Electricity from Lightning

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***Abstract*—Electricity is produced from a Lightning catcher, a lightning conductor, by using the principle of mutual induction. This generated electricity, passed into the grid system, is distributed to substations.**

I. INTRODUCTION

To produce electricity there are so many renewable energies present on the earth's surface. Some of the important renewable energies are

SOLAR ENERGY

A transducer which converts Solar Energy to Electric Energy in Solar Panel, Number of Solar Panels connected in series to get more Electricity. On the earth it is abundantly available, especially in Asia. Al-Agele H A et al. studied the agrivoltaic systems [1], in sustainable technology, recycling of photovoltaic modules studied by Kumar A & Taylor S [2], the operating principles of solar cells and system applications are written by Green M A, University of New South [3], Duffie J A et al. described the photovoltaics.

5th edition of John Wiley & Sons publication, [4], a book by Smets A H et al. said the conversion techniques of Solar Energy clearly [5]

WIND ENERGY

It is a transducer which converts mechanical energy obtained from rotating a wheel into electrical energy. Due to rotation of the earth, wind is always abundant on the earth's surface. A Burton T et al. explain the wind energy, in John Wiley & Sons book [6], Manwell J et al., explain the design and applications of wind energy [7], Ackermann T writes about wind power in John Wiley & Sons [8], the floating offshore future trends in wind turbines is estimated by Diaz H & Guedes Soares C [9], challenges in wind energy determined by Veers P et al [10], the blade recycling of wind turbines is calculated by Jensen J P [11].

TIDAL ENERGY / HYDRO ENERGY

In both cases if water falls from height, wheels of turbines rotate to produce electricity. Here a transducer converts mechanical energy due to rotation of a turbine by the flow of water into electricity. Earth consists of 2/3 of water on its surface. If the height of water falling is more the turbines rotate with greater speed producing high current. On the earth, Hydro energy is produced where water falls are situated and flowing of river from a height downward. The ocean energy tide power was written by Charlier R H & Finkl C W [12], Khan M J et al. identify different tidal energy technologies [13], wind turbines in tides estimated by Lande-Sudall D et al. [14].

Thermal Power Plant

The transducer converts heat into electricity in a Thermal Power Plant. Here heat is produced by coal burning. How the thermal power plant is designed and operated is said by Sarkar D, Elsevier Science (2015) [15], Nag P K writes the engineering concepts of power plants [16], Nag P K engineering thermodynamics cycle calculation [17],

Nuclear Power Plant:

In a nuclear power plant, nuclear fission starts by passing slow neutrons on fuel, and in this process an enormous amount of heat is produced. This heat, absorbed by coolant, becomes vapour, and the vapour passing on turbines, due to rotation of turbines, produces electricity. If excess current is produced, then coolant vapour is again cooled and reused as coolant. A book on nuclear core reactor engineering is written by Lamarsh J R & Baratta A J [18]. In nuclear power stations, what the secondary stage is, and its plan and design, is explained by Bowman C F et al. [19]. The nuclear power plant structural design is estimated by Meiswinkel R & Schnell J [20]. The lifespan of nuclear power plant is determined by Yi X J et al. [21], Munyanduri et al. analyse the fast breeder nuclear reactor [22].

The Lightning on the earth gives highest voltage of electricity. Due to its high value it is difficult to catch it. The process by which this electricity is caught in a smooth way is being worked out.

HOW MUCH ELECTRICITY PRODUCED IN LIGHTNING

PRINCIPLE

The principle on which the Lightning Catcher works is based on Mutual Induction. Here a Step Down Transformer is used to pass the high voltage and then to the grid system. Here excess voltage is produced in a very small time.

In the case of lightning, DC voltage is created. DC is more advantageous than AC because a) it has no skin effect, it passes into the entire cable, b) it requires only two wires, positive and negative, and c) it does not lose energy while passing into the wire.

II. PLACES CHOOSING TO CATCH LIGHTNING

1. A long Lightning Conductor Rod is placed on deserts or hill tops, because in these places human beings are not present.
2. Conducting Rods are placed longer distance from living houses, so houses are not destroyed.
3. Choose the place to easily transport the instrument.
4. Larger area is essential for catching, no other building or tree more height than the instrument, because distances are fixed by using this instrument.
5. On the top of a mountain once lightning catches then after distribution only next lightning catches, so there is a delay between two lightnings.
6. In desert lightning conductor are placed, where more lightnings normally occurs easily catches lightning because of height.
7. Excess voltage produced in milliseconds of time, so utmost care is taken, handle it with robot, and also experiment is controlled at least one kilometer away from the experiment place.
8. Excess electrical energy is stored into energy storage system.
9. If AC power is obtained convert it into DC by using an inverter system.

III. ESSENTIAL PARTS OF LIGHTNING CATCHER

The important parts of Lightning Catcher are

1. Lightning Conductor
2. The Step Down Transformer
3. Grid system

1. Lightning Conductor:

It is a height equal to the cell tower height, placed in an open place, surrounding which, for at least one kilometer, there is no construction/building. Lightning conductor is a construction type which divides the lightning from cloud attracted, then the lightning conductor immediately splits into 15 - 20 divisions for decreasing the voltage. At high speed the electricity moves into the earth because opposite charges are developed by passing into the divisions; grounding of the lightning takes place in milliseconds. Lightning touching the lightning conductor is immediately divided into fragments of current, otherwise the lightning conductor is spoiled. A special arrangement of 15 - 20 rods at the same distance from the main rod, of a shape called trisula, means three sharp edges at the top side, divides down into 15 - 20 divisions that are earthed at the same distance and same height by identical rods. Otherwise high voltage passed into one division would simply destroy the instrument, so lightning must split into 15 to 20 divisions immediately upon incidence on the lightning conductor. 15 - 20 step down transformers are placed near each one of the subdivisions.

2.Step Down transformer

Here a step down transformer is placed in the vicinity of the lightning conductor, for every subdivision of lightning conductor one transformer is used. Lightning from clouds falling on the lightning conductor, in a very small amount of time on the order of milliseconds, will go to the earth. Before that, it can divide into around 15 – 20 divisions from the branches of the lightning conductor. By the time lightning is incident on the lightning conductor, a step down transformer is placed, magnetic flux cuts the secondary coil, producing electric current, which is very much less than the actual voltage of the lightning. This electricity is then passed to the grid.

3. Grid

The grid consists of the Generation system, Transmission network, and Distribution network systems. The Generator system generates current; here lightning from clouds passing through the 15 - 20 divisions of the lightning conductor is passed through a step down transformer and sent to the Transmission System. The current is then sent to the Distribution System, which distributes it from one place to another. The Distribution system distributes current to household appliances, industrial uses, etc.

IV. WORKING OF LIGHTNING CATCHER

When lightning from cloud to earth is negative, the voltage created is 300,000 million volts, and then positive charges created on the earth receive this voltage. In the present case, the current is divided into 15 - 20 divisions, because all the rods are at the same height and identical rods are used for equal distribution. If lightning from the cloud is positive, a high voltage of the order of 400,000 million volts is required to be earthed, then negative charge from the ground flows onto these 15 - 20 divisions. Here we choose more ways for the lightning conductor to be earthed. In these 15 - 20 ways, opposite charges are developed equally and these are maintained identically and are at the same height. Lightning occurs within milliseconds, so care must be taken during this short earthing time. After earthing, the step down transformer immediately sends electricity to the distribution system. Excess power is diverted from the grid to special storage devices like a battery storage system or compressed air storage system, etc.

V. CALCULATIONS:

If voltage falling from down ward direction of cloud I.e., negative charges situated on cloud is =300,000 million volts or 300,000 volts per meter

300,000 million volts is distributed into 15 divisions

300,000 million volts / 15 =20,000 million volts

Convert to billion volts

20,000 million volts / 1000 = 20 billion volts

If 300,000 million volts is distributed into 20 divisions

300,000 million volts / 20 = 15,000 million volts

Convert to billion volts

15,000 / 1000 = 15 billion volts

If voltage falling on upward direction of the cloud means positive charges are earthed then voltage falling on the ground =400,000 million volts or 400,000 volts per meter

400,000 million volts distributed into 15 divisions

400,000 million volts / 15 = 26,666.67 million volts

= 26.67 billion volts

If distribution of 400,000 million volts into 20 divisions

400,000 million volts / 20 = 20,000 million volts.

=20 billion volts

VI. CONCLUSION:

Lightning from clouds is earthed through a special network, tri-edged at the top and divided into 15 - 20 divisions at the bottom, divided into fragments. The generated electricity, of the order of 15 billion volts - 20 billion volts from the bottom of a cloud and 26.67 billion volts - 20 billion volts from the top of a cloud, is passed through a step down transformer, transmitted, and distributed through the distribution system, and the electricity reaches our houses.

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