LIGHTNING AS A NEW RENEWABLE ENERGY SOURCE

SARAVANA KUMAR A/L ARPUTHASAMY

UNIVERSITI TEKNOLOGI MALAYSIA

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SARAVANA KUMAR A/L ARPUTHASAMY

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To my family who loves me,

for their understandings and encouragements towards my study.

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ABSTRACT

Lightning is a massive electrostatic discharge which occurs naturally. It consist of huge amount of voltage and current. It has been estimated that 40 to 50 lightning strike somewhere on the earth surface in a second. Annually around 1.4 billion of lightning strike occurs worldwide. Although the number of strike is very high lightning energy could not be convert to useful energy yet. Malaysia is one the country with tremendous lightning activity. As such, it better to initiate a study on lightning harnessing and promote it as new renewable energy sources that could be converted to useful electrical energy. Lightning can be a solution for the power crisis which is mostly depends on the non-renewable resources. However, there are some challenges in considering lightning as an alternative choice of energy. It is very hard to predict the location of lightning strike and harness the lightning energy because lightning strike occurs within few microseconds. In this research, the possible methods of converting lightning energy into useful electrical energy are studied and the best method that could practically applied will be proposed.

ABSTRAK

Kilat adalah nyahcas elektrostatik besar-besaran yang berlaku secara semula jadi. Ia terdiri daripada voltan dan arus yang amat besar. Ia telah dianggarkan bahawa 40 hingga 50 kilat menyerang di sesuatu tempat di permukaan bumi dalam masa satu saat. Setiap tahun kira-kira 1.4 bilion kilat berlaku di seluruh dunia . Walaupun bilangan sambaran kilat adalah sangat tinggi tetapi kilat tidak boleh ditukar kepada tenaga yang berguna. Malaysia merupakan salah satu negara dengan aktiviti kilat besar. Oleh itu, lebih baik untuk memulakan kajian mengenai kilat pemanfaatan dan mempromosikannya sebagai sumber tenaga boleh diperbaharui baru yang boleh ditukar kepada tenaga elektrik yang berguna. Kilat boleh menjadi penyelesaian untuk krisis kuasa yang kebanyakannya bergantung kepada sumber-sumber yang tidak boleh diperbaharui. Walau bagaimanapun, terdapat beberapa cabaran dalam menimbangkan kilat sebagai pilihan tenaga alternatif. Ia amat sukar untuk meramalkan lokasi sambaran kilat dan memanfaatkan tenaga kilat kerana kilat berlaku dalam masa yang singkat iaitu beberapa mikrosaat. Dalam kajian ini , kaedah yang mungkin bagi menukarkan tenaga kilat menjadi tenaga elektrik yang berguna dikaji dan kaedah yang terbaik yang boleh digunakan akan dicadangkan.

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E	-	Electric Field
D	-	Distance
M	-	Total Electric moment
T	-	Time
c	-	Speed of light
R_D	-	Resistor (front time)
R_E	-	Resistor (tail time)
C_S	-	Charging capacitor
C_B	-	Load capacitor
t_t	-	Tail time
t_f	-	Front time

CHAPTER 1

INTRODUCTION

1.1 Background Information

Power crisis is the major issue widely discussed all around the world. A lot power generation methods using fuels and coals have been discovered and successfully implemented in most of the countries. However these methods have been jeopardized by the non-availability of the energy resources. Some researchers had identified that these non-renewable sources may deplete in future. In addition, fuel and coal prices in the word market has been increased rapidly. As such, most of the countries in the world focus on renewable energy sources to replace the non-renewable energy sources. Some of the renewable energy sources such as solar, wind, tidal, and hydro already used in power generation by many countries in the world. Besides these renewable energy sources, lightning also can be considered as a new renewable source.

Benjamin Franklin was the first who have discovered the theory of electricity in lightning [1]. Following by this theory, a lot of studies and researches have been done to identify the source of lightning and the possibilities of harnessing the lightning energy. Lightning phenomena involves huge amount of voltage and current which occur within extremely short time period. A single lightning bolt consists of massive amount of energy which carries approximately 5GW [2]. This amount of energy is equals to the energy that

can be produced by 145 liters of petrol. Moreover, it has been estimated that lightning strike occurs within the range of 40 to 50 times every second worldwide resulting in 1.4 billion times a year [3]. Malaysia in one of the country with tremendous lightning activity. In 2010, Richard Kithil Jr (Chairman of the US National Lightning Safety Institute (NLSI)), has revealed during a talk held in University Putra Malaysia (UPM) that Malaysia has second highest number of lightning strikes in the world [4]. Besides that, Malaysian Meteorological department recorded 362 days of lightning strike in Subang [5]. These facts shows that Malaysia as one of the potential country to consider lightning as a new renewable energy.

The ultimate objective of this research is to identify the methods available to harness or convert lightning energy as a useful energy source. However, until now the practical technology in harnessing lightning energy for the large scale system was not been developed yet. Basically, the challenges in developing a practical lightning harnessing system can be divided into few stages. First is locating the lightning strike. It very difficult to predict the exact point where the lightning strike but there is some techniques to trigger the lightning artificially to a specific point. Next obstacles are to store the lightning transient voltage in a very short period of time and maintain it. The main focus of this research is to overcome these issues and models a practical lightning harnessing system in Malaysia.

Storage of lightning energy is one of crucial part in harnessing lightning energy as a new renewable energy. The various methods of harnessing the lightning energy discussed in this research. First method is using rocket launcher and the second method is using laser. Besides that capacitor storage method can be considered as possible method

to harness lightning energy. Last but not least, energy conversion method is also can contribute in storing the lightning energy. To investigate the storage system, a lightning impulse generator used in simulation to produce lightning. On the other hand, it is very dangerous to obtain the real lightning energy. A simulation model will be developed to study further on the storage system

1.2 Problem Statement

Power generation extremely dependent on fuels like petrol, diesel, bio diesel, coal and this source may deplete one day. Besides that it is also harmful for the environment. Since Malaysia is one of the countries with tremendous lightning activity, we may consider lightning as new clean source of power generation to replace the fuels and coal. As such, the possible method on harnessing the lightning energy is investigated in this research.

1.3 Objectives

i) To analyze lightning as a potential renewable energy source.

ii) To study on available technologies in storing the lightning energy.

iii) To model different configuration of lightning storage system circuit design and calculation.

1.4 Scope of Work

i) Analyze lightning as a potential renewable energy source.

ii) Study on available technologies in harnessing the lightning energy.

iii) Modelling lightning harnessing circuit using Pspice software and calculate the energy stored.

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