



The **Power**  
of **Inspired**  
**Solutions.**

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## Affirmation to our know-how

Not just our products, even processes, designs, solutions and ideas have been recognized at a global landscape.

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**C**onnecting  
**I**nnovation &  
**K**nowledge  
**I**nspired by  
**T**echnology

## **A new paradigm in Solutions**

For many decades, lightning as a phenomenon and its destructive effects have been carefully researched. With technology at the forefront, various products have been designed to significantly bring down the negative effects of destruction caused by lightning. A few companies have invested in R&D and have driven the scope of solutions with Innovation and Know-how.

CIKIT, a home-grown company, based in India, is an entity that was founded with the core idea of bringing innovative solutions into the field. This has been possible by channeling decades of knowledge into every process, solution and products that we design.

At CIKIT our foremost passion is to make such innovative solutions extensively available and hence the realization that they have to be technology driven and inspired.

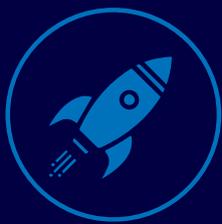
Welcome to CIKIT.





## **Vision**

Our vision is to provide enduring and indigenous safety & security solutions and services against lightning & short circuit currents through well researched processes that are priced optimally and are of benchmark in quality.



## **Mission**

Create footprints in the category to ensure we become and remain the most sought after and renowned Indian brand in world markets.



## **Quality & Development Policy**

- Create high levels of competency and innovativeness to every deployed resource through adequate and appropriate training, education and exposure to build a highly quality conscious organization.
- Stay ahead of the innovation and standards benchmarks in design, process, manufacturing, service and solutions.
- Ensure "zero tolerance" and "uncompromising standards" for manufacturing and services by utilizing the best possible materials, equipments and resources to deliver on commitments and quality.



## **Technology Aided. Standards *Driven.***

Being disciplined & positive is a part of CIKIT's culture, whether it's learning & acquiring knowledge, or practising what we have learnt, or executing the task, at CIKIT we make sure that there is a system and a procedure to follow. Such attributes are inculcated into every member of CIKIT right from their first day of inception into the organisation. Being disciplined brings in perfection in our actions and accountability for what we have done, and positivity helps us look for more possibilities to improve ourselves in every task we execute. Regular trainings and knowledge sharing sessions helps us to be at the forefront of the industry standards and norms followed across the globe.

Considering various geological and climatic factors affecting the performance of the Lightning Protection & Earthing Systems, our R&D team is constantly working on the improvisations to provide suitable products and solutions to get the desired results. Such improvisations would be clearly visible in our product range. Our approach to solutions is strictly as per Electrical Standards followed by engineers across the globe collaborated with our hands of experience working in this industry for several years in various site conditions.

We adapt ourselves to the latest technologies to bring more innovations to the product lines at the same time we make sure that we don't deviate from the standards to be followed and adhere to it completely.

Our proficiency in various Indian & International Electrical Standards allows us to design and develop solutions for all kinds of requirement, whether to design Lightning Protection System as per the conventional IEC 62305 standards or by following the modern French NFC17-102 standard, shows that we are unbiased.

All the products manufactured by CIKIT Electricals are tested and certified by World's renowned laboratories in India and abroad.

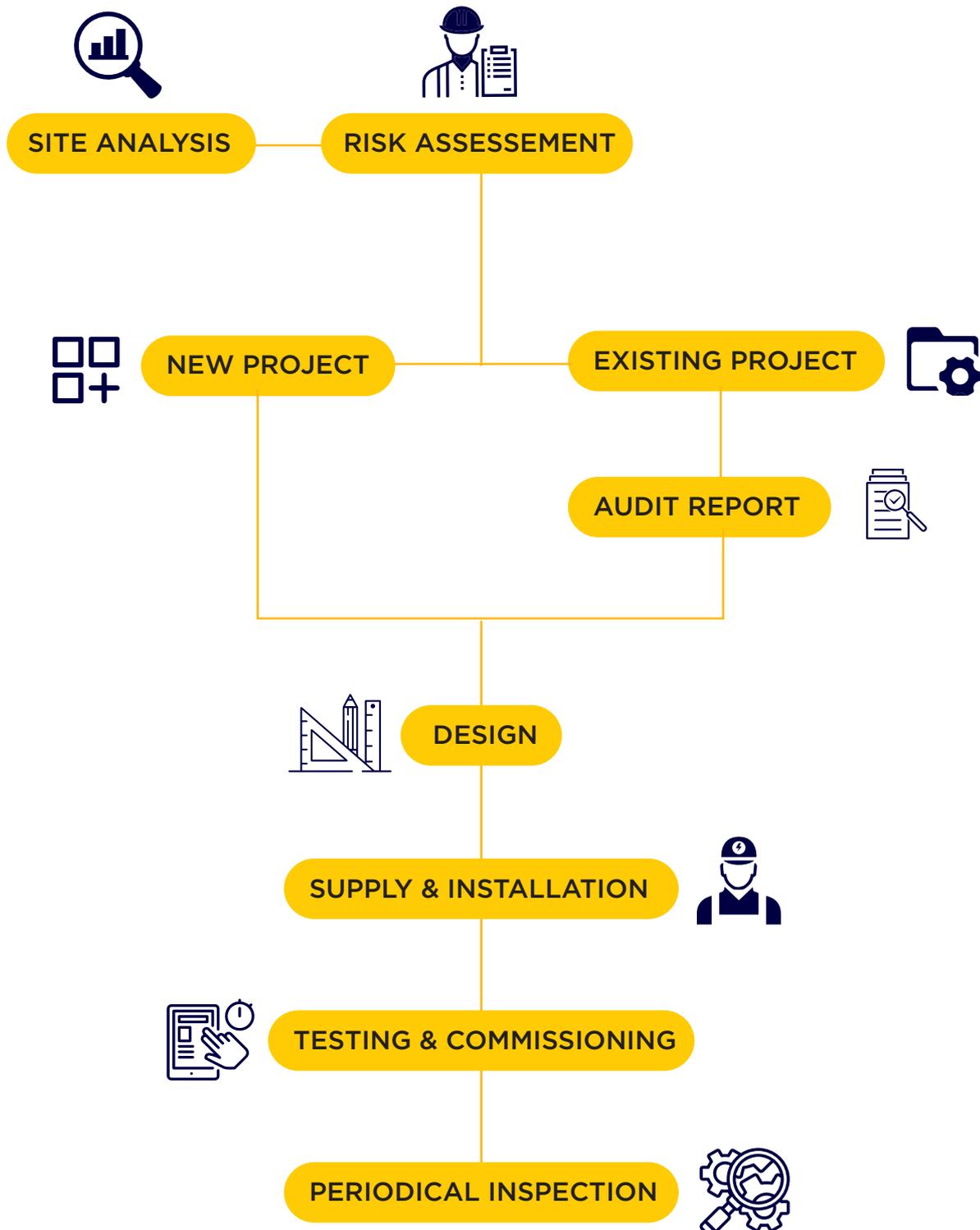
## Our Expertise

S.No	Name of the Industries	Standard details
1	<b>Renewable Energy</b> 	<b>LPS - IEC 61400 - 24</b>
		LPS - IEC 62305, NFC 17- 102
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-11
<p>Windmills and Solar Panels are at high risk due to possibility of destruction by lightning strikes due to its elevation and the wide spread vacant land areas chosen for the installation of such structures. Redesigning or modification of Lightning Protection System post the installation of these structures isn't advisable as it would attract heavy expenses and hence a properly designed LPS as per relevant standards is mandate.</p>		
2	<b>Oil Industry</b> 	<b>OISD-GDN-180</b>
		LPS - IEC 62305
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-11
<p>Due to the storage of explosive and hazardous materials in the Oil &amp; Gas Industry, a direct lightning strike or secondary surges could lead to major disaster leading to loss of lives, resources and equipments. A properly designed and well executed LPS is required to protect this industry from such catastrophe. Level 1 Lightning Protection System of relevant standards should be considered for efficient protection.</p>		
3	<b>High rise building (Residential &amp; commercials), Data centerst</b> 	<b>NBC 2016</b>
		LPS - IEC 6230
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-11
<p>Taller buildings in general attract lightning strikes, hence an efficiently designed LPS is highly critical to safe guard these structures from destruction caused due to lightning. Also such structures should make sure quality earthing system and surge protection devices are installed to protect the lives and expensive electronic equipments housed in these structures. National Building Code guidelines to be followed while designing LPS for such tall buildings.</p>		
4	<b>Railway</b> 	<b>RDSO/197/2008</b>
		LPS - IEC 62305
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-11
<p>With the continual up-gradation &amp; automation of the entire Railways Operations System, quality Lightning Protection System, Surge Protection &amp; Earthing System is required to ensure uninterrupted smooth operations of the railway network. Research Designs &amp; Standards Organisation (RDSO) and Rail India Technical &amp; Economical Services (RITES) act as the technical advisor and consultancy company for the design and installation of Lightning Protection, Surge Protection and Earthing Solutions for the Indian Railways.</p>		
5	<b>Cultural and historical monuments</b> 	LPS - IEC 62305
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-11
		<p>India has got numerous number of historical monuments and heritage sites across the length and breadth of the country. Protecting them will result in preserving the rich cultural heritage of our country and the sheer architectural marvel of our ancestors. Every structure is unique in its style, and custom designed Lightning Protection System will ensure these building survive with the same old charm for many centuries to come.</p>

S.No	Name of the Industries	Standard details
6	<b>Power Generation</b> 	<b>IEEE 142</b>
		LPS - IEC 62305
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-11
<p>Direct Lightning Strokes or over-voltage surges caused due to Lightning could cause major destruction to electrical equipments and will interrupt power supply. The fault current level of a substation will be very high and hence appropriate sizing of the earth conductors should be used to withstand the heavy fault currents without any damage.</p>		
7	<b>Hospitals and health care</b> 	LPS - IEC 62305
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-11
		<p>Hospitals and health care centers are one of the highly sensitive areas where either the interruption of supply for a smaller duration or malfunction of equipment by very narrow margin will result in loss of human life. Not to forget the most expensive and highly sensitive lifesaving electronic equipments housed in these hospitals makes the protection against both the direct and indirect effects of lightning very essential.</p>
8	<b>Telecommunication towers</b> 	<b>IEC 61643 - 21</b>
		LPS - IEC 62305
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-21
<p>Telecommunication towers are more prone to lightning strikes because of their position and height of the structures. The electronic devices used for transmitting and receiving the data are very delicate and requires good ground reference for its reliable operation. In order to provide uninterrupted and efficient service, lightning protection system along with SPD and earthing is very imperative for telecommunication towers.</p>		
9	<b>Manufacturing Industry</b> 	LPS - IEC 62305
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-11
		<p>Due to the advancement in technologies, the industries have undergone a huge transformation. The taller structures in the industries and chimneys make them more prone to lightning strikes and the sophisticated equipments used for industrial automation makes them more sensitive to lightning impulses. Safety of the operators will be the primary focus of Lightning protection system and in addition to that it will reduce the down time of machineries which result in huge revenue loss. Hence proper lightning protection system and surge protection modules should be installed as per the standards to ensure the safety of the people and equipments.</p>
10	<b>Educational and Research institutions</b> 	LPS - IEC 62305
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-11
		<p>The educational and Research institutes contain very valuable and confidential information which are obtained as a result of continuous efforts for several years. A single accident due to either direct or indirect effects of lightning strikes may result in loss of vital data. Hence properly designed LPS is very essential for the Research institutions.</p>
11	<b>Military and defence</b> 	LPS - IEC 62305
		Earthing - IS 3043,BS 7430
		Surge protection device - IEC 62305 part -4; IEC 61643-11
		<p>Defense sector uses delicate devices for surveillance and signaling purposes. Storage of highly explosive materials emphasis the need for protection against lightning. Properly designed and well executed protection system as specified by the Military Engineer Services (MES) should be installed to ensure the reliable operation of those devices and protection of explosives.</p>

## Oriented towards Solutions. Inspired by R & D.

At CIKIT Electricals, we take pride in calling ourselves a Total Solutions provider for Lightning & Earthing related threats rather than a mere product seller. Whether it is R&D for developing new products or to any of the services we offer, we constantly thrive to provide simple but righteous solutions at the most cost effective manner.

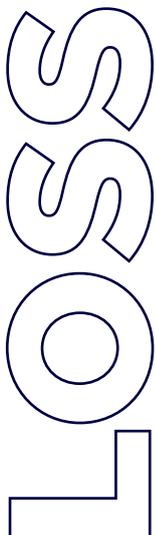


## Lightning - Between **Awe** and **Destruction**

Lightning is a beautiful natural spectacle which leaves everyone awestruck. It is also one of the most devastating & destructive phenomenon of nature. When positive and negative energies grow large enough, a giant spark - referred to as lightning occurs between the two charges, sometimes between the clouds and the ground. Such lightning strike discharges up to 10 billion joules of energy and produces a current of approximately 50 to 100 kA. Though they last for a few microseconds, the average temperature of it can be around 20,000 degree Celsius.

Among all the natural disasters, lightning stands high for causing the maximum damage to human lives and equipments across the globe. With the ever-growing use of highly sophisticated electrical and electronic equipments in both industries and residential structures, it has become even more important to protect the structures in order to provide ultimate safety to equipments and living beings housed inside those premises from direct & indirect damages caused due to lightning effects.

As per IS/IEC 62305, the losses due to the damages caused by lightning are categorized into four types as



**of human life**

**of service to public**

**of cultural heritage**

**of economic**



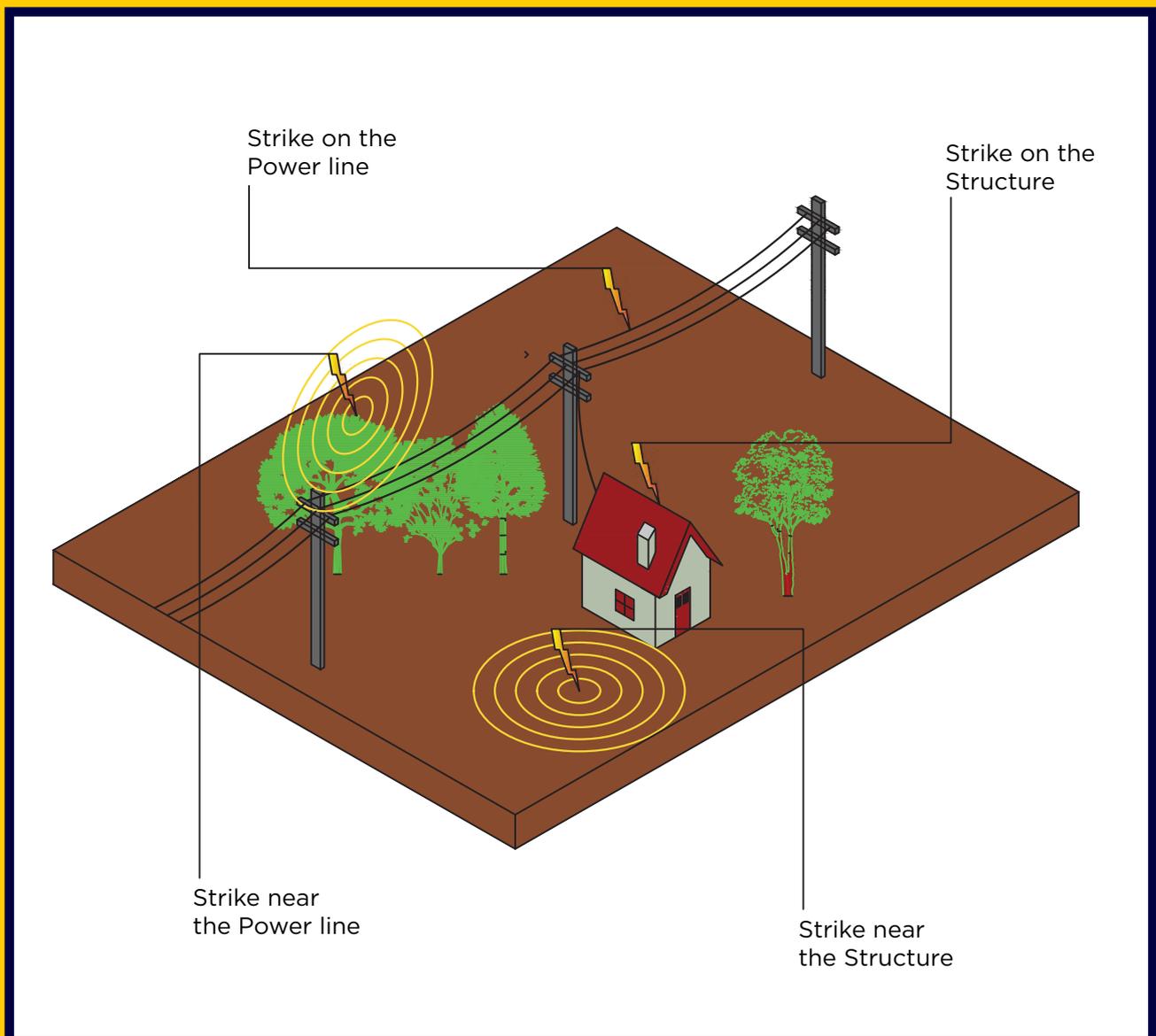
# Lightning **causes** damages in two ways

## Direct strikes

## Indirect strikes

Direct lightning strike on any given structure is not the only source of damage. The risks are caused by

- Direct lightning strikes on a structure
- Lightning strikes adjacent to the structure
- Lightning strikes on the power lines connected to the structures
- Lightning strikes adjacent to the line connected to the system



## What Ought to be!

An overall Lightning Protection system should provide protection against both the direct and indirect effects of lightning strikes.

It should be able to protect

- ✓ Structures and human beings from direct lightning strikes.
- ✓ Electrical and electronic components from surges due to lightning impulse currents.

An overall Lightning Protection System contains

- 1) Properly designed Air termination system for capturing the Lightning strikes.
- 2) A down conductor system having sufficient cross sectional area for creating a safe path for the lightning current from the air termination system to earthing system.
- 3) Good earthing system for dissipating the lightning energy into ground as soon as possible without considerable increase in Ground Potential Rise.
- 4) A single integrated earthing system by interconnecting lightning protection earthing, system earthing and telecommunication earthing below the ground level.
- 5) Equipotential bonding of exposed water pipes, metal parts and structures.
- 6) Surge protection modules for power lines and telecommunication cables.

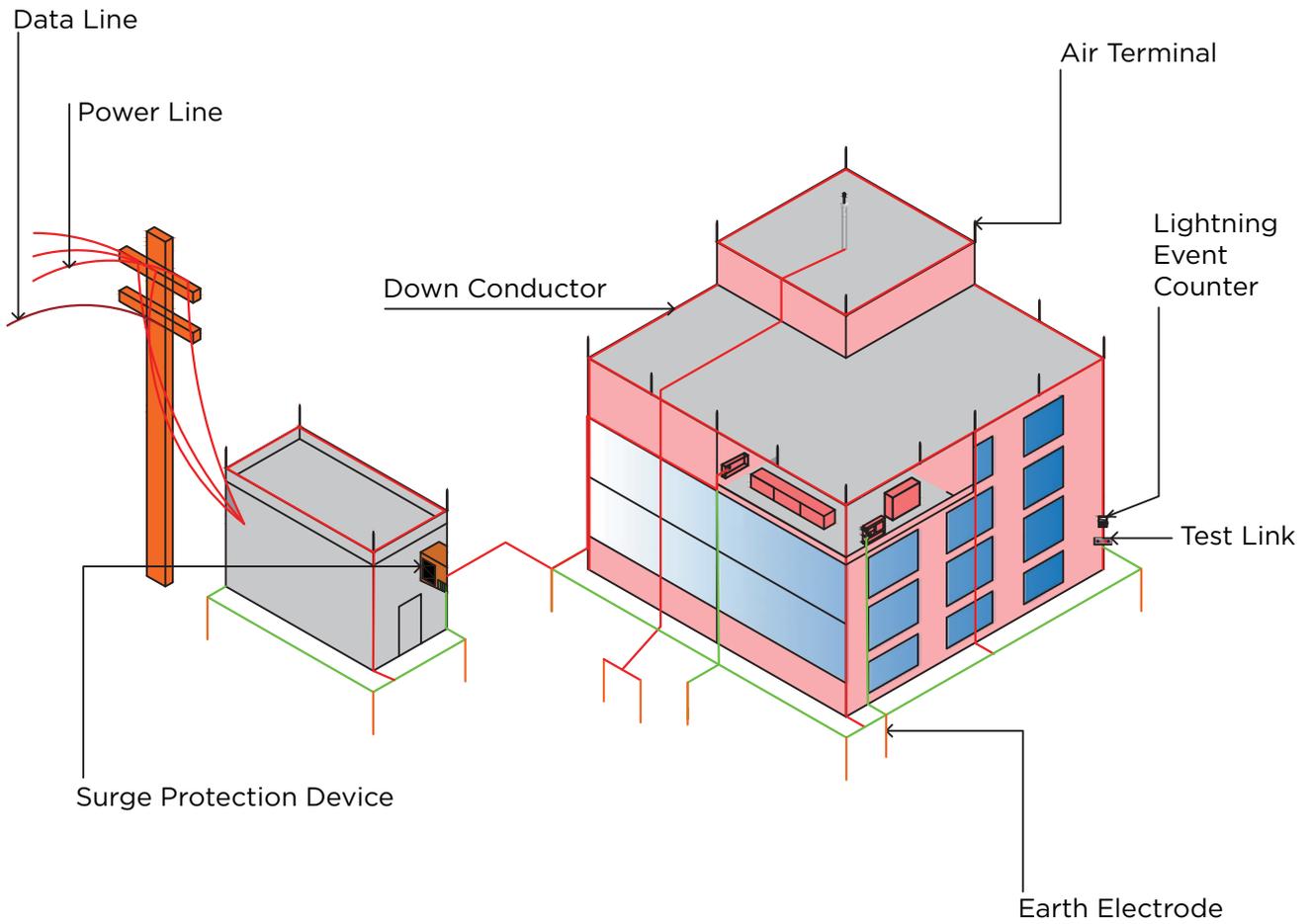
Protection against direct lightning strikes shall be achieved by a properly designed and installed external lightning protection system.

Whereas the protection against lightning impulses shall be achieved by installing surge protection modules of suitable current rating based on the site condition.

For both direct protection and indirect protection measures, earthing plays an important role in dissipating the energy into the ground.

**Lightning Facts**

**The study of lightning is called as Fulminology.**

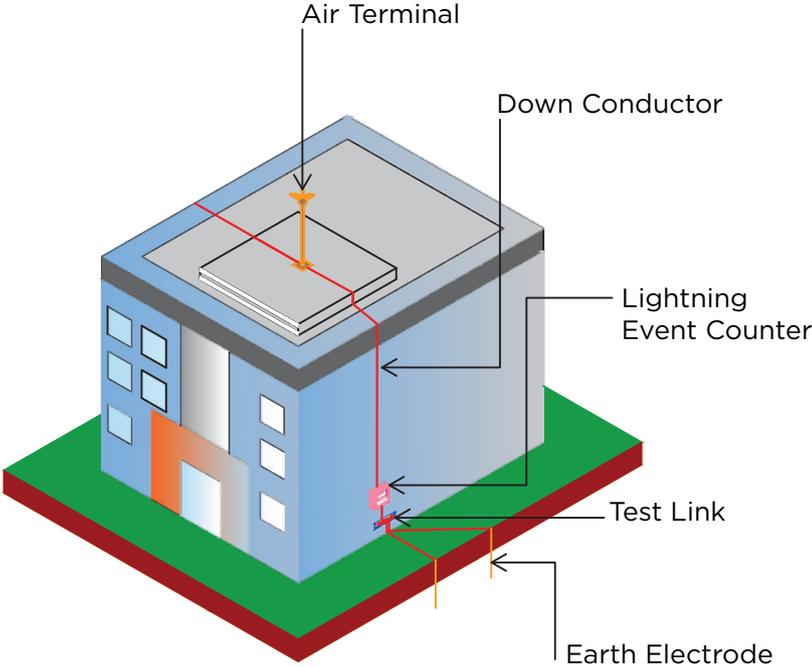


## External Lightning Protection System

External Lightning Protection System will protect the buildings/structures from physical damages due to direct lightning strikes.

An external Lightning Protection System consists of,

- 1) Air terminal system to safely capture the lightning flashes.
- 2) Down conductor system to safely conduct the lightning current to the earth.
- 3) Earth termination system to safely dissipate the lightning current into the earth.



### Lightning Facts

**The fear of lightning and thunder is called Astrophobia.**

In most cases, the air terminal and down conductor may be placed directly over the structure to be protected. The Lightning protection system isolated from the structure is more preferred for areas with a high risk of explosion and fire.

## Air termination system:

The probability of a structure being struck by a lightning flash can be greatly reduced by a properly designed air termination system. It can be comprised of an amalgamation of the following elements.

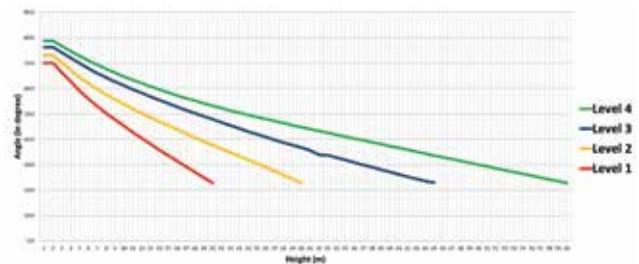
- 1) Rods    2) Catenary wires    3) Meshed conductors.

The position of the air termination system shall be designed by using the following placement methods as specified by IS/IEC 62305-3.

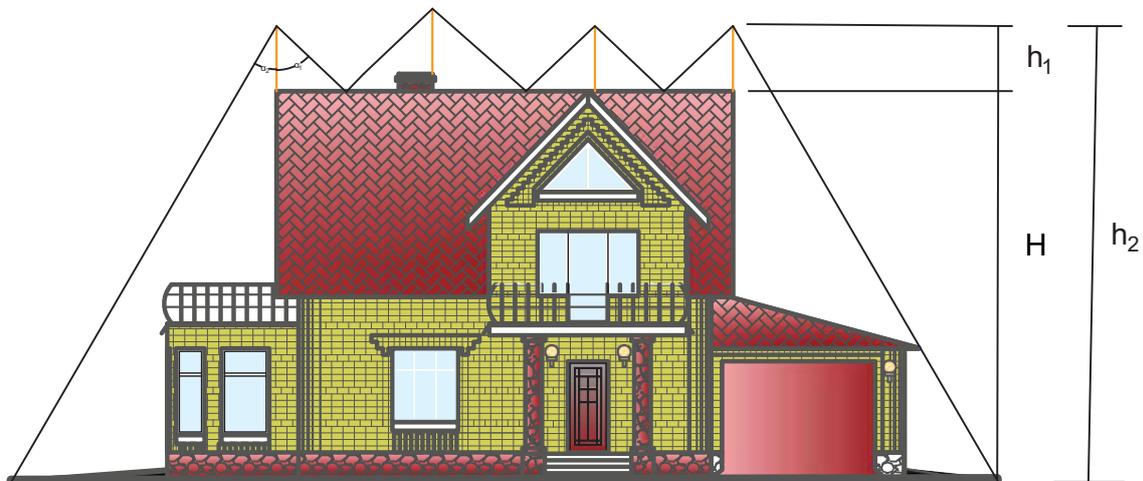
- 1) Protection Angle Method    2) Rolling Sphere Method    3) Mesh Method

## Protection Angle Method:

Protection Angle Method or Cone of Protection Method is the traditional method of protecting the structures from lightning strikes. It is suitable for simple shaped buildings. It also has limitations on the height of the air terminal.



In this method, an air terminal rod of height 'h' is placed at the top of structures to be protected. The volume protected by the rod will have the shape of a right circular cone with the protection angle from the top, which depends on the class of LPS and the height of the air-termination system from the reference plane.



H - Height of the building

h1 - Height of air terminal rod from floor level

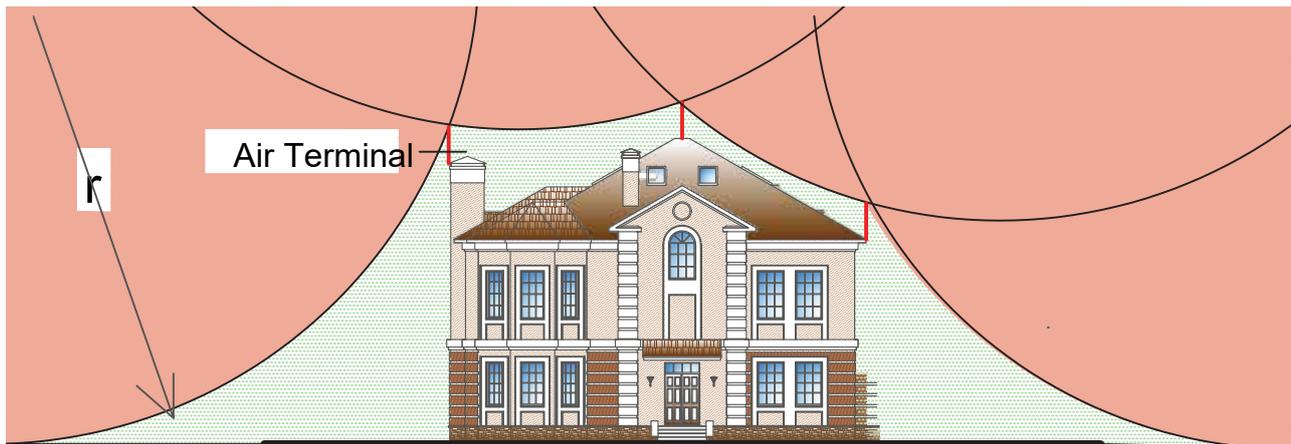
h2 - Height of air terminal from ground level

a1 - protection angle corresponds to height h1

a2 - protection angle corresponds to height h2 (H + h1)

## Rolling Sphere Method:

In rolling sphere method, the lightning protection system is designed by rolling an imaginary sphere of radius 'r' around and on top of the structure to be protected in all possible directions. Wherever the sphere makes contact with the structure, that particular point is considered to be highly prone to being struck by lightning, and the area beneath the sphere is considered to be as safe zone. The point of installation of air terminals are designed in such a way that the sphere touches only the tip of the air termination system and does not make any direct contact with the structure to be protected.



S.No	Class of LPS	Rolling sphere radius, r (m)
1	I	20
2	II	30
3	III	45
4	IV	60

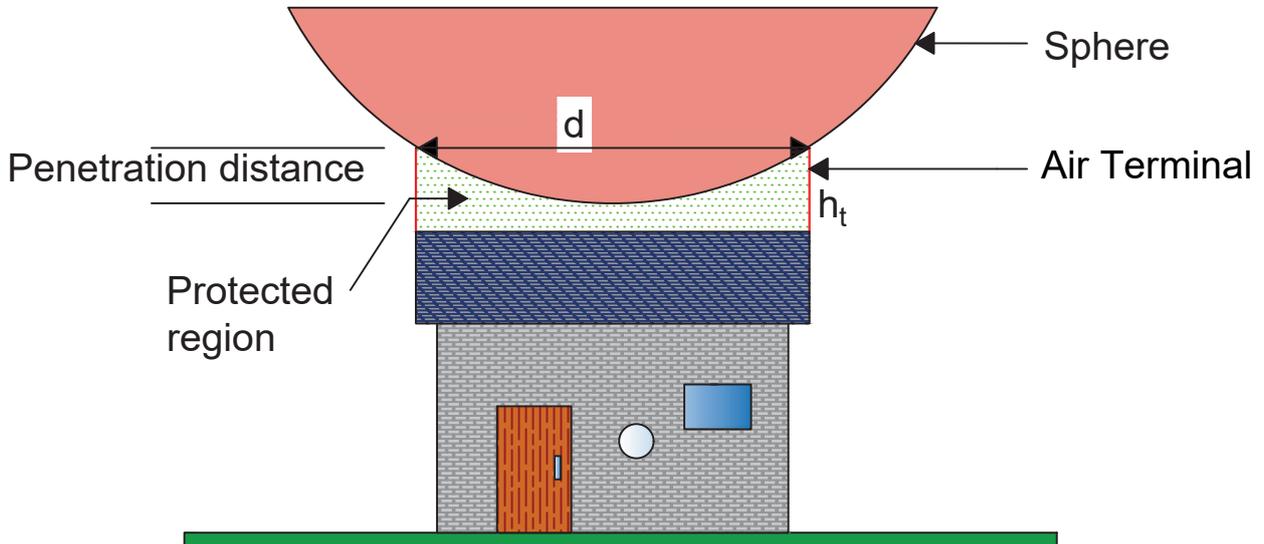
$$p = r - \sqrt{[r^2 - \left(\frac{d}{2}\right)^2]}$$

The penetration distance of the rolling sphere below the level of conductors in the space between the conductors can be calculated by using the formula (IS/IEC 62305-3).

## Lightning Facts

**Lightning flashes more than 3 million times in a day world wide-that's about 40 times a second. Not all those flashes hit the ground-some happen between or inside clouds.**

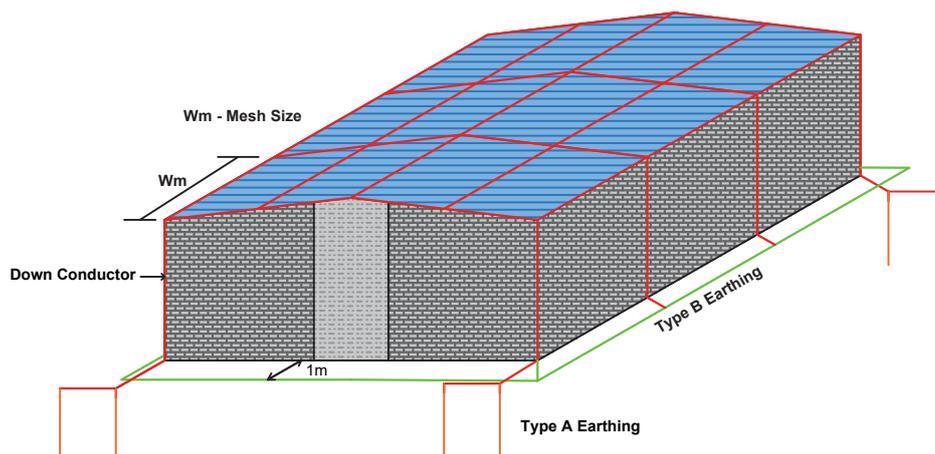
## Penetration distance



### Mesh Method:

S.No	Class of LPS	Mesh Size $W_m$ (m)
1	I	5x5
2	II	10x10
3	III	15x15
4	IV	20x20

Mesh method of lightning protection is suitable for structures with flat surfaces and sheds having slope less than  $1/10$ . The conductor is laid in the form of mesh on the roof of the structure to be protected. The size of the mesh depends on the class of LPS.



## Down Conductor system:

The function of a down conductor system is to provide a dedicated conductive path for the lightning current from the air-termination system to the earthing system.

For each non-isolated LPS, there should be a minimum of two down conductors. The down conductors should be equally spaced and it should be distributed around the perimeter of the structure to be protected.

The distance between the down conductors as specified by IS/IEC standard is shown in the table

Class of LPS	Distance between conductors, m
I	10
II	10
III	15
IV	20

The down conductor system should be designed in such a way that the following points are ensured.

- 1) Several parallel current carrying paths exist.
- 2) Length of current carrying path is kept to minimum.
- 3) It is always preferred to have the down conductor as a direct continuation of the air terminals.
- 4) The down conductors should not be installed on the gutters or water sprouts.
- 5) Equipotential bonding to conducting parts is performed.
- 6) If the wall is made of non-combustible materials, then the down conductors can be directly positioned on the wall.

The materials used for down conductor system should have the capacity to withstand the heavy impulse current. Hence it should meet the minimum cross-sectional area requirements provided by IS/IEC 62305 for the different materials in different configurations.

## Lightning Facts

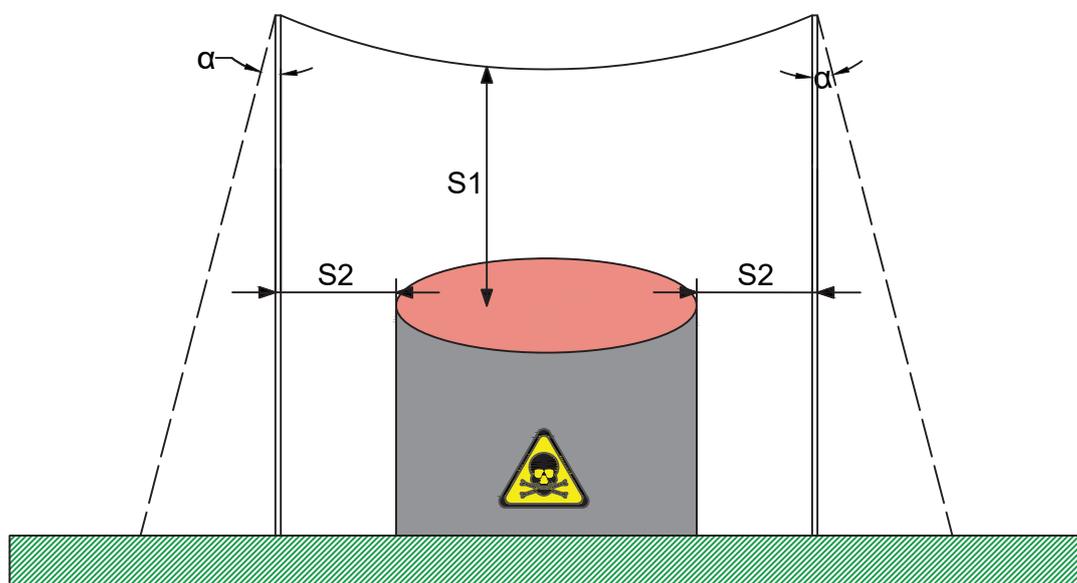
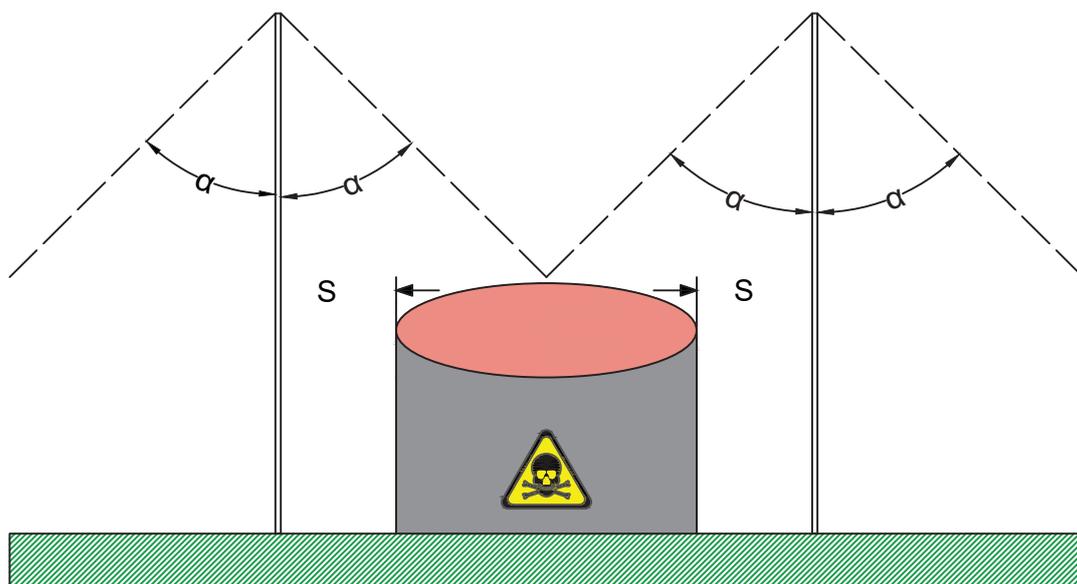
**The temperature of a lightning bolt is about 54,000 degrees Fahrenheit - roughly five times hotter than the surface of the sun!**



## Isolated Lightning Protection System:

In an isolated LPS, the air terminal and down conductors are isolated from the structure to be protected. An isolated lightning protection system is preferred for structures on which the effect of sudden temperature rise on the down conductor or the electromagnetic interference due to lightning impulse currents may cause fire accidents or explosions. For the structures which contain explosive materials, isolated lightning protection system is preferred.

The air terminal is generally installed on a free standing mast adjacent to the structure to be protected in order to maintain geometric and /or electrical separation. Both the air terminal and down conductors won't have any contact with the structure to be protected. The separation distance between the air termination or down conductor and the structural metal parts may be calculated as per IS/IEC 62305-3. Catenary wires can also be used as air terminals in an isolated LPS.



## Early Streamer Emission (ESE)

ESE Air Terminal Rod is an active type lightning arrester which stimulates continuous upward leader before any other object does within its radius of protection. Due to its earlier triggering of upward leader, the area of protection is much larger when compared to a simple conventional air terminal rods.

The area protected by an ESE terminal depends upon the time difference between the streamer raised from an ESE terminal and the streamer raised from other passive components located at same height. If this time difference is higher, the area protected by the air terminal will also be higher. That time difference is generally termed as triggering advance time and it is always expressed in micro seconds ( $10^{-6}$ s or  $\mu$ s).

### Lightning Facts

**When lightning strikes sand or sandy soil, it fuses together the grains to create small glass-like tube art known as a fulgurite.**

## Triggering Advance Time ( $\Delta t$ ):

The triggering advance time is defined as the difference in triggering time of an early streamer lightning rod and a simple conventional air terminal rod obtained when both rods are exposed to the same atmospheric & electrical conditions.

$$\Delta t = \text{TSR} - \text{TESE}.$$

where,

TSR = The mean triggering time of the upward leader of a simple conventional air terminal rod.

TESE = The mean triggering time of the upward leader of a ESE air terminal rod.

As per NFC 17-102/2011, the value of ' $\Delta t$ ' should be between  $10\mu$ s and  $60\mu$ s. An air terminal is considered as ESEAT only if the triggering advance time is greater than  $10\mu$ s., also the value of ' $\Delta t$ ' being greater than  $60\mu$ s, it is to be still considered as maximum  $60\mu$ s for all design calculations.

## Radius of Protection - NFC 17-102/2011

The radius of protection is the distance between the point where you want to place the (ESE) air terminal rod and the farthest point from the structure or building to be protected. For calculating the radius of protection, it is very important to get the triggering advance time of the device and the height of the mast on which the ESE air terminal rod is mounted upon.

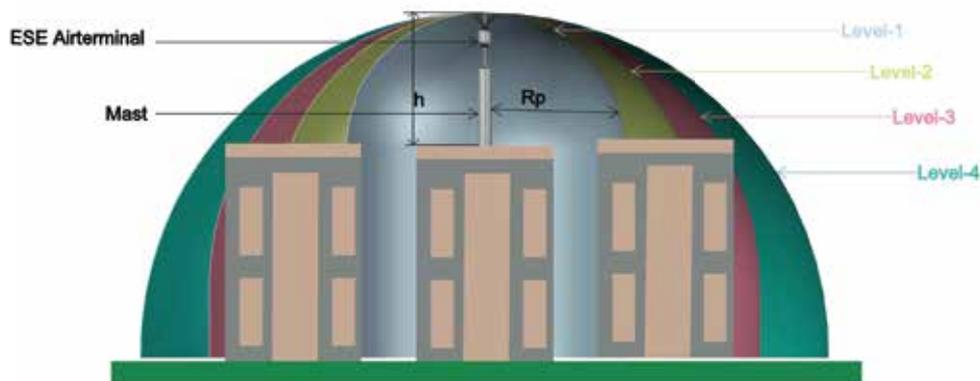
The ESE Air terminal should be installed at least 2 meters over the surface of the structure to be protected.

### Calculation for Radius of Protection:

For Early Streamer Emission air terminal, the radius of protection for different levels can be calculated using the following equation:

$$R_p(h) = \sqrt{(2rh - h^2) + \Delta(2r + \Delta)} \text{ for } h \geq 5\text{m}$$

$$R_p(h) = h \times R_p(5)/5 \text{ for } 2\text{m} \leq h \leq 5\text{m}$$



$h$  - Height (m) of the mast above the considered surface.

$\Delta$  -  $\Delta = \Delta t \times 10^{-6}$ s

$\Delta t$  - The triggering advance time gain obtained during the test ( $\mu$ s)

$r$  - Depends on the selected level of protection (in meter)

$r = 20$  for Level 1 protection;

$r = 30$  for Level 2 protection.

$r = 45$  for Level 3 protection;

$r = 60$  for Level 4 protection.

Height of ESE air terminal and its efficiency to the corresponding protection level can be calculated from the above respective formulae.

The working principle for different level of protection of an ESE module is the same, however the efficiency of the ESE modules alone varies among different level of protection. The ESE levels and their efficiency details are as follows,

Level 1 Protection: 99%      Level 3 Protection: 91%

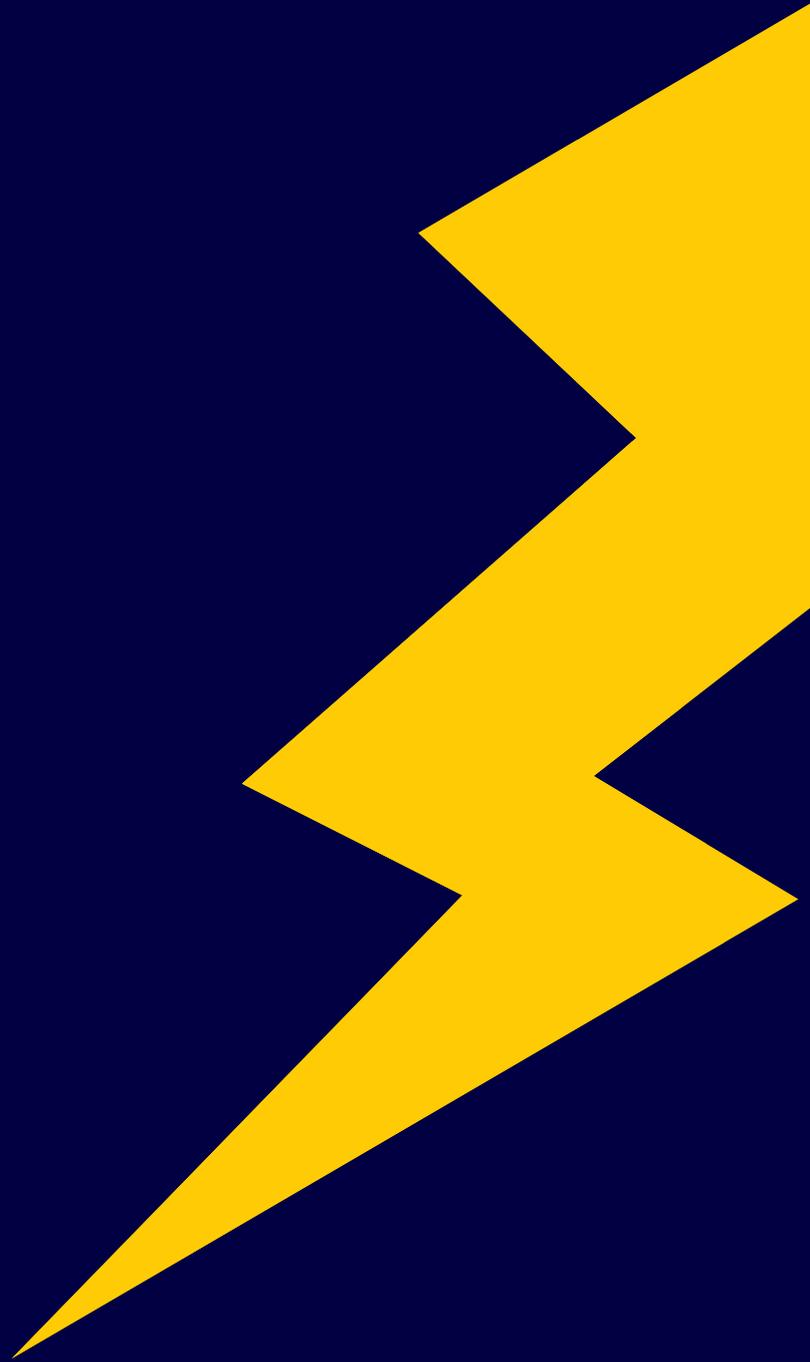
Level 2 Protection: 97%      Level 4 Protection: 84%

For buildings taller than 60 meters, minimum of 4 down conductors should be used.

## **Earth Termination System:**

The Earth termination system is a part of lightning protection system which is intended to conduct and disperse the lightning current into the earth. The shape and dimensions of the earth electrode plays a major role in quickly dissipating a high frequency lightning current into the ground. In general, a low earthing resistance value of less than 10 ohms is recommended for lightning protection system.

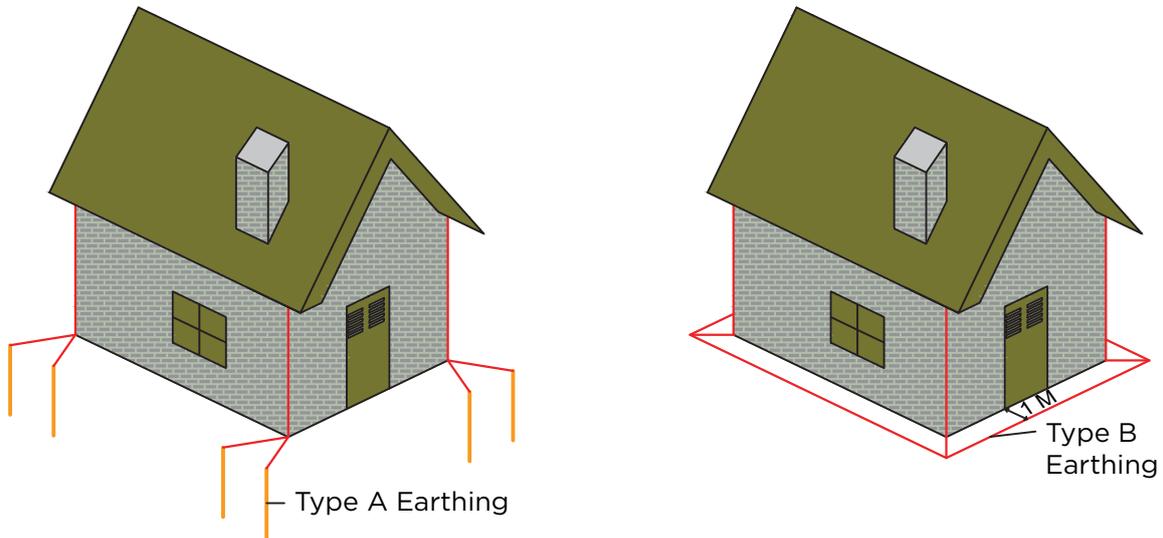
IS/IEC 62305 suggests that the earthing of lightning protection, power systems and telecommunication systems can be interconnected below the ground level to form a single integrated earthing system.



There are 2 types of earth electrode arrangements for lightning protection and the details are as follows:

**i) Type A arrangement**

**ii) Type B arrangement**



**Type - A arrangement:**

The total number of earth electrodes per down conductor in Type A arrangement shall not be less than two. The earth electrodes shall be installed vertically into the ground, but in difficult site conditions horizontal installation of earth electrodes also can be considered.

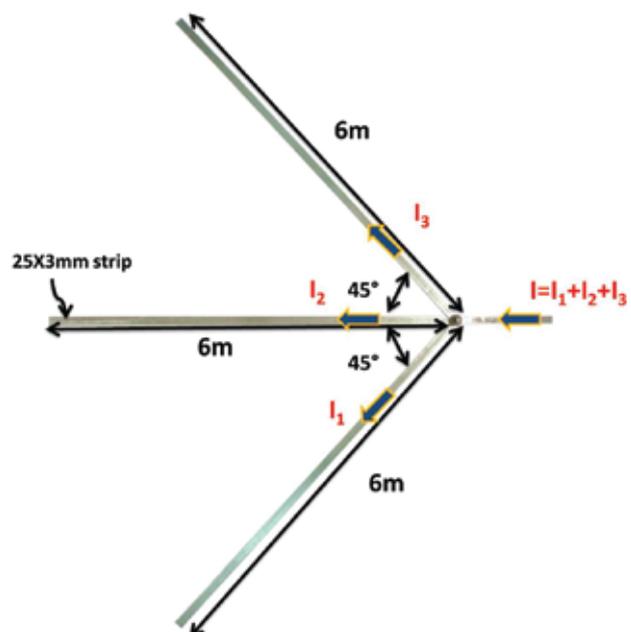
**Type - B arrangement:**

Type B arrangement comprises of ring conductor laid around the structure to be protected or the foundation earth electrode forming a closed loop. In case of ring earth assembly, at least 80% of total length of conductor should be in contact with the soil.

The ring earthing system should be buried at a depth of at least 0.5 meter and should also maintain a minimum distance of 1 meter from the external walls of the structure to be protected.

**Goose foot arrangement**

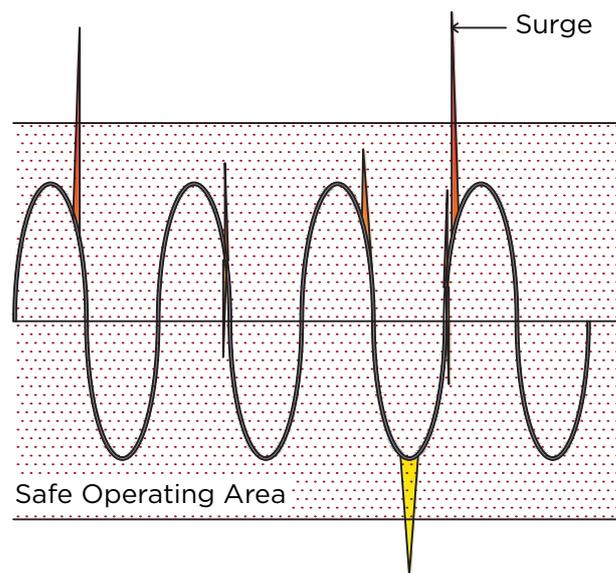
As per NFC 17-102, This type of arrangement comprises of horizontal earth electrode in the shape of goose foot. The conductor used can be of any conducting metal except aluminium but of the same dimension and cross sectional area of the down conductor brought down from the air terminal. The standard also prescribes that the earthing conductors should be laid at least 0.5meter beneath the ground level.



## Internal Lightning Protection System:

Internal Lightning Protection System will provide protection to electrical and electronic equipments housed inside the structure from the lightning impulse surges.

Transient overvoltage are of very high magnitude voltages that exists for a very short duration of time, expressed in terms of micro seconds. Even though these surges exist for a very short duration, their magnitude is more than sufficient to cause damages in the electrical and electronic devices.



Each and every electronic/electrical device is designed for a specific operating voltage and current values. If these devices are exposed to values which are much higher than the rated values, the devices may get damaged. The damages caused due to transient surges may not be seen immediately and the level of damages depends on the magnitude of the transient surges.

The effects on the electrical devices due to surges are mainly classified into three types as,

- 1) Interruption of operation or degradation
- 2) Damage of components
- 3) Prematured ageing of the devices

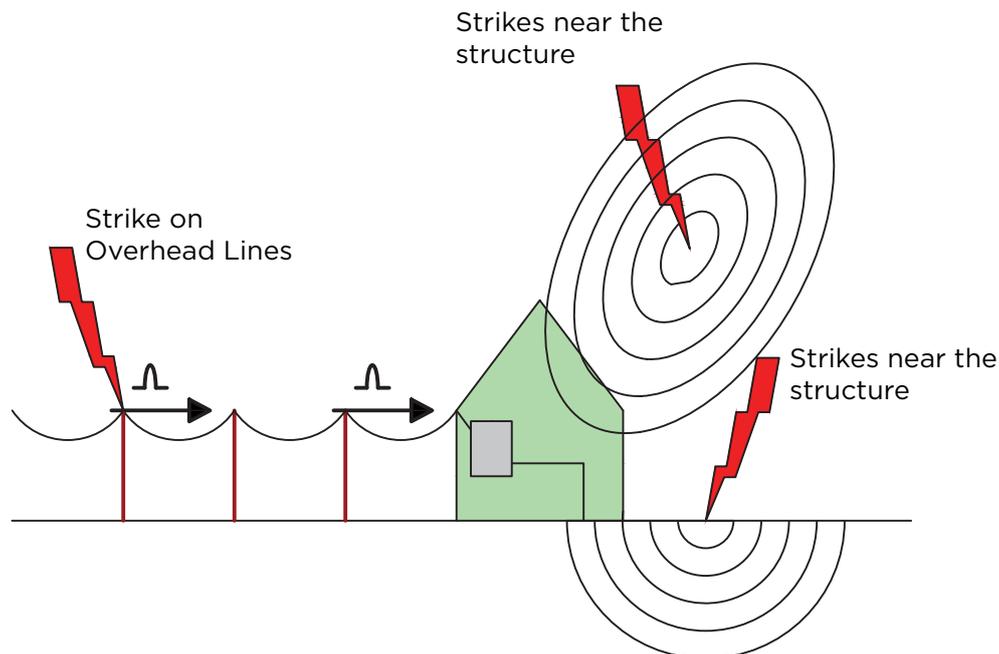
The most common causes of transient overvoltage are,

- Lightning
- Industrial and switching surges
- Electrostatic discharges (ESD)
- Nuclear electromagnetic pulses (NEMP)

Among these, lightning is the natural source of impulse surges. The magnitude of lightning impulse surges will be much higher than the surges caused by other sources. Hence the protection is always designed by considering the lightning impulses.

Apart from the direct lightning strikes on the structures and near the structure, lightning strikes on the power line and adjacent to the power lines are also destructive. These are generally termed as indirect effects of lightning strikes.

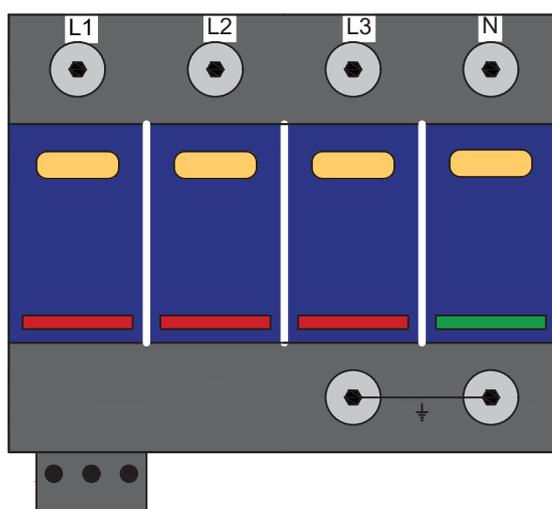
## Indirect Effects of Lightning Strikes



Surge protection devices in combination with a good earthing system shall be used to protect the electrical and electronic devices from the indirect effects of lightning strikes.

## Surge Protection Devices:

The Surge Protection Devices (SPD) is a generic name for any device that protects from voltage surges and is an effective solution for the overvoltage problem.



Surge Protection Devices (or SPDs) are units combining several protection components like Metal Oxide Varistor, spark gaps, gas discharge tubes, thermal protection fuse and indicators to protect the electrical and electronic devices from voltage surges. They divert the transient surges to the ground thereby protecting the equipments.

## The need for protection:

The problems due to surges are present from the earlier days but it was not taken into consideration because of the lesser sensitivity of the loads which were used earlier. Because of the technical advancements in electronic industry, we are gradually migrating towards the automation of processes in industries. For monitoring and control, we use electronic devices which are very sensitive to transient surges and electromagnetic disturbances. The higher sensitivity of the electronic devices towards these transient surges due to lightning and switching impulses emphasizes the need for surge protection devices.



The effect of surges with a lower magnitude may not be felt at the time of encounter but it will slowly affect the life time of product which leads to premature ageing of the electronic devices. Hence these surges are considered as the silent killers of electronic equipment.

Considering the growing needs of surge protection modules, different countries have their own standards for the surge protection methods to be followed.

### **Surge Protectors for Low-Voltage installations:**

- NF EN 61643-11 (France)
- DIN EN 61643-11 (Germany)
- EN 61643-11 (Europe)
- UL 1449 (USA)
- IEC 61643-11 (International)

### **Surge Protectors for Telecom equipment:**

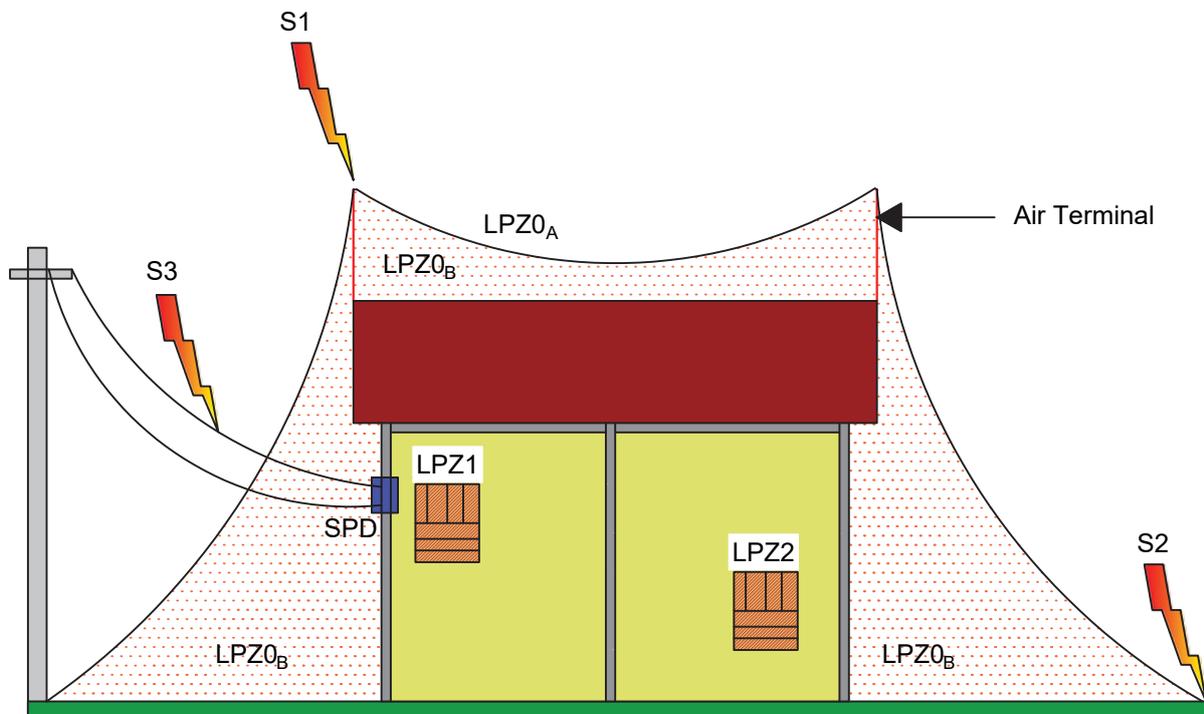
- IEC 61643-21 (International)
- ITU-T recommendations K11, K12, K17, K20, K21, K36 (International)
- UL 497 A/B (USA)

## Lightning Protection Zone:

Protection measures such as LPS, shielding wires, magnetic shields and SPD determine the Lightning Protection Zones (LPZ). The protection zones as specified by IS/IEC 62305 are as follows.

S.No	Zone	Threat
1	LPZ OA	Threat is due to - Direct lightning flash - Full lightning electromagnetic field.  The internal systems may be subjected to full or partial lightning surge current.
2	LPZ OB	LPZ OB is protected from direct lightning strikes and the threat is due to full electromagnetic field. The internal systems may be subjected to partial lightning surge current.
3	LPZ 1	Surge current is limited by current sharing and by isolating interfaces and/or SPDs at the boundary.
4	LPZ 2, ..., n	Surge current may be further limited by current sharing and by isolating interfaces and/or additional SPDs at the boundary.

The different zones as specified by IS/IEC 62305 is shown below.



The AC power surge protectors are split into 3 categories in IEC 61643-11 and IEC 61643-21, following 3 classes of tests. These different tests depend on the location of the surge protector in the AC network and on the external conditions.

## Surge protectors:

### Type 1 surge protectors:

Type 1 surge protectors are generally installed at places where the probability of a direct lightning strike risk is high and where a very high energy withstand capacity is required. Type 1 devices are tested to meet the requirements of Class I as specified by IEC 61643-11. They are tested by injecting impulse currents of 10/350  $\mu$ s to simulate the direct lightning strike consequence.

### Type 2 surge protectors:

Type 2 surge protectors are generally installed at the main switchboards. These devices are tested by injecting 8/20  $\mu$ s impulse currents to meet the requirements of the Class II test as specified by IEC61643-11.

### Type 3 surge protectors:

For a very sensitive, precise, and sophisticated equipment, the secondary stage of surge protection is required in addition to the primary protection. These devices have a lower energy withstand capacity than the SPDs used for the primary protection and are tested with a combination waveform (1.2/50  $\mu$ s - 8/20  $\mu$ s) as prescribed in Class III test.

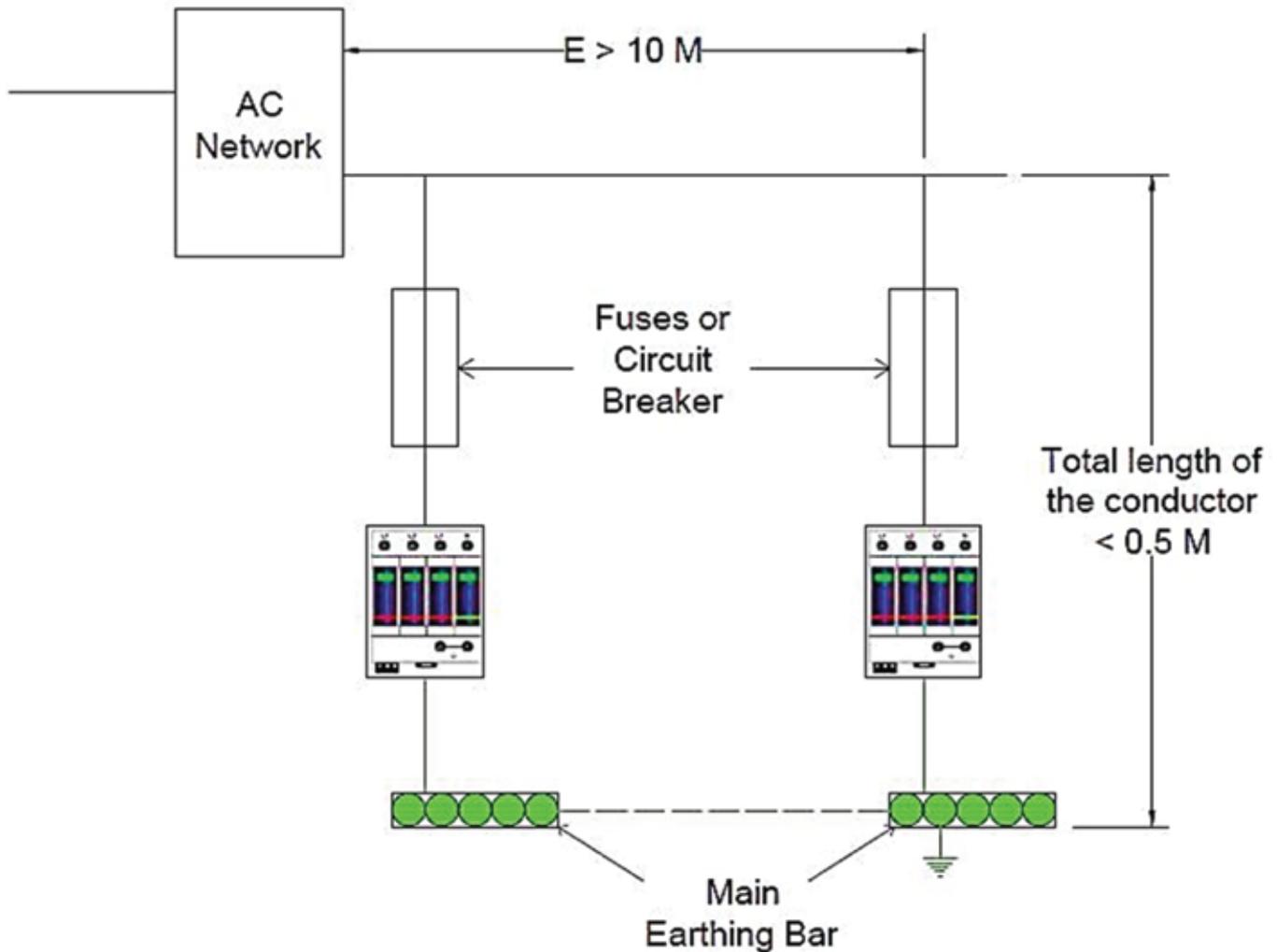
The type of SPD corresponding to the lightning protection zone is as follows.

S.No	Configuration	SPD	Location
1	Zone 0	Type 1	Origin of the installation (Panel or main switchboard)
2	Zone 1	Type 2	Main switchboard
3	Zone 2	Type 3	Close to protected equipment

## SPD installation Guidelines:

Surge Protectors are connected in parallel between active wires and Bonding network

- The parallel connection length must be shorter than 50 cm
- If the equipment to be protected is more than 10 meters away from the SPD, an additional SPD should be installed.



The surge protection modules of different types are commonly used in various industries. Few examples given below,

- AC surge protectors in Manufacturing Industries
- Power Line & Data Line Protectors for Commercial & Residential buildings
- Photovoltaic Surge Protectors for Solar industries
- Surge Protectors for High Frequency Transmission & Signaling Systems
- High Mast Lighting & Street Light Surge Protectors

## Earthing:

The process of connecting current carrying/non-current carrying conductor of an electrical system to earth to provide a dedicated low resistance path for the rapid discharge of electrical energy from the system to the earth during any abnormal condition is called **EARTHING**.

Connecting current carrying conductor of an electrical system to earth for limiting the potential of the system with respect to the general mass of the earth is called **SYSTEM EARTHING**.

Connecting non-current carrying metal work association with equipment, apparatus and appliance connected to the system is called **EQUIPMENT EARTHING**.

The Earthing Resistance of any electrode depends upon the following factors:

- Resistance of the (metal) electrode.
- Contact resistance range between the electrode and the soil.
- Resistance of the soil surrounding the earth electrode.

The Resistance to earth of a particular electrode depends upon the electrical resistivity of the soil where it is installed. Soil resistivity has a direct effect on the resistivity of the earthing system and it is an indication of a given soil's ability to carry electric current to flow through it.

### Why do we need earthing?

- To ensure the safety of the operator.
- To provide a low resistance path to the fault current bypassing the operator.
- To maintain step and touch voltage within limit.
- To ensure the safety of equipment from overvoltage and leakage current.
- To improve the stability of system during ground faults.
- To provide common reference point to the electrical supply system.
- To discharge the lightning surges as soon as possible without much increase in Ground Potential Rise.

### Components of Earthing

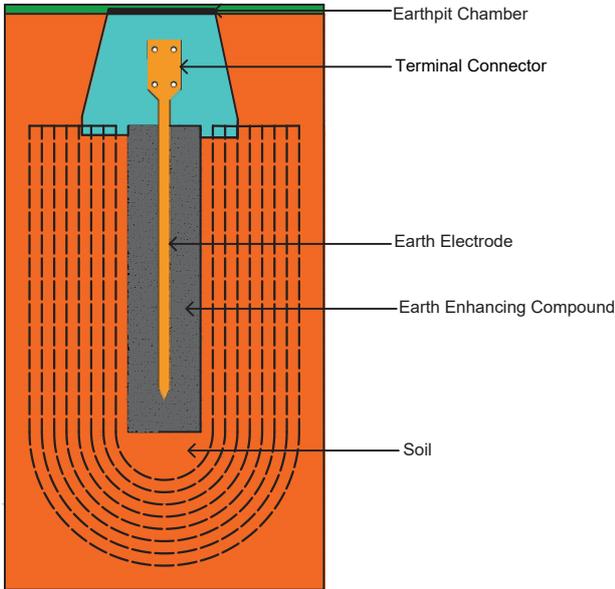
The major components of Earthing System are

- Earth Electrode
- Earth Enhancing Compound
- Terminal Connector

#### **myth and fact**

**Myth** Plate earth electrode will have lower resistance value than pipe earth electrode.

**Fact** IS 3043 states that to obtain a low overall resistance value, the current density should be as low as possible in the medium adjacent to the electrode. Hence a pipe or rod earth electrode will have a much lower resistance than a plate of equal surface area.



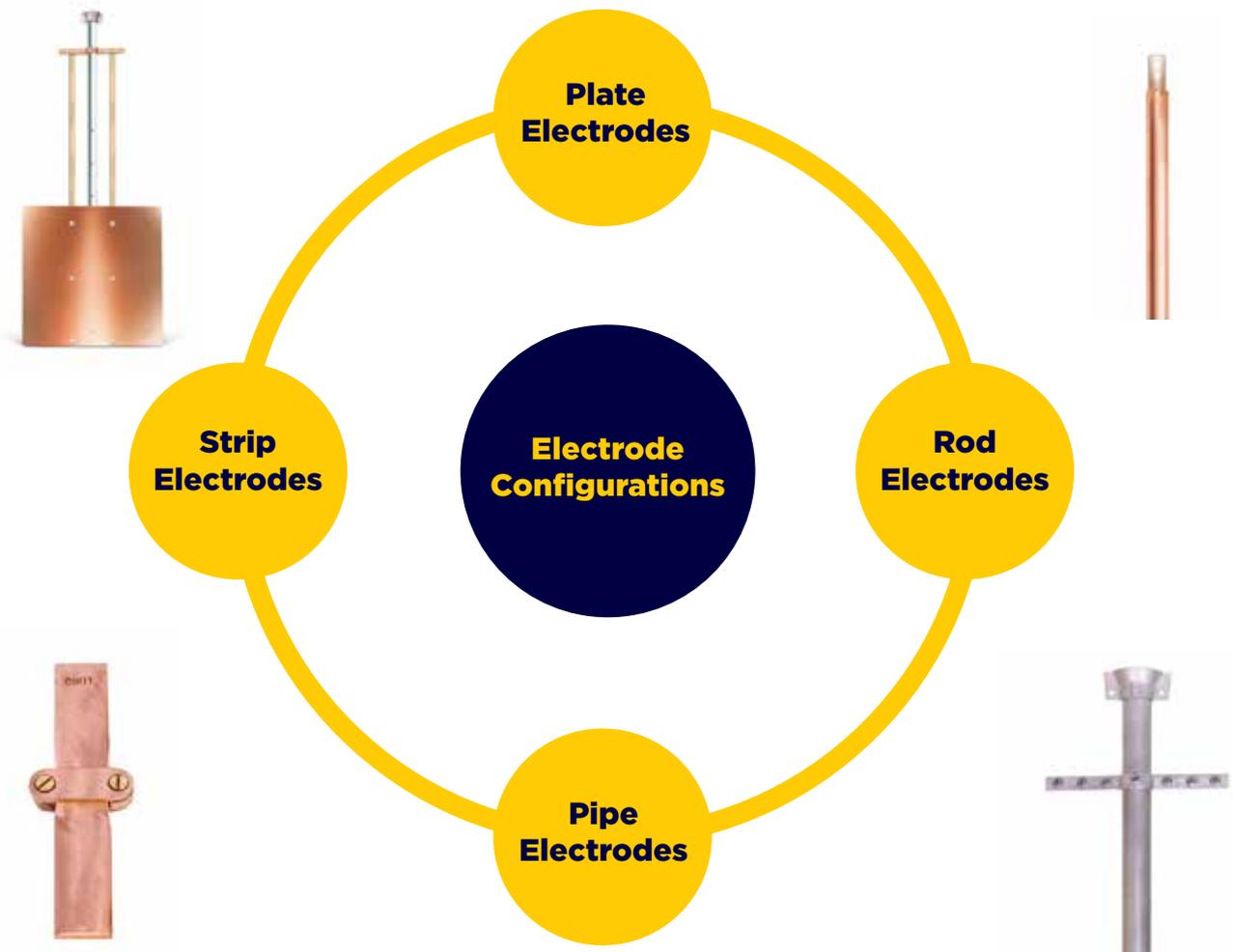
### myth and fact

**Myth** Earth resistance value highly depends on the moisture content of the soil. So we can achieve very low resistance value by watering the earth pits.

**Fact** Moisture content of soil is one of the main controlling factors of soil resistivity. IS 3043 states that, the moisture has very high impact on the resistivity of soil up to 20% of weight of soil. So we can't achieve lower earth resistance values by increasing the moisture content beyond 20% of weight of soil.

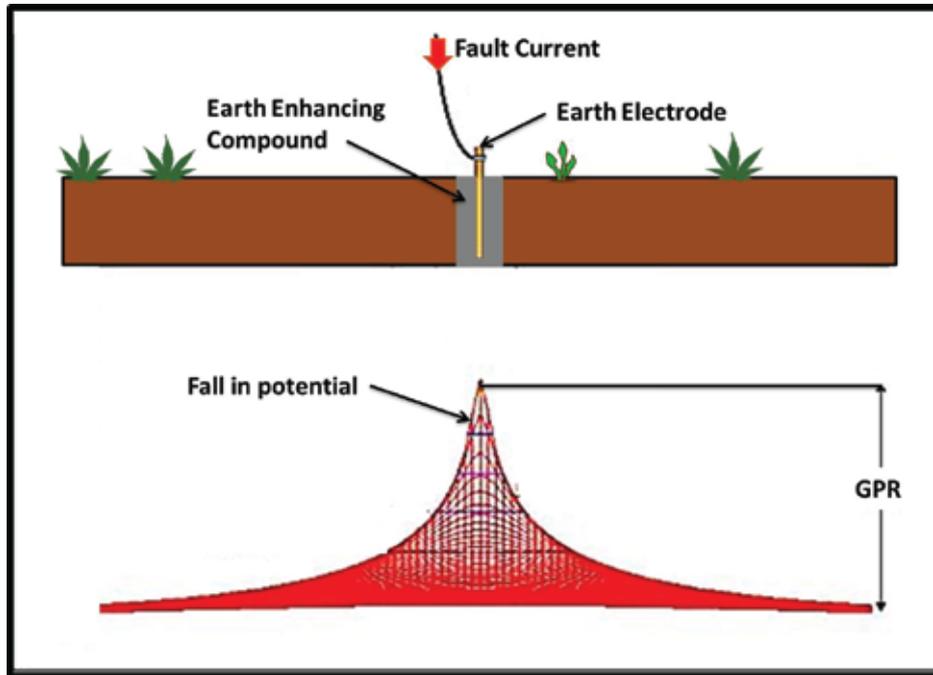
## Earth Electrodes

Earth Electrodes are the most important part of earthing system. The main function is to dissipate the fault current to ground as soon as possible without rise in ground potential. If the resistivity of soil is very high then artificial treatment of soil can be done using the Earth Enhancing Compounds. IS3043 suggests the following configurations of Earth electrodes.



## Earth Enhancing Compound:

Earth enhancing compounds are highly conductive compounds which are filled around the earth electrode by replacing the existing high resistance soil to provide a low earth resistance value and to improve the performance of earthing system.



In areas where the resistivity of soil is high, multiple earth rods even in large numbers may sometime fail to produce an adequately low resistance to earth. The alternate way for reducing the earth resistance value is to reduce the resistivity of the soil immediately surrounding the earth electrode as the major part of the fall in potential occurs closer to the electrode surface. Hence, using highly conductive earth enhancing compounds around the earth electrode is an effective way of achieving low earth resistance value.

### Characteristics of Earth Enhancing Compound:

Since the materials are used directly in the soil, the effect of these materials on the environment is very high and it may pollute the land and ground water. Hence, special care should be taken while choosing the raw materials to be used as Earth Enhancing Compound. The Earth Enhancing Compound should have the following characteristics,

- It should have low resistivity.
- It should be chemically inert to the subsoil.
- It should not pollute the environment.
- It should provide a stable environment for the earthing system.
- It should not be corrosive to the earth electrodes used.
- It should be able to absorb & maintain moisture for a longer period to enhance conductivity

#### **myth and fact**

**Myth** Providing salt in the area surrounding the earth electrode reduces the earth resistance value. More the salt content lesser will be the resistance.

**Fact** IS 3043 states that, increase in the percentage of salt beyond 5% of weight of moisture has very low impact on earth resistance value.



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