SOURCE OF

ELECTRICAL ENERGY FROM LIGHTNING STRIKE

Pradipta Acharya

Lecturer, Department of Electrical Engineering

Elitte Institute Of Engineering and Managemen (Diploma, B.tech and M.tech)

<u>Abstract</u> - Today's modern world are very much dependable on power for their fruitful need. But now a days enormous use of power imperil our planet, because conventional resources for harnessing electrical power are gradually decreasing day by day in our planet called "earth". So we have to find out some innovative ideas to achieve adequate supply of electricity and simultaneously not to jeopardized our environmental natural balance. In this paper we describe an innovative way to extract electricity from lightning strokes.

Keywords: lightning, electricity, imperil, harnessing, conventional resources.

1. INTRODUCTION

In today's world our modern society facing the electrical energy crisis due to limitation of conventional resources in our planet. Due to this reason we are producing electrical energy from different types of non-conventional sources like solar, wind, tidal etc. to create balance between supply and demand. Now we are trying to harnessing electrical energy from lightning strokes.

From 1980s there have been several experiments or endeavor to produce and store electrical energy from lightning.

According to Dr. Karl Kruszelnicki in northern continent of south American10°(degrees) north from equator a lake "Maracaibo" is located in the state of Zulia in Venezuela known as "*lightning capital of the world*". Here in every year out of 365 days 297 days lightning storms occur. In that location 82 percent lightning strikes, so that this location is called "*Never ending storm of catatumbo*". Catatumbo is a river beside the lake Maracaibo.

Lightning is a natural phenomenon caused by large discharge of electricity in the atmosphere from IC(Intracloud) or CC (cloud to cloud)or CG (cloud to ground) with a flash of bright light and sound. In this paper I am given a concept that how electrical energy is stored with the help of lightning discharge from cloud to ground (CG). To store this huge amount of electricity we are considering a super capacitor as a storage device. Here a special type of material used to build the super capacitor called "*Graphene*". It is a combination of carbon based materials with mixed metal oxides and conducting polymers.

2. LIGHTNING

When heats above the ground surface of the earth rises as a hot air to the atmosphere and atmospheric water vapour cools and forms a cloud. Due to this continuous process cloud gets bigger and bigger. This giant cloud is called "

Cumulonimbus cloud" or thunder cloud. This clouds normally formed approx (18000 to 20000) ft near the tropopause.

Now this giant charged cloud floating with positive charged particles at the top portion and heavily negative charcharged particles float at the bottom portion of the cloud. As a result a giant spark will occur inside the cloud and we see a lightning spark. This phenomenon is called "*cloud to cloud lightning* ".

Now sometimes lightning will occur between cloud to ground. Because if we consider a giant capacitor whose one plate consider as a earth surface and other is near most cloud surface where earth surface consider as a positive and charged cloud surface consider as a negative plate.



Fig 1 layer of tropopause where Cumulonimbus cloud form.

Now when a cumulonimbus cloud form in a location near tropopause an electric field is produce between positive portion of ground and heavily negative charged area of the cloud. As the difference between the two charges gradually increase the positive charged particles rises and accrue to a taller object. The negatively charged particles creat a channel called "stepped leader" to release the charge towards that particular location on he earth surface. Therefore a dazzling flash of bright light with sound occure between charged cloud and earth surface. This channel is called a streamer. It is so powerful that breaks the dielectric medium called air between cloud with negatively charge and ground with positively charge. This phenomenon is also known as cloud to ground lightning.

I am showing step by step process through the figure below how lightning strikes from cloud to ground.



pool of positively charged particles.

Negatively charged area in the storm will send out a charge.

Fig 2. Cloud to ground lightning strikes.

3. FULGURITE

It comes from a latin word fulgur. Sometime lightning bolts strikes in a sandy area deliver approx 5 giga joule of energy. During this moment sand particles melt and fuse within some milli-seconds with the contact of this huge energy. Sand melts at about 1800°c and temperature of bolt reaches approx 30000°c. After that a glassy silica mineral (amorphous Sio₂) looks like a form of cylindrical tubes less than 21 meter produce in the sandy area. This form of cylindrical tube is known as "FULGURITE". Generally it occurs beneath the layer of sand. Below the figure shows how fulgurite will occure beneath the sand when lightning bolt strikes the sand layer.



Fig3.Fulgarite formation after lightning strike.

4. SUPER CAPACITOR MATERIAL

In recent trend we are using super capacitor in exchange of batteries as a strong device. Super capacitor has a capability to store high energy as compared to regular capacitor. Super capacitor also called electric double layer capacitor (EDLC). It contain two metal plates coated with activated carbon porous material.

Two plates are immersed in an electrolyte made of positive and negative ions dissolved in a solvent. At the time of applying voltage separate charged layers are produced with (0.3- 0.8)nm separation distance. It's life span approx (10 to 20) years with (80 to 100)% capacity. Most of the supercapacitors performance based on the materials that is use in watt/kg. In case of super capacitor fabrication carbon based materials are widely used due to high surface area, availability and low cost. Here is the figure below show the classification of super capacitors.



Fig 4. Classification of supercapacitors based on electrode material.

Here we use the material know as "graphene" as a coating of a two metal plates of a supercapacitor. Graphene is basically an allotrope of carbon in the form of a single layer atoms in two dimensional hexagonal lattice, where one atom forms each vertex. It is approx 200 times stronger than steel with excellent conductor of heat and electricity and has a light absorption abilities.

Graphene have been developed by synthesis process. Graphene are another part of graphene-graphite family.



Fig 5. How graphite is converted in graphene through oxidation and reduction process.

5. CALCULATION OF NUMBER OF CELLS

Assume the lightning stroke is 200,000A for 0.5 mSec. The charge transferred is i t = 100 coulombs.

Now assume that the largest voltage we would want to store in the capacitor bank is 1 megaVolt. To store 100 Coulombs at 1 MV, C = Q/V 100 coulombs/1 MV = 100 µfd. So we need a 100 µfd/ 1MV capacitor bank.

Some datas have been collected by me during lightning strik through lightning distance timer software.



Fig6. Through this we can find the average lightning strike in a perticular area and also which location is suitable for our energy storage area through lightning strike.

6. HARVESTING LIGHTNING ENERGY

First I consider a tall tower, on the roof of the tower lightning arrester placed made by graphene. After that choosing a proper location where average maxmum amount of lightning strike occure in a year. After that we connect it through a common transducer placed in a specific location by copper wire with adequate thickness. The topic related proposed diagram is given below.



Fig 7. Electricity produce by lightning strike.

When lightning strikes on the arrester, a huge amount of electricity captured by the lightning arrester. Then it is flowing through the cables and fed to the circuit. After that high amount of DC voltage is fed to the graphen base super capacitor name C_1 , C_2 , C_3 with high capacitance range discuss in calculation. Hence these super capacitors with storage act as a dc voltage source which is fed to the load. If ac is needed we convert it by usaing a inverter circuit then fed to the load.

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