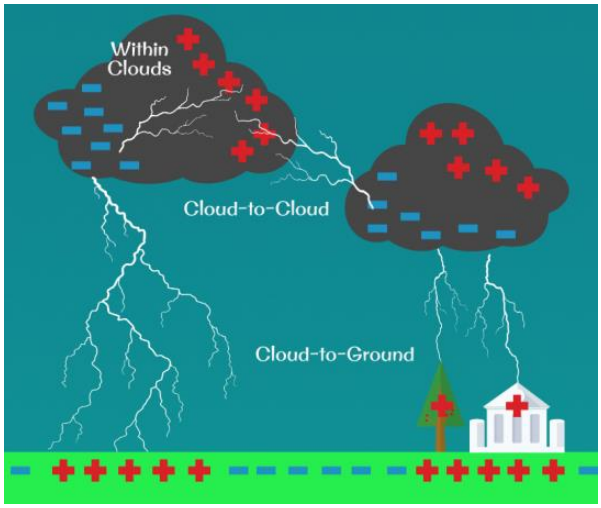
INTRODUCTION

1. The value of electronic eqpts held with units/fmn has increased enormously. These electronic eqpts are susceptible to voltage and current transient events. It is imperative to study the lightning strikes and protective measures to save human lives, structures/buildings, and eqpts from it.

2. Lightning is an electrical discharge caused by imbalances between clouds and the ground, or within the clouds themselves. Most lightning occurs within the clouds. It is a natural phenomenon caused by the separation of electric positive and negative charges by an atmospheric process, where fine cloud particles acquire a positive electrical charge at the top of the cloud and larger particles acquire a negative electrical charge at the bottom of the cloud. When the separated charges get very large the dielectric str of the air between the positive and negative region of the cloud breaks down into a giant spark.



EFFECTS OF LIGHTENING

3. **Direct Effects (Strikes on Structures)**. A direct strike on a building or structure will seek a path to the ground either via the structure's lightning protection system or via any other metallic path via a series of flashovers which may be quite unpredictable. As well as a direct strike to buildings and structures, lightning may directly strike power lines, antennas, antenna feeders, and overhead telephone cables as well as mechanical services like water and gas piping. The aim then must be to intercept these impulses as they enter the building and bypass them to earth.

4. **Indirect Effects (Network Overvoltage)**. As well as direct lightning strikes, indirect effects can also be damaging. For example, if lightning strikes a building or any of the services mentioned above, transient over-voltages may be caused through resistive, inductive, and capacitive coupling as described below:-

(a) **Resistive Coupling**. When lightning strikes the ground near a building and the rise in ground voltage affects electrical earthing systems (earthed pipework, wires, etc.) and is conducted back through these into the nearby building where it can travel through the electrical system

(b) **Inductive Coupling**. When lightning strikes a lightning conductor and generates a large electromagnetic pulse of energy which can be picked up by nearby cables in the form of a destructive voltage surge due to electromagnetic induction.

(c) **Capacitive Coupling**. When lightning strikes overhead high-voltage power distribution cables, while much of the lightning energy is dissipated by integral high voltage surge protection devices, a large proportion will travel along with the distribution system and find a way into the power systems of individual buildings, devastating any electronic equipment it feeds.

PROTECTION OF STRUCTURES AND ELECTRONIC EQPTS FROM LIGHTNING

5. Lightning protection systems, essentially lightning conductors (protection of structures) and voltage surge devices/protectors (known as SPDs to provide protection against overvoltage), offer effective protection if they are defined and installed with care.

Structure/Buildings Protection

6. The protection of living/storage buildings is primarily done by installing lightning conductors. The purpose of these is to protect structures against direct lightning strikes. By catching the lightning and running the discharge current to earth, they avoid damage connected with the lightning strike itself and the circulation of the associated current. Lightning conductors are divided into four categories:-

(a) **Single Rod Lightning Conductor (Franklin Rods)**.

(b) **Lightning Conductors with spark-over-device**. These are equipped with a sparkover device which creates an electric field at the tip, helping to catch the lightning and improving their effectiveness.

(c) **Lightning Conductors with Meshed Cage**. The meshed cage consists of a network of conductors arranged around the outside of the building.

(d) **Lightning Conductors with Earthing Wires**. This system is used above certain buildings, outdoor storage areas, electric lines (overhead earth wire), etc. The electrogeometric model of the sphere applies to these.

7. A checklist for structure lightning protection is given below:-

(a) Building to have an intact roof conductor network (wherever an observer stands on the roof, a lightning conductor should be visible no more than 10m away).

(b) Building to have an intact system of down-conductors (there should be an intact down-conductor located at least every 20m around the perimeter of the building).

(c) Each down-conductor is to be connected to an intact earth pit and earth rod. The down-conductor must be securely fastened to the earth rod.

Electronic Devices Protection

8. The best way to protect electronic eqpts from lightning is to plug out the eqpt from the main power supply and take out all data/comn cables. However, this is not humanly possible every time because an accurate prediction of a lightning strike can't be done. And there are also some critical eqpts, which need to run all the time.

9. The most commonly used protection devices such as fuses and circuit breakers are too slow in relation to the phenomenon of lightning and can in no way protect electrical or electronic equipment from overvoltage caused by lightning. Voltage surge protectors or Surge Protection Devices (SPDs) are necessary to protect electronic eqpts from lightning. SPDs provide active protection of the eqpts but they are only fully effective when installed carefully and correctly.

10. SPDs are of different types (usually gas discharge tubes, metal oxide varistors, and high-speed clamping diodes), based on which these are selected for different types of applications like power supply lines and data/communication lines.

11. A checklist for protection systems for various electronic equipment:-

(a) Proper and correct installation of SPD on the main power distribution board.

(b) Installation of SPD on the telecommunication lines, feeding modems, and telemetry equipment.

(c) All data/signal/network cables outside the building over distances of more than 10m (either underground or overhead) should be equipped with SPDs at the controls section end of the cables?

RECOMMENDATIONS

12. All critical buildings/structures to be identified such as amn stores, telecom exchanges, or living/office accn in lightning-prone areas. These buildings/structures are recommended to be installed with lightning conductors to safeguard them from any direct lightning strike. And a periodic review of the efficacy of already existing conductors should be done.

13. Critical and expensive electronic eqpts need to be protected from voltage surges that happen due to lightning. For example, LORROS MK-IV has already been fitted with SPD worth ₹5650.00/- by 619 EME Bn, which protects LOOROS MK-IV from voltage surges. A similar exercise is recommended to be done for MATRIX EXCHANGE which is most prone to voltage surges due to lightning strikes and a major chunk of the ACSFP repair fund is expended for the same. Similarly, other electronic eqpts need to be identified for the installation of SPDs after the cost-benefit analysis.

14. To safeguard electronic items, 'manual plugging out of power cables and external comn/data cables' wherever and whenever feasible during thunder strikes, requires no less emphasis than any other technical solution. Therefore, it should be included in the eqpt handling SOPs for operators and the same should be briefed periodically to them.

CONCLUSION

15. Lightning is an important and essential part of the earth's ecosystem but can be destructive at times. It is sometimes hard to understand why some places seem to be prone to lightning. Very tall objects are frequent targets because they represent the shortest path from a cloud to earth. Injury, damage, and fires are usually the result of lightning not being able to find a quick and easy path. A good lightning protection system helps provide that path, thus reducing the probability that damage will occur to people, structures, and eqpts. The implementation of a lightning protection system includes technical knowledge, and it should be as per defined standards.