A Research on Improvement of Power Quality using Improved Configuration of Lightning Rod

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Abstract— The quality of power is very necessary now days and cannot be avoided at all. The power quality is very important for every instruments used in daily life. From generation of power to the distribution of power, the quality has to be maintained at every part of the system. Variation in power quality can leads to the fault in the system and sometimes it causes to the major fault and distruct the electrical equipments. Lightning is major thing which affects the quality of power as it can cause the power failure, voltage transient, sags, swells, variation in the power angle and also affects the frequency of the system.

Keywords: instruments, generation, variation, equipment, transients

I. INTRODUCTION

Electrical power quality involves voltage, frequency, and waveform. Good power quality are often defined as a gentle supply voltage that stays within the prescribed range, steady a.c. frequency of the rated value, and smooth voltage curve waveform. The issues between the power quality what comes out of an electrical outlet and therefore the load used into it. The term is employed to explain electrical power that drives an electrical load and therefore the load's ability to function properly. Without the right power, an device may malfunction, fail or not operate in the least. There are some ways during which electrical power are often of poor quality and lots of more causes of such poor quality power.

Power quality is a major issue now days. As the demand of power increases rapidly the quality of the power is becoming the major issue for all countries whether they are small countries or big, developed or the developing countries.

II. DEVIATION IN POWER QUALITY

A. *Voltage*

- Variations shows in the peak voltage are important to different types of equipment.
- The peak voltage increased to the rated voltage by 10 to 80% for 1 minute, that's called swell.
- Voltage deviation is the major issue to the electric power quality.

B. *Frequency*

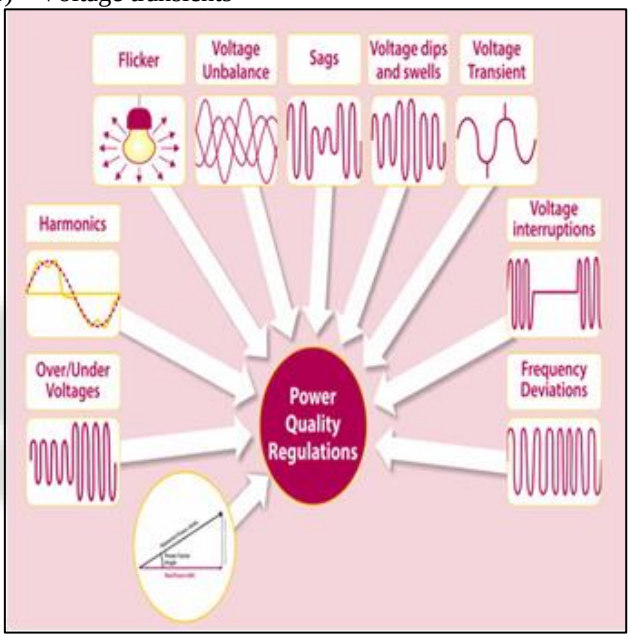
- Variations in the frequency.
- Nonzero low frequency impedance occurs when a load draws high power.
- Nonzero high frequency impedance occurs when a load demands large current, then suddenly stops demanding it, there will be a dip or spike in the voltage.

C. *Waveform*

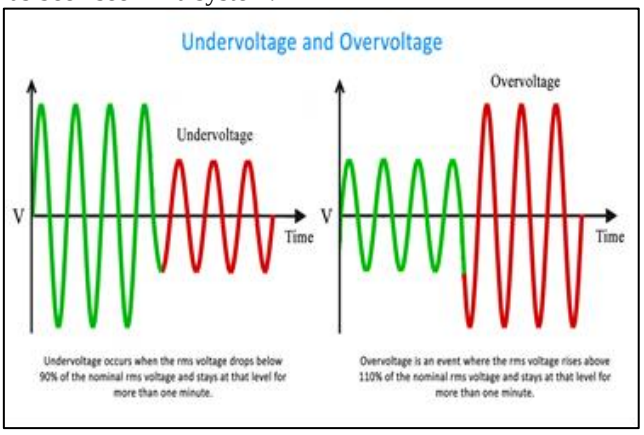
- The waveform of voltage and current ideally follows the form of a sine or cosine
- Generally generators cause voltage distortions and loads cause current distortions. These distortions occur as waveform more rapid than the nominal frequency, and are referred to as harmonics.

More issues with power quality

1) Sag
2) Swell
3) Overvoltage
4) Under voltage
5) Flicker
6) Voltage transients



This figure shows the various issues with the power quality. These two figures are clearly shows the power quality issue has been seen in a system.



III. LIGHTNING: ISSUES TO THE POWER QUALITY

A. *Introduction*

Lightning is a basically produce by the two electrically charged portion in the atmosphere or ground equalize each

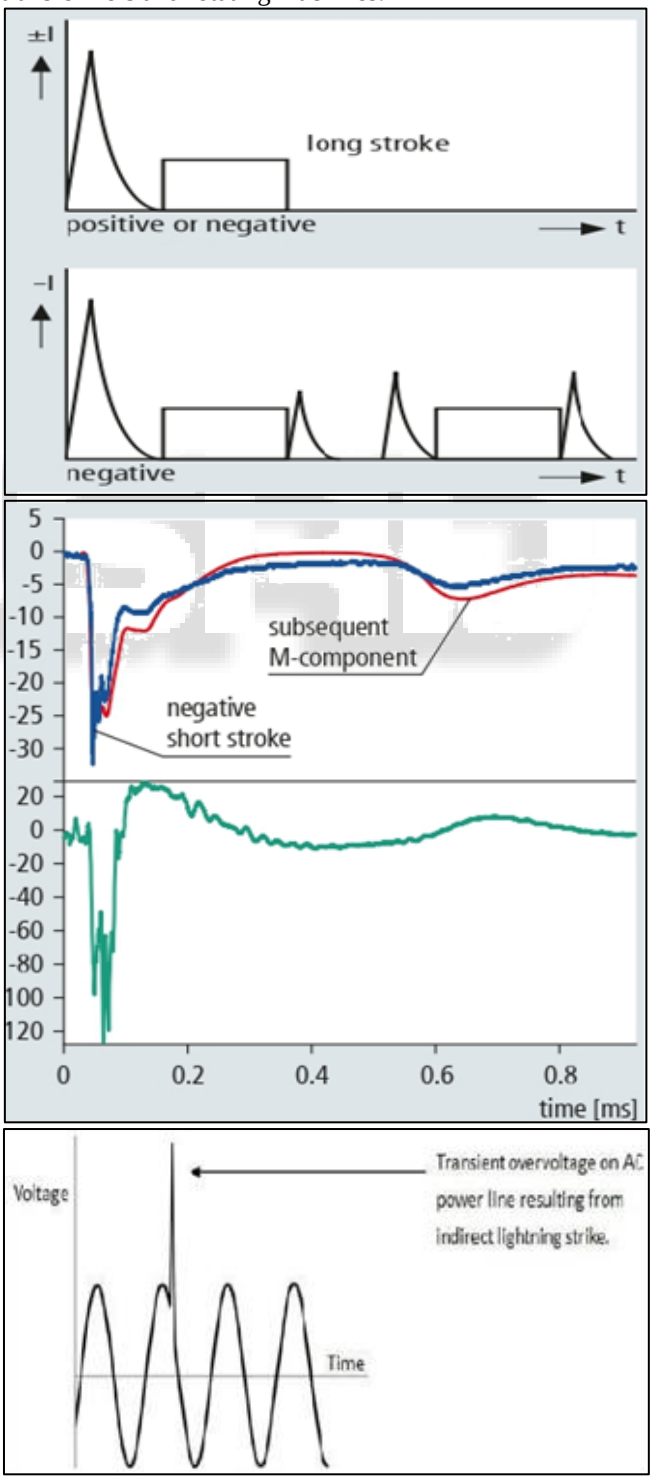
other and causing the sudden release of a large amount of energy. This is a natural phenomenon. This discharge has been produce vast range of electromagnetic radiation, as the electrons moves rapidly and produce energy as well the radiations. Thunder can be seen due to the lightning and a sound can also hear because of the shock wave produce by the stricking of the electron and other particles .Lightning can be seen commonly during thunderstorms and during the heavy rainy season and other weather systems. Volcanic lightning generally seen during volcanic eruptions.

B. How Lightning effects the Power System Stability

Lightning directly affects the performance of power lines in both direct and indirect ways where the transient voltages may cause flashover on the electrical equipments on the main line. it has been seen that when lightning strikes directly , it may intercept with line conductors, towers or shielding wires. The probability of direct strike in a very given region increases with line height, thus, high voltage (HV) lines may subject to direct strikes over medium voltage (MV) or low voltage (LV) lines. On the opposite hand, when lightning strikes the bottom or any object near a line, the electromagnetic fields will propagate altogether directions. The capacitive and inductive coupling of electromagnetic field with conducting wires induces voltage within the power system. The lightning overvoltage may cause significant problems in MV and LV power lines thanks to the low value of critical flashover (CFO) voltage compared to it of HV line. Moreover, the possibility of an indirect effect is on top of that of an on the spot strike as for any lightning event around an influence line, LIOV can appear on the facility line. In fact, many parts of India experience up to 200 thunderstorm days p.a. which is one among the countries with a really high flash density within the world. it has been claimed that about 50% of total failures in their system are caused by lightning strikes. so it is necessary to think about the effect of lightning on many electrical components like insulators. The selection of power line insulators should be done after thorough investigation on the weather of a selected region and voltage conditions of the system. The configuration of the road and therefore the radial distance between conductors with relevance the bottom may additionally affect the electrical field distribution along an insulator and therefore the value of the breakdown voltage under various conditions.

Energy spectrum of the lightning current is extremely wide lightning current increases from 2 kA up to 200 kA. Peak currents may exceed 200 kA. If the facility equipment isn't protected the over-voltage will cause burning of insulation. Thus it results into complete shutdown of the facility.

Over voltage tends to worry the insulation of the electrical equipment's and certain to cause damage to them when it frequently occurs. Over voltage due to surges that may result in spark over and flash over between phase and ground at the weakest point of the network, breakdown of gaseous, solid, liquid insulation, that cause failure in transformers and rotating machines.

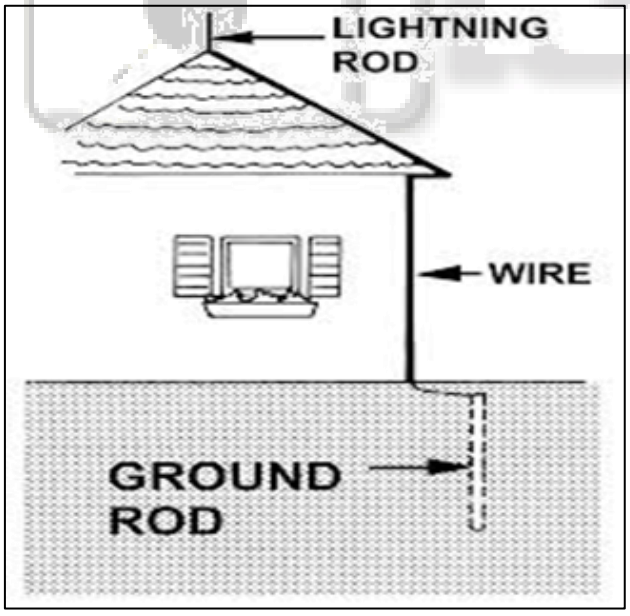


These figures shows the fluctuations in voltage and in line current due to the lightning, we can see clearly how the lightning effects our power system parameters and hence our various electrical components as well. These sudden fluctuations in the system may causes to severe faults in the system. This can also lead the black out in a specific region. To overcome these faults and these various fluctuations some special type of equipments are used for the good power system. These equipments are mounted and used at the substation, buildings, transmission lines poles and nearby the various grids. Some special equipments are- lightning rod and surge protection.

C. Lightning rod and surge protection

When lightning strikes on the transmission line, the line voltage rises to risky voltage stage. Therefore, these lightning strike need to be prevented falling on the transmission line to guard the lightning rods are used. Lightning rods are used to mounted on the highest top point on the pinnacle ground at the Constructing top and top of the transmission line tower, pinnacle of the chimney and many others. This protects the electrical equipments from the direct lightning. They seize the lightning current and connect to the ground, hence all current ground by the conductor.

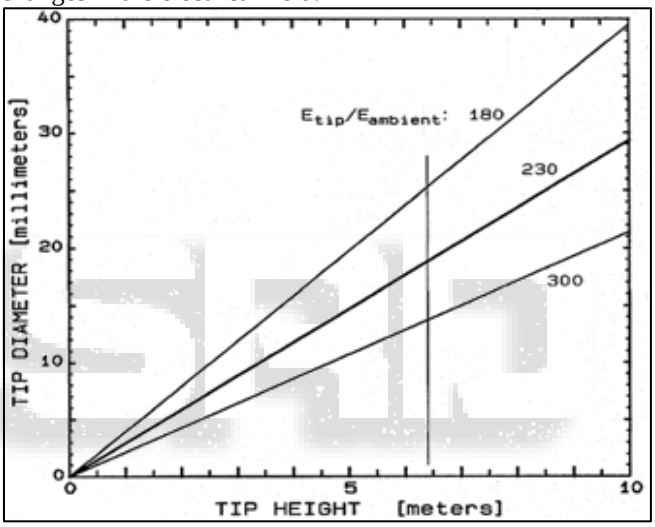
lightning protection initially was suggested for erecting grounded metal rods to provide a path to the earth for lightning. This protection has been made less effective because the tips of lightning rods are sharp; we think that the lightning rods may provide good protection if they were not sharpened enough which limiting the strength of the electric fields.

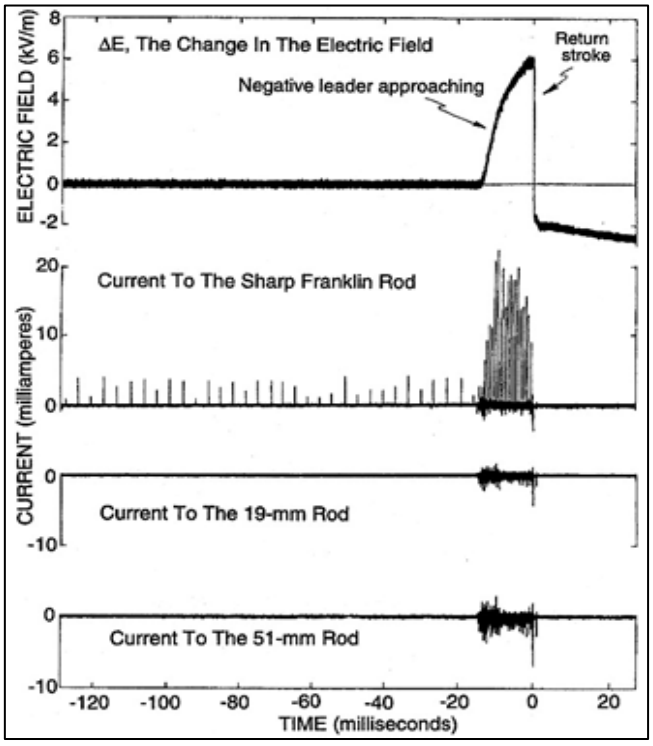


IV. RESULT

For the later analysis, the requirements for this formation of an upward-going, positive return-stroke leader from the relative object that receive lightning can now be noted. These requirements are the object is an exposed conductor of electricity that is connected to the ground; very strong, upwardly directed, electric fields develop in the air above the rod tip and with strengths sufficient to spread electrons from negative ions in the air which creating electron avalanches and bars of positive ions that moves more fastly than they getting away by ion movements; and the electric field in the air just above the movement of positive ions jointly to strengths greater than threshold value which is necessary for the spread of electrons from negative ions in air.

The displacement current caused by changes in the electric fields and the charge emissions which is associated with the making of ions around the top of the rod. As shown by these and other recordings, the sharp or pointed Franklin rod emitted strong positive charge during the close stepped leader lightning that comes from the thundercloud. On the other side, there were no matched pulsed emissions from the blunter rods during the negative leaders lightning he displacement current of the another type of rod was recorded at the strike. The current waveforms are shown in Fig. for the 19mm and the 51mm rods before the strike are seen to be large as compare to the displacement current because of changes in the electrical field.





V. CONCLUSION

The overall conclusion of the recent research on the lightning protection devices such as lightning rod which is found to be more significant to the others protecting devices. A lightning rod is mounted or to be fixed on the transformer, power lines when the lightning occur, the current which is excessive in amount is too grounded by means of the conductor.

The above study lead us to conclude that sharply pointed shaped lightning rod are not enough good to protect the electrical devices from lightning as they failed to give a path to pass the current to the ground. The other consideration clearly shows that blunt shaped or round shaped lightning rod are more effective as compare to the pointed shaped as this provide the direct path to the lightning current to the ground and protects the structure as well their components.

So this special type of configuration of the lightning rod lead the power stability in the system as the overall power quality is maintained by the rod throughout the whole system.

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