avoiding the expense of tower construction, or the need for yaw mechanism. Magenn Air Rotor System is devices that effectively extract energy from the air flow, more specifically kinetic energy, and convert it to.

## II. METHODS AND MATERIAL

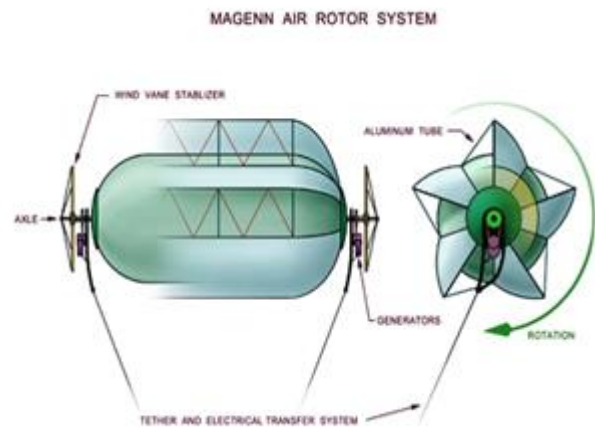
### A. Magenn Air Rotor System

#### i Air Rotor System:

An air rotor wind turbine concept base on the Magnus Effect has been proposed and is kept uplift by helium gas generating rated power. A height of 400 feet is enough to catch the maximum 3 m/s wind speed need to sustain adequate supply of electricity. The turbine spins in the air turning the generators. The rotation stabilizes the turbine while energy is transferred down to the ground through the tether. A Magenn Air Rotor System is a lighter than air tethered wind turbine that rotes about a horizontal axis in response to wind generating electrical energy. This electrical energy is to be transferred down to ground for immediate use, or to a set of batteries for later use, or to the power grid.

Helium gas sustains it and allows it to ascend to a higher altitude than traditional wind turbine. It captures the energy available at the 400-1000 feet low level and nocturnal jet steam that exit almost everywhere.

Its rotation also generate the Magnus effect which provide additional lift, keeps it stabilized, and position it within a controlled and restricted location to adhere to Aviation Rules guidelines.



**Figure 2:** Magenn Air Rotor System

#### ii Magnus Effect :

This is the effect, discovered in the mid 1800's, that creates lift when a spherical or cylindrical object is spun while moving in a fluid. A dimpled golf ball, hit properly, has a back spin that causes it to lift in flight. A baseball curve-ball pitch uses the Magnus effect.

A back spin causes a low pressure region to form above the object & high pressure to form below, resulting in lift. A large object like the air rotor create substantial lift, so much so that the device should actually work in a wind stream, without using a lifting gas like Helium.

#### iii Magnus Effect Airship:

Fred Ferguson proposed the Magnus Airship in the 1980's. This airship utilized the Magnus effect for the first time in lighter than air craft. This Magnus Airship was a large spherical envelope filled with helium to achieved static, buoyant lift. As the sphere rotated during forward motion, a Magnus lift was generated proportional to the airspeed flowing over the sphere; the faster the vehicle, the higher the Magnus lift.

The sphere rotated backward as the craft flew forward. The resulting lift at cruise was greater than the total buoyant lift which could be up to 10 tones payload depending upon the final production size. As the wind speed increase, rotation increases, lift increases, drag will be minimized because of reducing of leaning and stability increases.

#### iv Helium Gas Use :

The air rotor is filled with Helium gas, which is inert and non-flammable. The lifting gas creates a lift force that is in excess of the total weight of the system. The Helium gas provides at least the positive lift versus the overall weight of the unit. Additional lift is also created when the rotor is spinning in a wind. The aerodynamic effect that produces additional lift is also created when the rotor is spinning in a wind. The aerodynamic effect that produces additional lift is the Magnus Effect. The 4 KW rated power unit would require slightly over 6000 cubic feet of Helium. The price of He varies country to country but it is abundantly available It could cost between 7-17 cent per cubic foot depending upon location. Helium leaks at a rate of 0.5 cent per month or 6 cent per year, therefore the air rotor units will have to be topped up with Helium every 4-6 month.

#### v Material Use:

The wind rotor is constructed with composite fabric used in airship. The fabric will be either woven Dacron or Vectran with an inner laminated coating of Mylar to reduce porosity and an exterior coating of Tedlar which will provide ultra violet radiation protection, scuff resistance and color. Dacron is used for boat sails. Mylar in silver toy helium balloon and Tedlar is the plastic coating founded in all-weather house siding.

#### vi Height Restriction:

The air rotor unit may not operate in controlled airspace or within five miles of the boundary of an airport. The unit that operated over 150 feet will have a lightning system including individual lights that are placed every 50 feet on the tether. The light will flash once per second. The deployed unit will have a Rapid Deflection Device installed that will automatically and rapidly deflate the balloon if it escapes from its moorings. The device will be equipped with at least two deflate system that will

bring the unit slowly and safely to the ground. If a unit cut down system does not function properly it will immediately notify the nearest ATC facility of the location and time of escape. It also provides lightning protection.

### B. Construction Details

Construction of the Magenn Air Rotor System has following important parts:

#### i. Aluminum Tube:

Aluminum tube is used for to restrict air flow, and gives thrust for the rotor to rotate in the direction as shown in the figure 2&3. Here it converts the actual linear motion of wind flow energy into rotary motion, which is necessary to rotate the generator shaft.

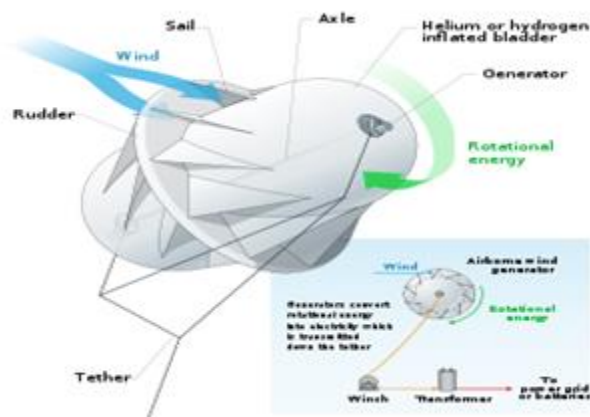


Figure 3: Construction Details of MARS

#### ii. Cylindrical Balloon:

It is the balloon which is cylindrical shape and is filled with helium air which is lighter than air; hence it could be placed above 300m height, and where as conventional wind-mills could be maximum 125m height.

#### iii. Wind Vane Stabilizer:

It is one of the important parts of Magenn Air Rotor System. It restricts the MARS in horizontal direction, and gives stability to the balloon.

#### iv. Axle & Generator:

It acts as a frame which is a single shaft connecting balloon, and aluminum tube to the generator shaft, hence it is the power transferring element of the Magenn Air Rotor System. Generator is the actual machine which converts the rotary motion into electrical power & transfers power to the base station which is connected to battery storage plant or electrical power grid.

#### v. Tether (Transmission Cable):

The tether represents a key element of a magenn air rotor system power generation system. It retains the airborne part of the MARS to the ground and provides the electric link between the balloon to local power network and the ground based power and control station, which is connected to the grid.

### C. Operation of AWTG

The Magenn Power Air Rotor System (MARS) 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.

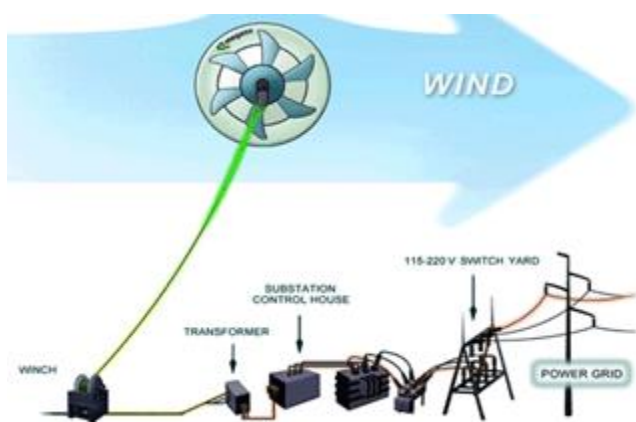


Figure 4: Operation of MARS

The cylindrical MARS 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 MARS 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 Magenn Power Air Rotor system 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. The closed structure allows Magenn Power to produce wind rotors from very small to very large sizes at a fraction of the cost of current wind generators

## III. RESULTS AND DISCUSSION

### A. Comparison Mars with Conventional Wind Turbine

- i.) Magenn Air Rotor System is less expensive per unit of actual electrical energy output than competing wind power systems.
- ii.) Magenn Air Rotor System will deliver time-averaged output much closer to its rated capacity than the capacity factor typical with conventional designs. MARS efficiency will be 40 to 50 percent. This is hugely important, since doubling capacity factor cuts the cost of each delivered watt by half.
- iii.) Wind farms can be placed closer to demand centers, reducing transmission line costs and transmission line losses.
- iv.) Conventional wind generators are only operable in wind speeds between 3 meters/sec and 28 meters/sec. Magenn Air Rotors are operable between 1 meter/sec and in excess of 28 meters/sec.
- v.) Magenn Air Rotors can be raised to higher altitudes, thus capitalizing on higher winds aloft. Altitudes from 400-ft to 1,000-ft above ground level are possible, without having to build an expensive tower, or use a crane to perform maintenance.
- vi.) Magenn Air Rotors are mobile and can be easily moved to different locations to correspond to changing wind patterns. Mobility is also useful in emergency deployment and disaster relief situations.

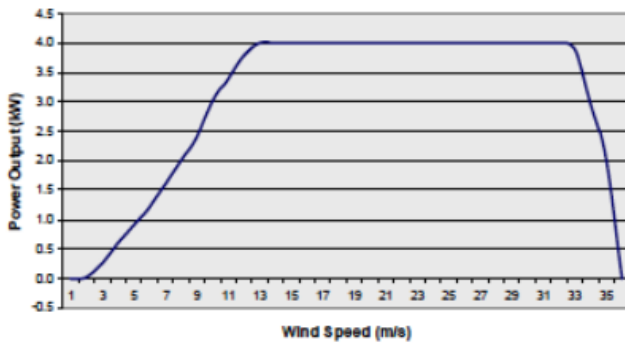


Figure 5: Power Output Vs Wind Speed of MARS

## B. Future of Mars

High-altitude wind is an enormous reservoir of energy, the second biggest energy flow after sun radiation. It also highly exploitable without causing environmental issues, as a recent study found 1800 terrawatts can be generated without impacting the climate.”

According to the Airborne Wind Energy Group, there are nearly 50 commercial high-altitude wind energy projects in development, chief among them Google’s Makani Power from the same Google X labs which are bringing us Google Glass.

## C. Advantages of Mars

- i.) It is the renewable source of energy
- ii.) It does not require any land, because whole structure is situated on the atmosphere.
- iii.) Wide range of wind speeds - 2 to more than 28 meters/second
- iv.) Higher altitudes - from 200 to 1,000 feet above ground level are possible without expensive towers or cranes.
- v.) Fewer limits on placement location - coast line placement is not necessary
- vi.) Ideal for off grid applications or where power is not reliable.

## D. Disadvantages of Mars

- i.) Due to flying rotor, it disturbed the airline transport path.
- ii.) There are chances of broken the connection between flying turbine and ground system.

## IV. CONCLUSION

With the demand for energy requirements increasing tremendously, it can be met by alternative energy resources such as wind.

Particularly, wind at high altitudes can generate more power compared to the conventional wind turbines. In addition, this alternative energy source offers benefits such as easy deploying, low installation cost and maintenance systems, and less wind fluctuations. In terms of operational lifetime, installation cost and reliability, so a magenn air rotor system generator is considered as a promising alternate for traditional power sources.

## V. REFERENCES

- [1] G. D Rai, "Non-Conventional Energy Source", 2nd Edition, Khanna Publication.
- [2] Archer, C., Caldeira, K.: Global assessment of high-altitude wind power. *Energies* 2,307–319 (2009). DOI 10.3390/en20200307
- [3] Masters, G. M.: *Renewable and Efficient Electric Power Systems*. Wiley-IEEE Press, New York (2005)
- [4] Kamini N Shelke, Mohini D. Duraphe, "Magenn Air Rotor System", *IJERA*, ISSN:2248-9622, Vol. 2, Nov-Dec 2012, pp1566-1568
- [5] P. Yashwanth, P.Venkata Ganesh, E.Arunprakash, S.Benisha, "Floating Power Station(Mars the Future Wind-Mill)", *IOSR Journal of Electrical and Electronics Engineering (IOSRJEEE)*, ISSN: 2278-1676 Volume 2, Issue 1 (July-Aug. 2012), PP 10-13
- [6] Alter, Lloyd, " Magenn Air Rotor System Finally Floats", *Treehugger.com*, May 5 2008, <http://www.treehugger.com/files/2008/05/magenn-air-rotor-float.php>