Federation of Myanmar Engineering Societies

Lightning Protection for Power Systems: A Practical Overview

Presented By

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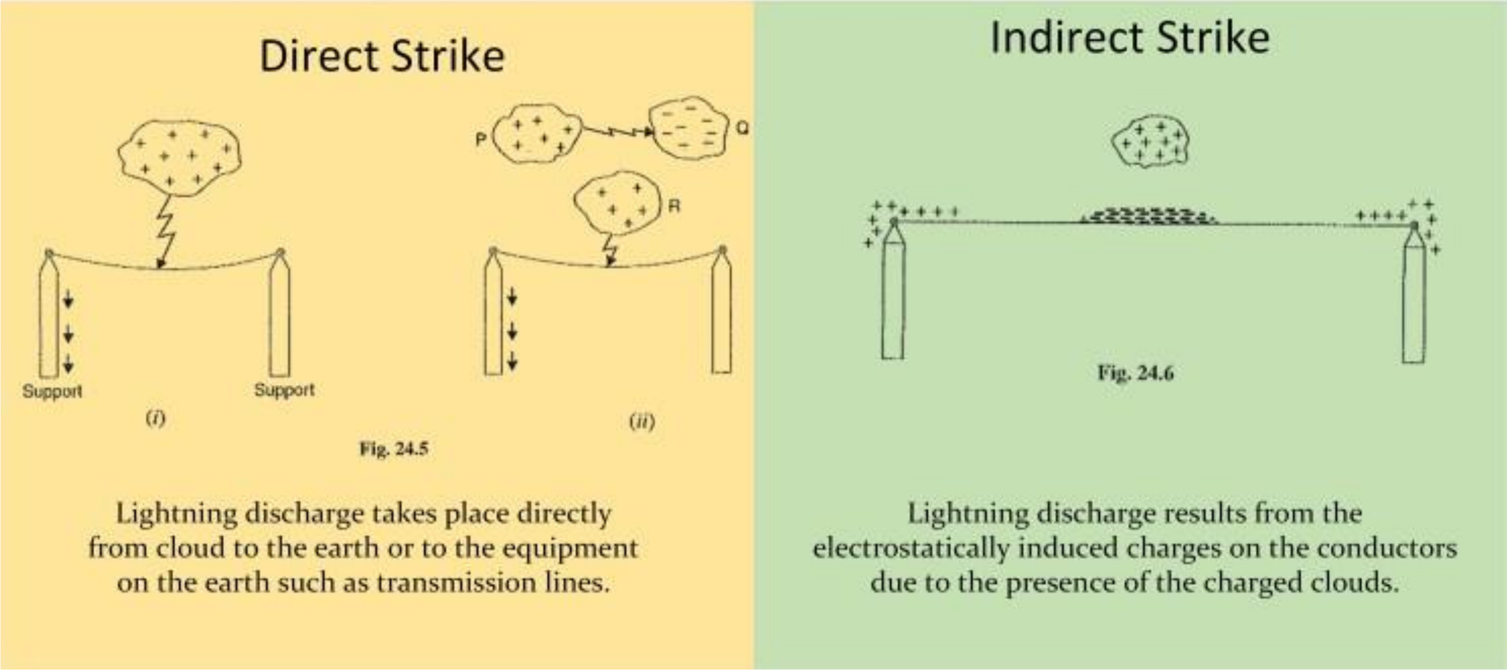
Introduction

- **Background**
  - Importance of lightning protection
  - High lightning density in tropical regions ASEAN/Myanmar
  - Increasing dependence on electrical infrastructure
  - Sensitive modern equipment
  - Impact on power reliability

"Lightning is one of the major external threats to power system reliability."

Objectives

- Understand lightning phenomena
- Understand lightning effects
- Identify impacts on power systems
- Identify protection methods
- Apply practical engineering solutions
- Present practical protection methods



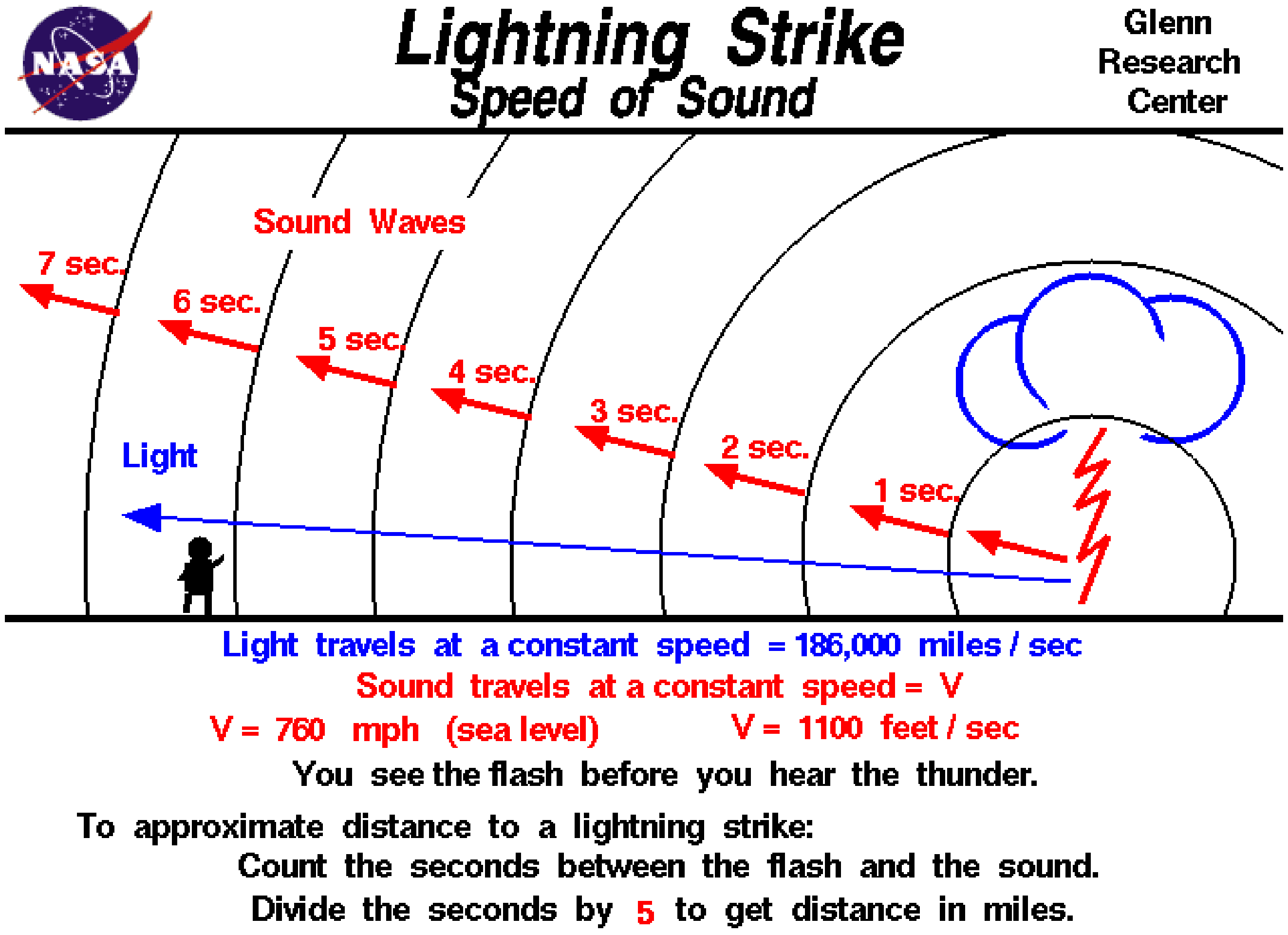
Lightning Fundamentals

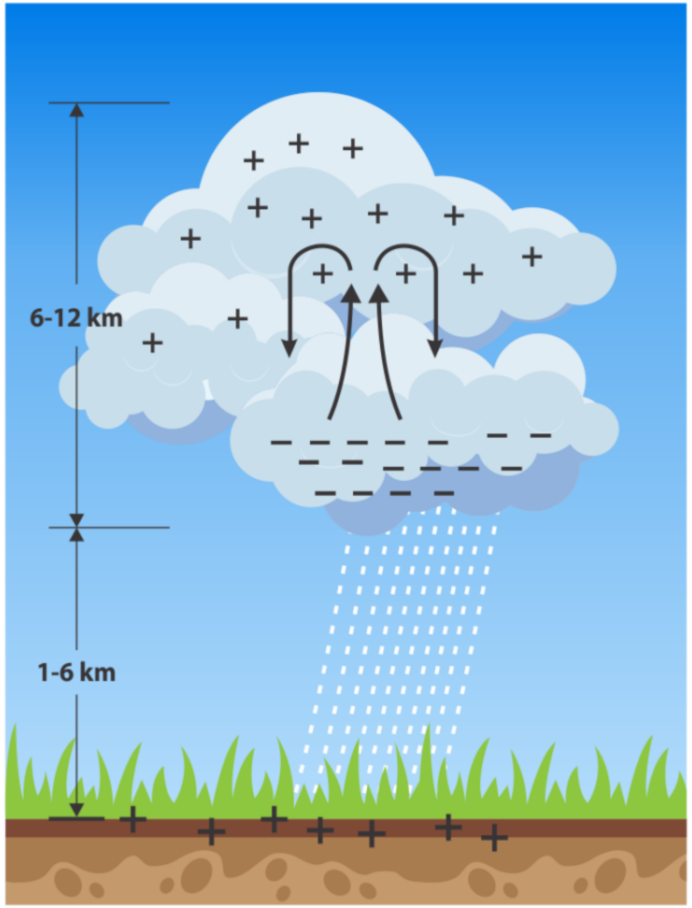
What is Lightning?

- ❖Electrostatic discharge between cloud & ground
- ❖Voltage: up to millions of volts
- ❖Current: 10–200 kA

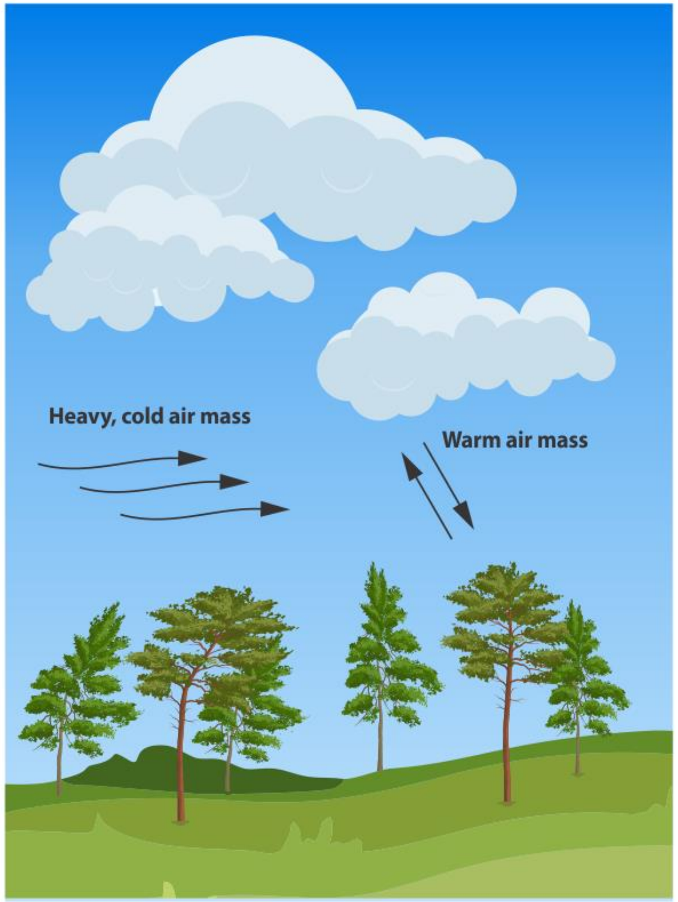
Lightning Fundamentals

- •Cloud-to-ground lightning
- •Direct vs indirect strikes
- •Transient overvoltage

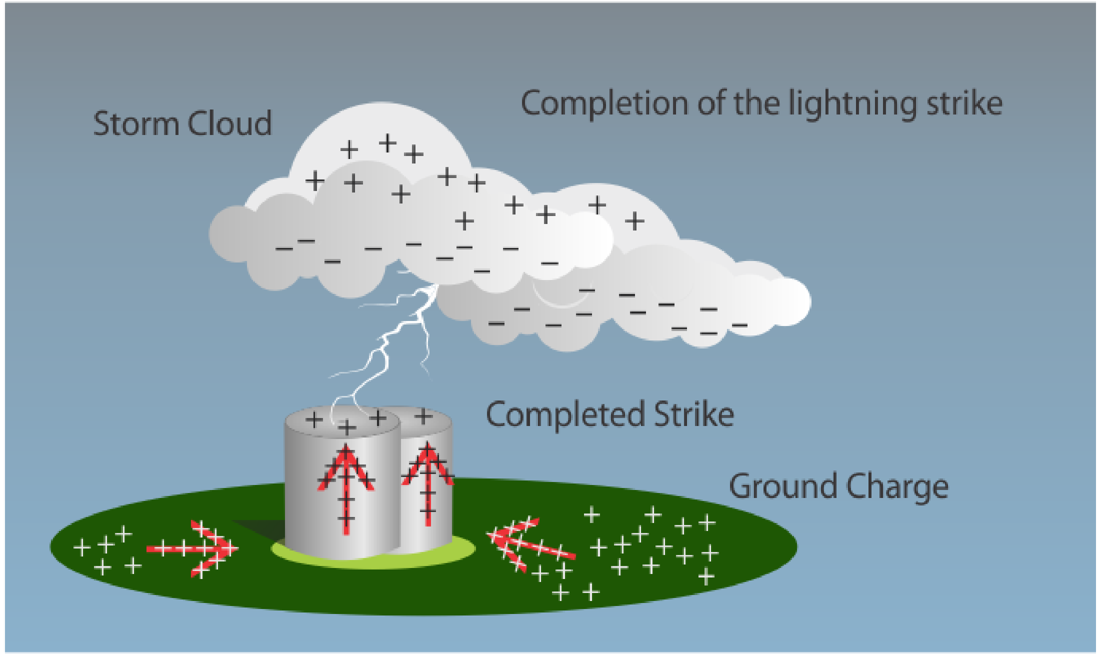




Typical charge distribution in cumulonimbus cloud

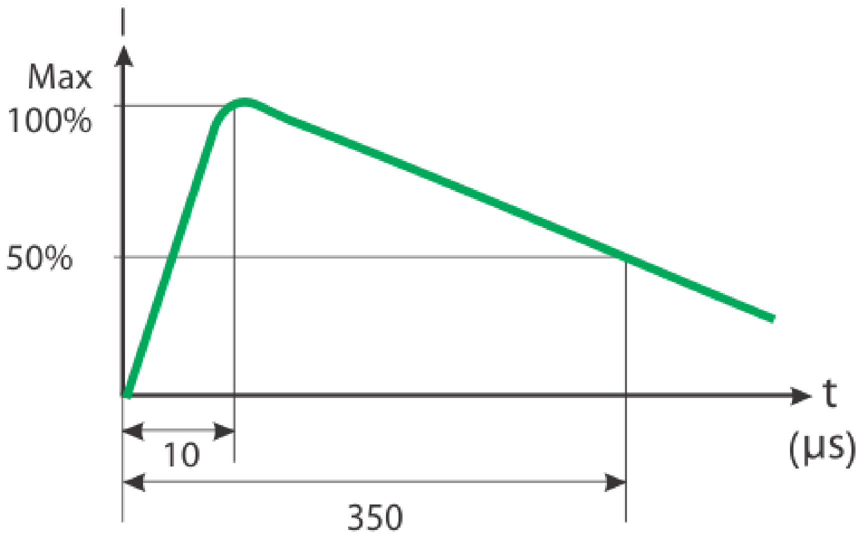


Cumulonimbus clouds generated by frontal storms

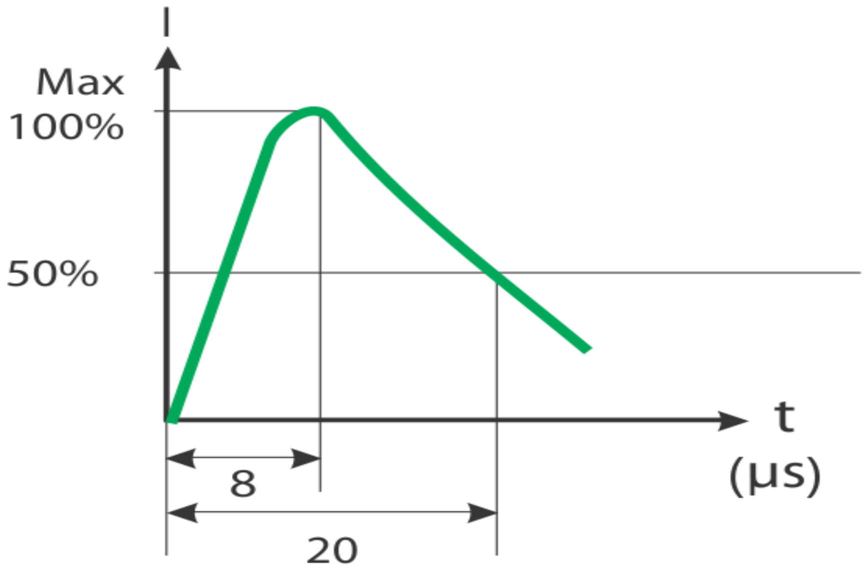


Lightning Formation

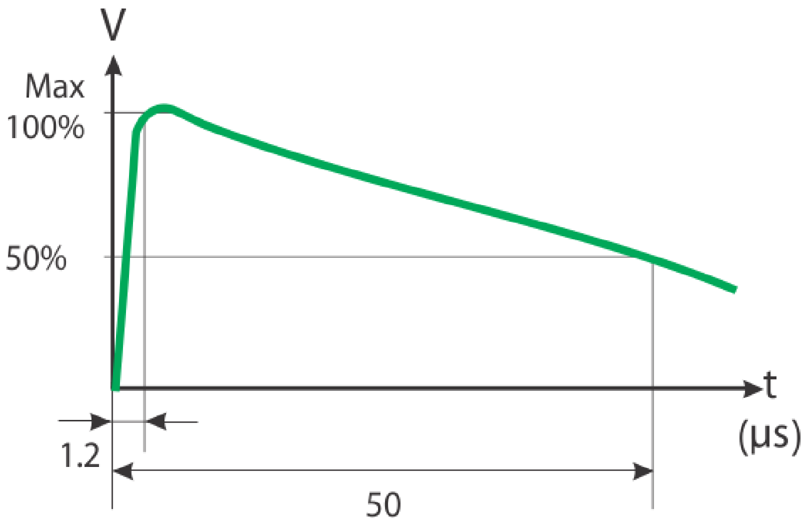
Direct lightning strike 10/350 µs



Indirect Lightning Strike 8/20 µs



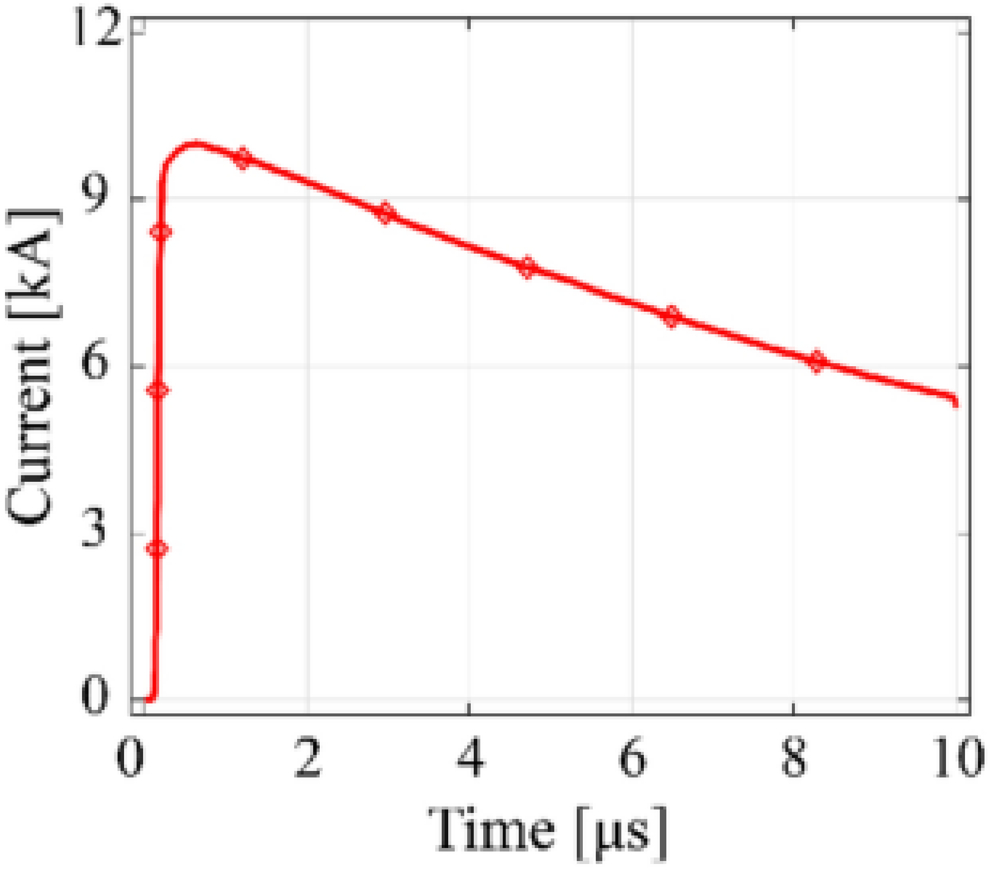
Overvoltage created by the lightning, stroke is characterised by the 1.2/50 µs voltage



Lightning Waveform

❖ Fast rise time (μs)

❖ High peak current



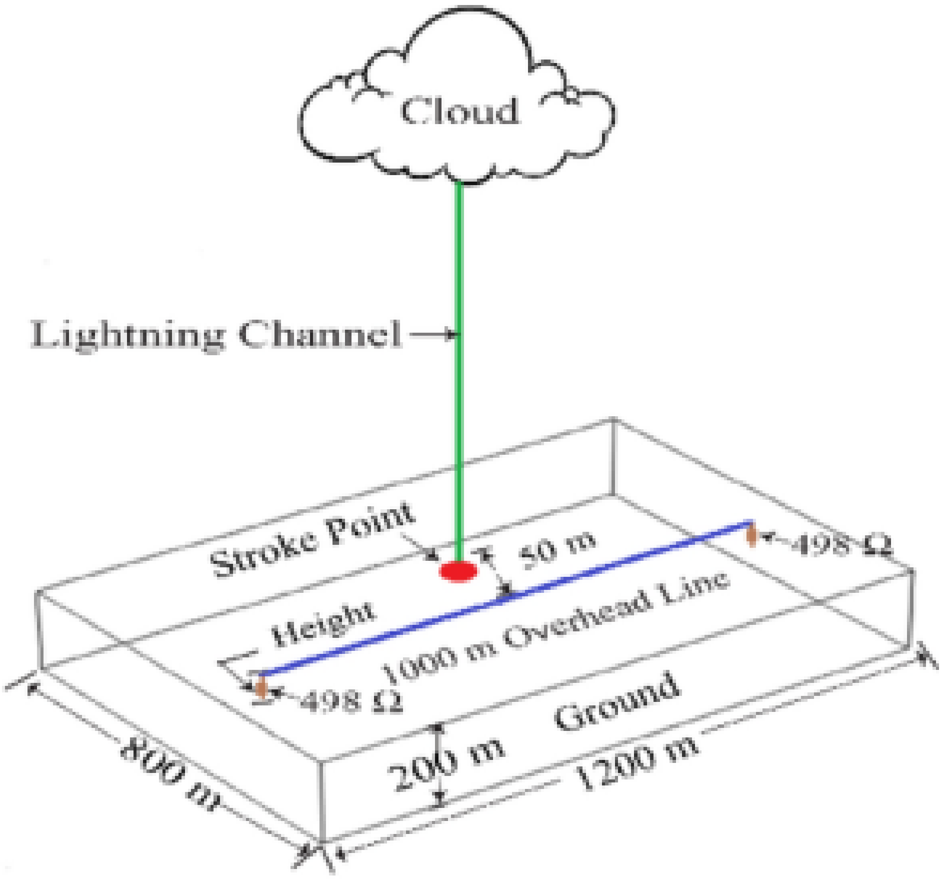
(a)

Lightning Characteristics

❖ Peak current: 30–200 kA

❖ Rise time: microseconds

❖ High energy



(b)

Impact On Power Systems

Generation Systems

- ❖ Generator insulation stress
- ❖ Control system damage

Transmission Systems

- ❖ Line tripping
- ❖ Tower flashover

Distribution Systems

- ❖ Transformer damage
- ❖ Consumer outages

Industrial & Buildings

- ❖ Sensitive electronics failure
- ❖ Fire hazards

- ➢ Insulation breakdown
- ➢ Transformer failure
- ➢ Relay malfunction
- ➢ System outage
- ➢ Overvoltage
- ➢ Equipment failure

Myanmar / ASEAN Context

Tropical Thunderstorms

- **High lightning density** due to the tropical climate.
- Frequent **convective storms** → high risk of:
  - Direct lightning strikes
  - Induced surges in transmission and distribution systems
- Annual lightning flash density in ASEAN is among the **highest in the world**, especially during monsoon seasons.
- ☞ **Impact:**
  - Increased failure of transformers, insulators, and overhead lines
  - Frequent outages in rural and urban grids

Weak Grounding Systems

- Many installations (especially older or rural systems) suffer from:
  - High earth resistance (> 10 ohms in some areas)
  - Poor soil conductivity (dry, sandy, or rocky conditions)
- Lack of standardised grounding design based on **IEEE 80 / IEC 62305**

Impact:

- Ineffective dissipation of lightning current
- Higher risk of:
  - Equipment damage
  - Step and touch voltage hazards
  - Fire incidents

Increasing Infrastructure Development

- Rapid urbanisation in cities like Yangon and across ASEAN
- Growth in:
  - High-rise buildings
  - Industrial zones
  - Renewable energy systems (solar farms, EV charging)
- **Challenge:**
- Many new projects **do not fully integrate lightning protection systems (LPS)** at design stage
- Inconsistent enforcement of international standards like:
  - IEC 62305
  - Institute of Electrical and Electronics Engineers guidelines

"Myanmar and ASEAN face a **high lightning risk + weak grounding + rapid infrastructure growth** — making robust lightning protection not optional, but essential."

Protection Philosophy

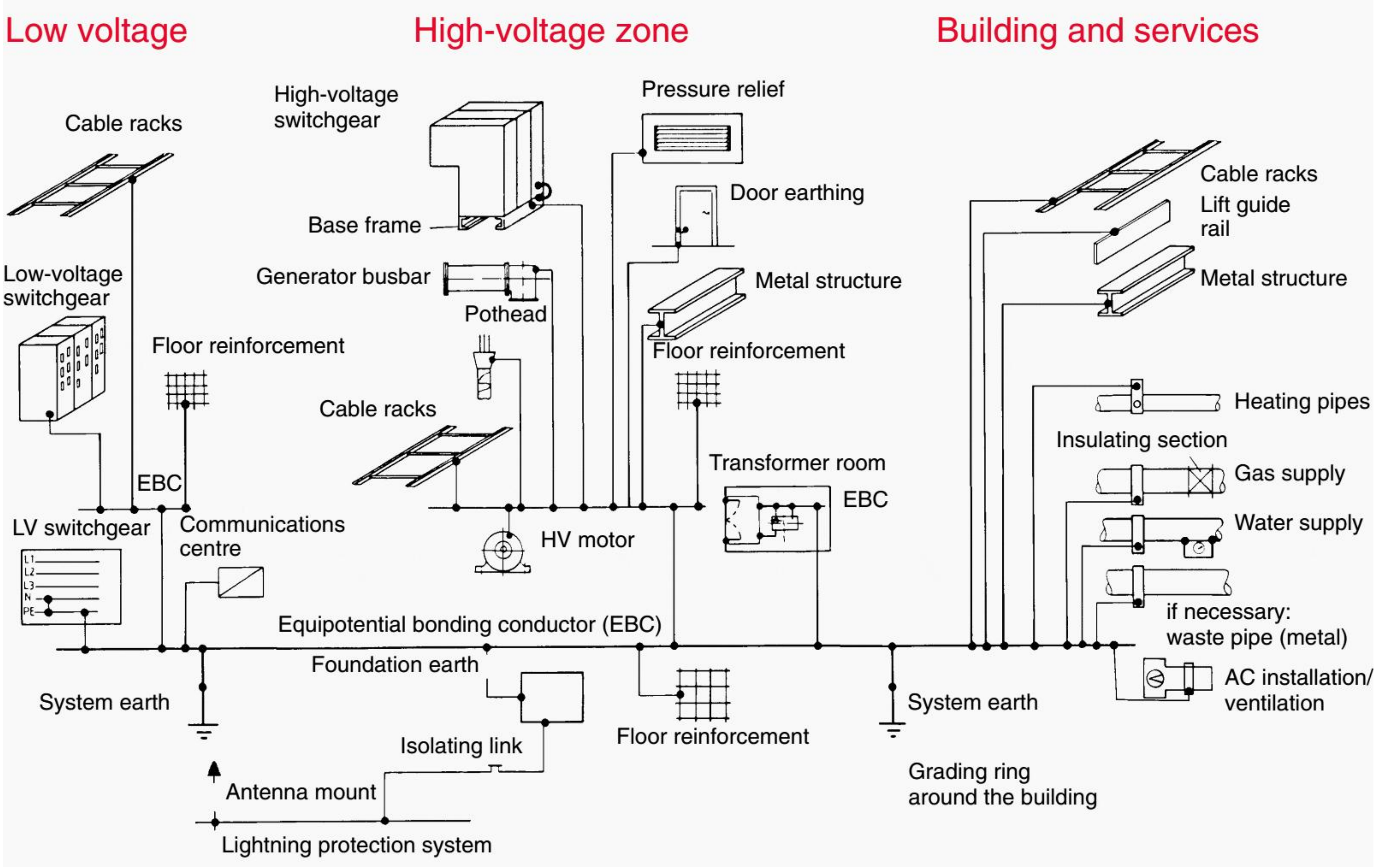
How air terminals intercept lightning strikes:

1. As a thunderstorm cloud approaches, a **stepped leader** (downward electrical channel) extends from the cloud toward the ground surface
2. The air terminal's pointed tip generates a concentrated electric field and launches an **upward streamer** toward the descending leader
3. When the upward and downward channels meet in mid-air, a conductive pathway forms
4. Lightning current flows through the air terminal, down the conductor, and into the grounding system

Why lightning preferentially strikes air terminals:

- **Height advantage:** Air terminals are positioned at the highest points, providing the shortest path to ground
- **Superior conductivity:** Metal construction conducts electricity far better than building materials
- **Electric field enhancement:** The pointed geometry of air terminal tips concentrates the electric field, facilitating upward streamer formation

Important clarification: Air terminals do not "attract" additional lightning to a building. They provide a controlled, safe strike point when a lightning discharge is imminent in the vicinity, protecting the structure and its occupants.


Low voltage
High-voltage zone
Building and services
Cable racks
High-voltage switchgear
Pressure relief
Door earthing
Base frame
Generator busbar
Pothead
Metal structure
Low-voltage switchgear
Floor reinforcement
Cable racks
Floor reinforcement
Transformer room
EBC
EBC
LV switchgear
Communications centre
HV motor
L1
L2
L3
N
PE
Equipotential bonding conductor (EBC)
Foundation earth
System earth
Isolating link
Antenna mount
Lightning protection system
Floor reinforcement
System earth
Grading ring around the building
Cable racks
Lift guide rail
Metal structure
Heating pipes
Insulating section
Gas supply
Water supply
if necessary: waste pipe (metal)
AC installation/ ventilation

Surge Protection Devices (SPD)

- Type 1: Lightning current
- Type 2: Surge protection
- Type 3: Sensitive loads

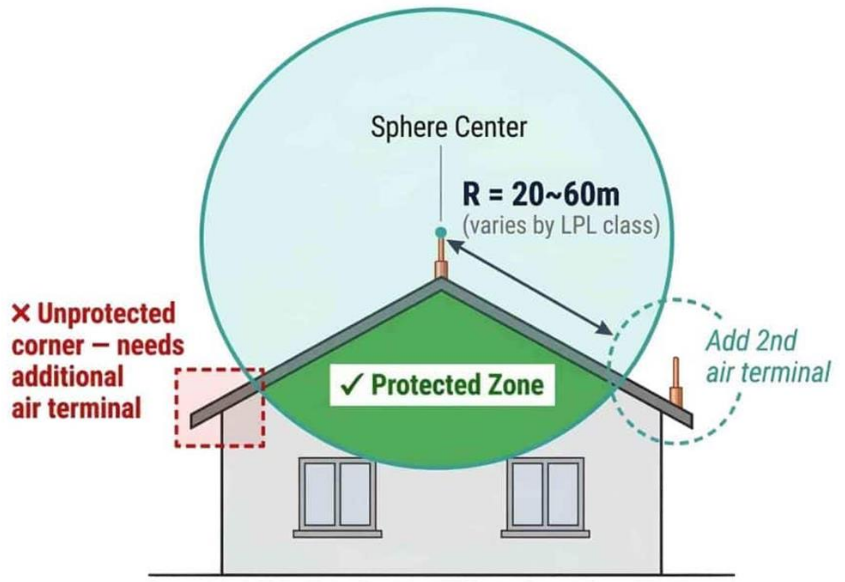
Lightning protection for buildings or structures

A lightning protection system is installed on the roof of a high-rise building as a bolt of conductor lightning to the ground, ground rod on the sky background.

Rolling Sphere Method for Air Terminal Placement:

- The **rolling sphere method** (also called striking distance method) is the internationally recognised standard for determining air terminal protection zones per IEC 62305 and NFPA 780.
- Engineers visualize a sphere of a specific radius rolling over the building surface.
- Any area the sphere cannot touch (because it rests on air terminals or protected surfaces) is considered within the lightning protection zone.

Rolling Sphere Method for Air Terminal Protection Zone Design



Rolling Sphere Radius by LPL Class

LPL Class	Radius (R)	Typical Application
LPL I (Highest)	20m (66ft)	Explosive storage, critical infrastructure
LPL II	30m (98ft)	Hospitals, data centers
LPL III	45m (148ft)	Industrial facilities
LPL IV	60m (197ft)	Residential buildings

Rolling Sphere boundary · Protected Zone · Unprotected Zone · Air Terminal position

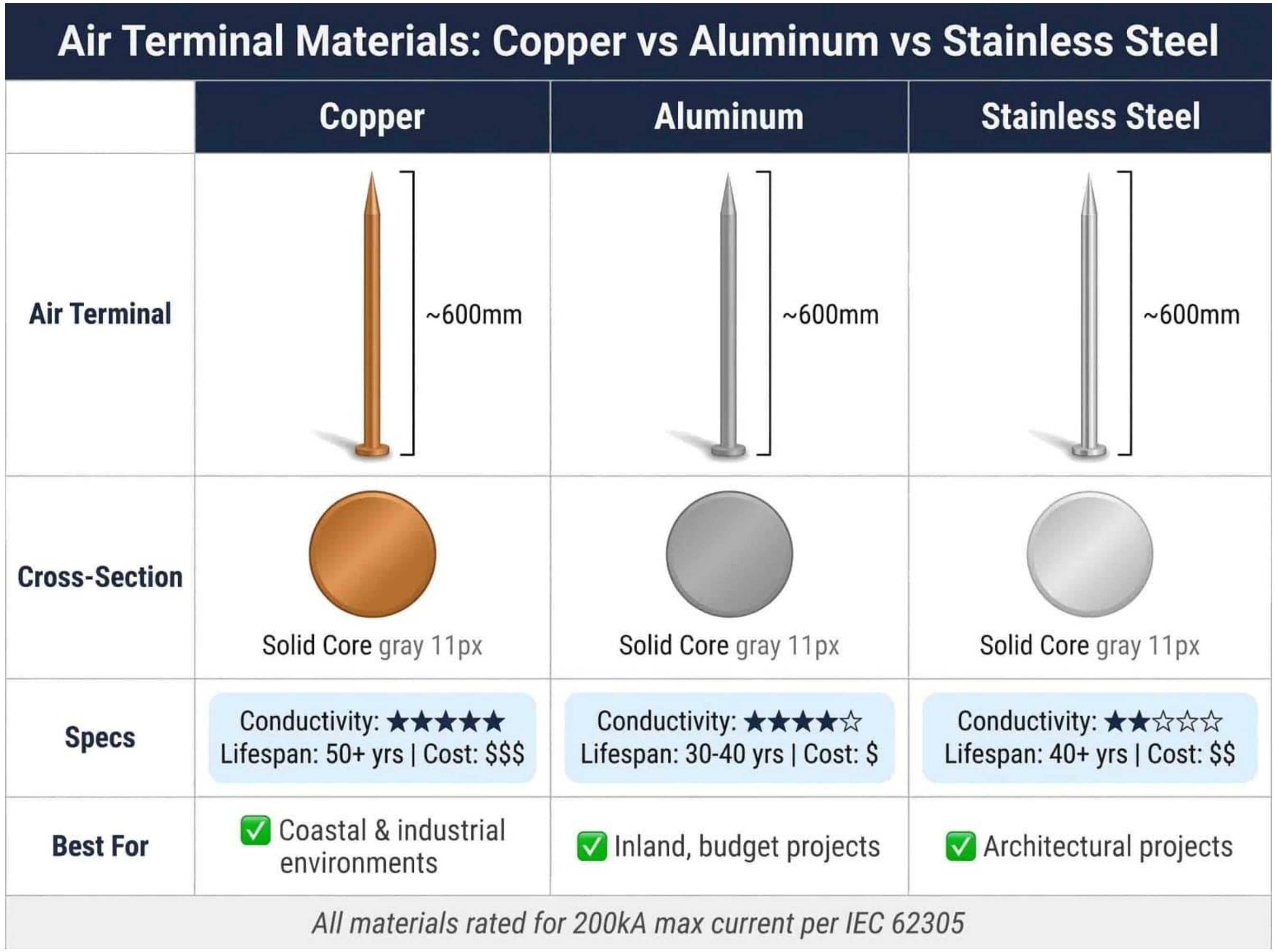
Based on IEC 62305 / NFPA 780 Rolling Sphere Method

Rolling sphere method for determining air terminal protection zones according to IEC 62305

- **The height and placement of lightning rods directly determine the size of the lightning protection zone.**
- **Larger buildings typically require multiple rods or a mesh conductor network to achieve complete lightning protection coverage according to the rolling sphere method calculations.**

Air terminal material selection guidance:

- Choose copper rods: Most professional applications, coastal and industrial environments, projects requiring maximum reliability
- Choose aluminium rods: Inland locations, budget-limited projects, large installations where weight matters
- Choose stainless steel rods: Architecturally sensitive projects with high aesthetic requirements



Air Terminal Materials: Copper vs Aluminum vs Stainless Steel

	Copper	Aluminum	Stainless Steel
Air Terminal	~600mm	~600mm	~600mm
Cross-Section	Solid Core gray 11px	Solid Core gray 11px	Solid Core gray 11px
Specs	Conductivity: ★★★★★ Lifespan: 50+ yrs | Cost: $$$	Conductivity: ★★★★☆ Lifespan: 30-40 yrs \| Cost: $	Conductivity: ★★☆☆☆ Lifespan: 40+ yrs \| Cost: $$
Best For	✅ Coastal & industrial environments	✅ Inland, budget projects	✅ Architectural projects

All materials rated for 200kA max current per IEC 62305

Comparison of air terminal materials - Copper, Aluminum, and Stainless Steel

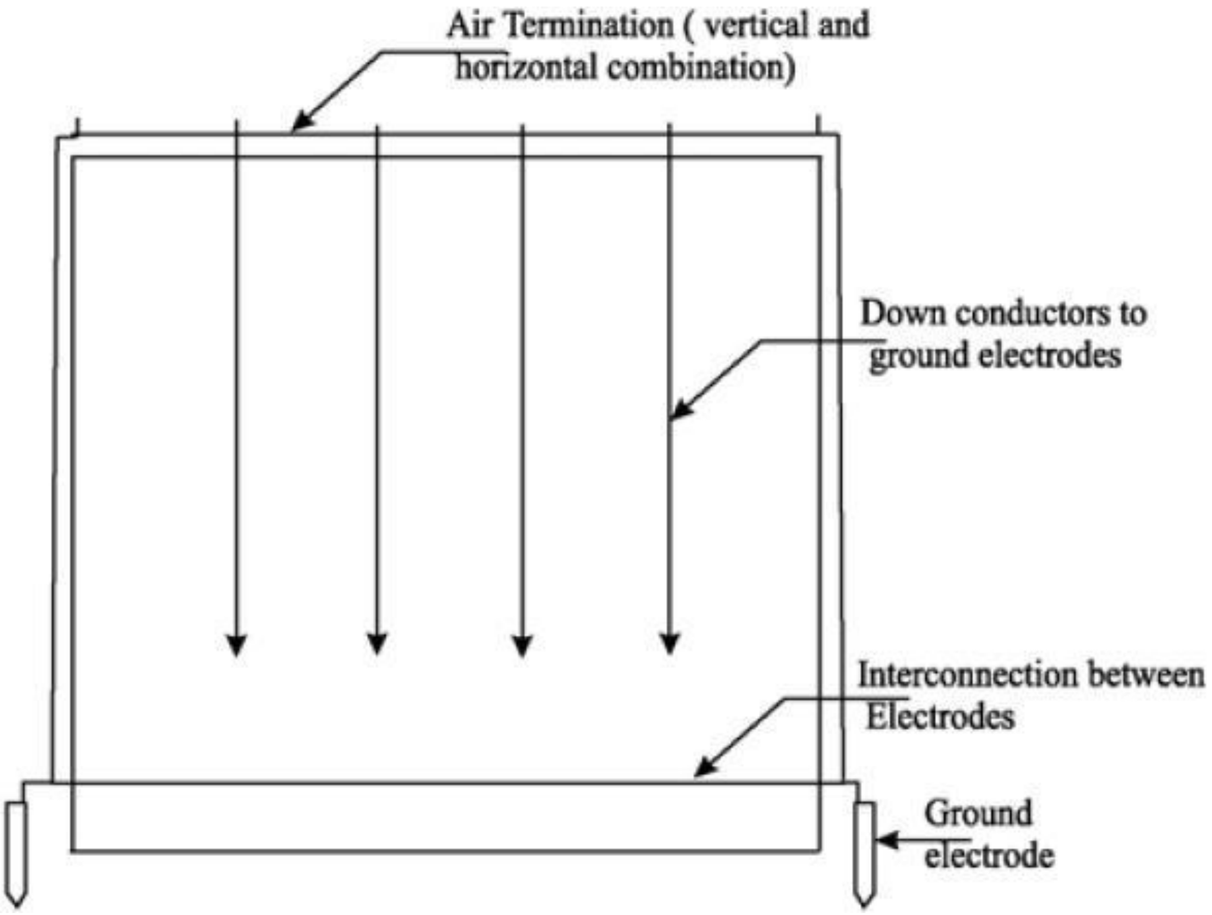
CORE TECHNICAL SECTION

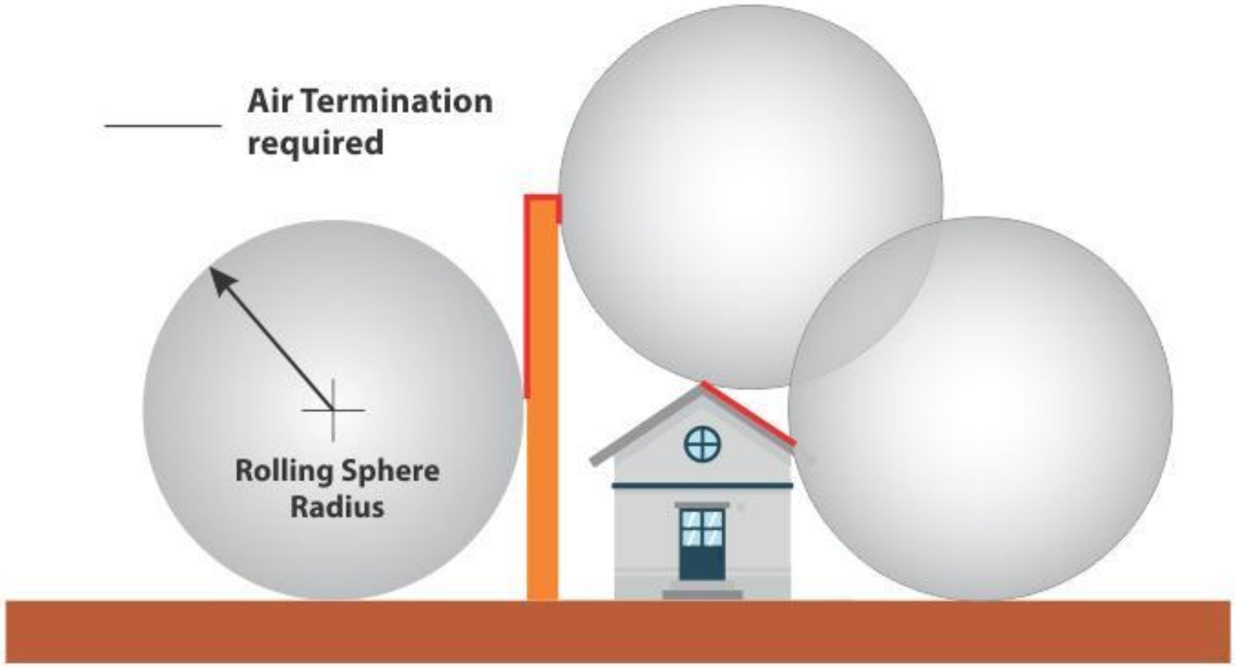
External Lightning Protection System (LPS)

Protection Layers
- External LPS
- Internal protection (SPD)
- Grounding system

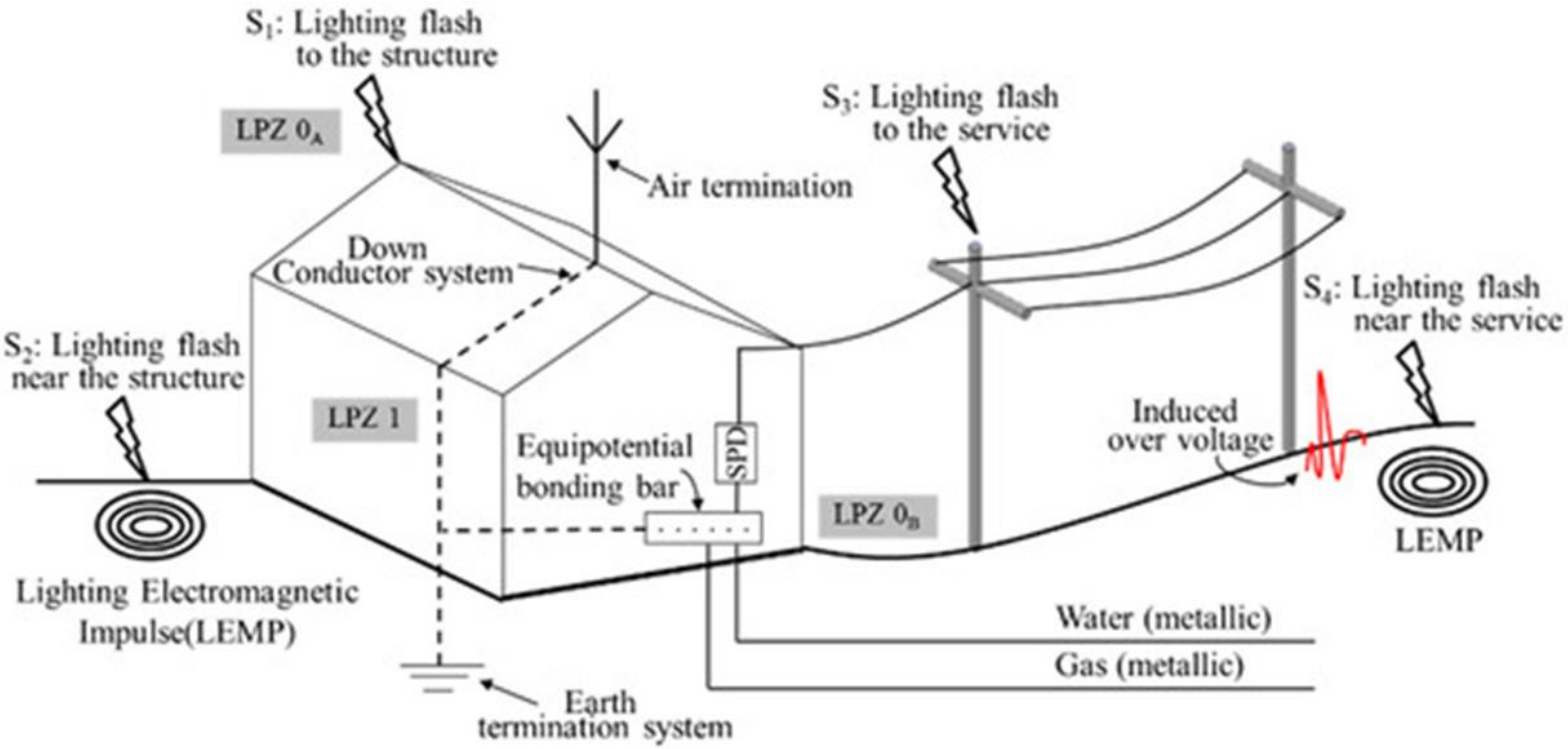
LPS Design Methods
- Rolling sphere method
- Protective angle method
- Mesh method

Components
- Air terminals
- Down conductors
- Earth electrodes





Application of the rolling sphere method

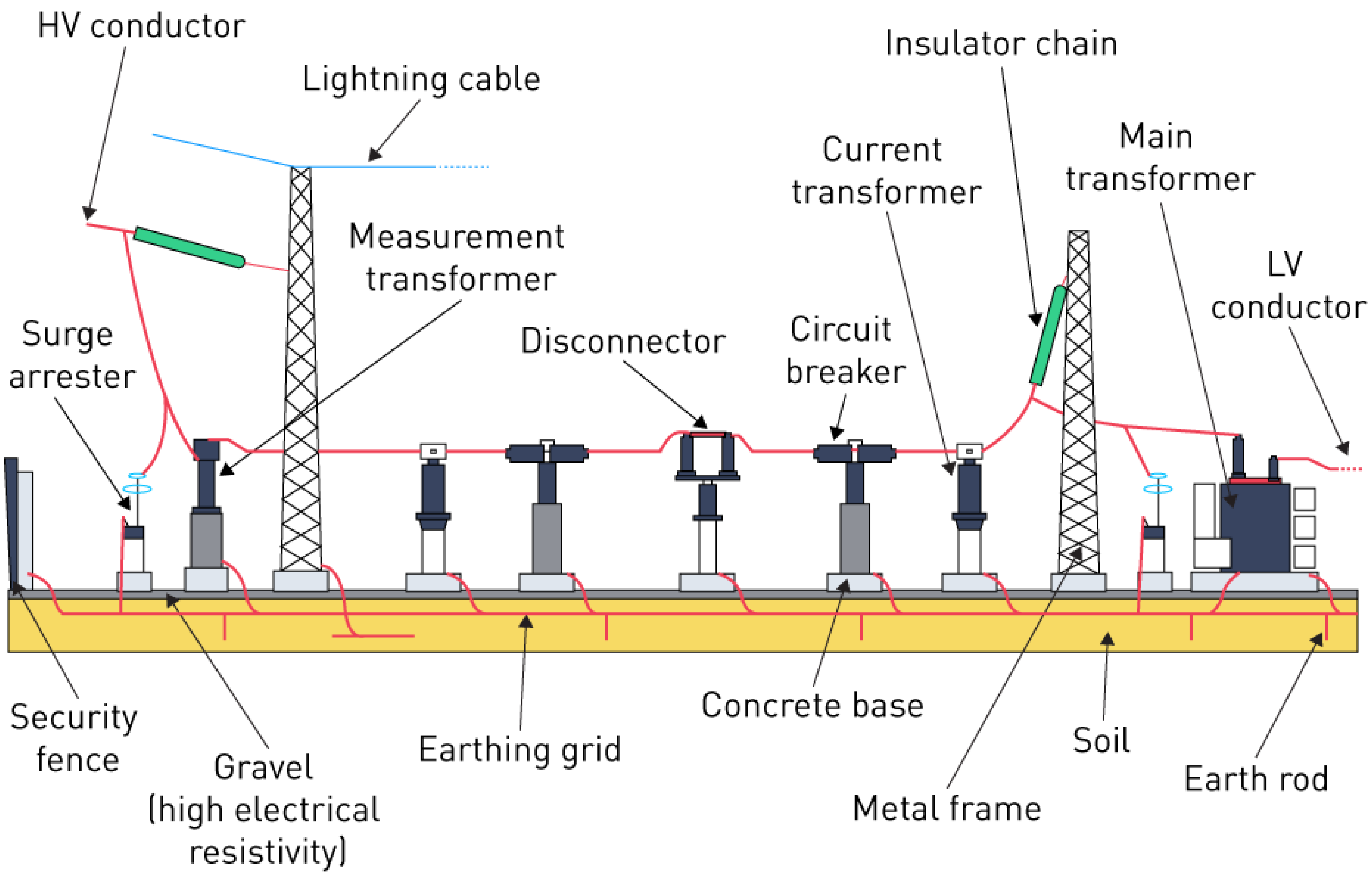


S_1: Lighting flash to the structure
LPZ 0_A
Air termination
S_3: Lighting flash to the service
Down Conductor system
S_4: Lighting flash near the service
S_2: Lighting flash near the structure
LPZ 1
Equipotential bonding bar
SPD
LPZ 0_B
Induced over voltage
LEMP
Lighting Electromagnetic Impulse(LEMP)
Water (metallic)
Gas (metallic)
Earth termination system

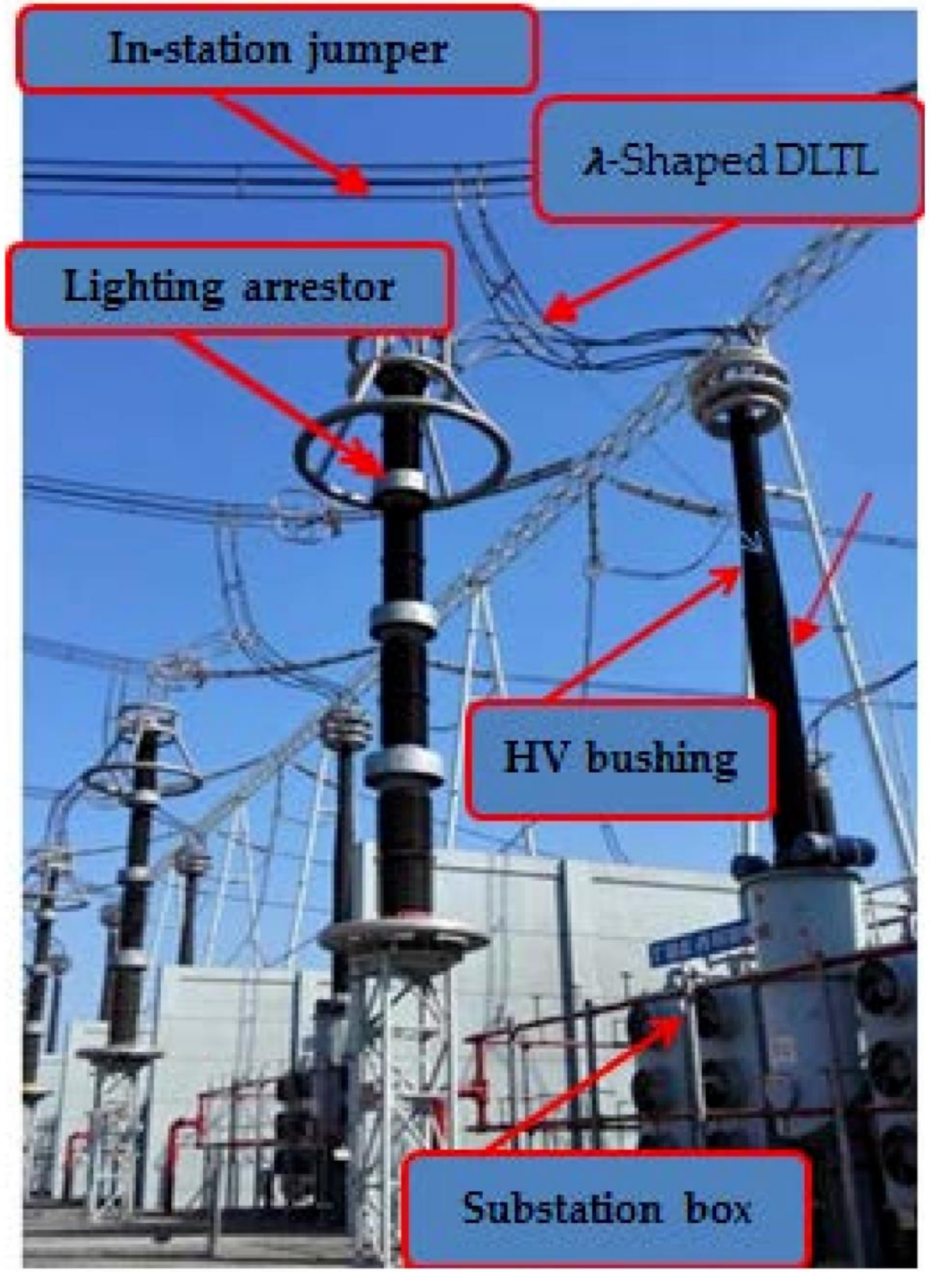
Substation Protection

- Shield wires
- Ground grid
- Surge arresters

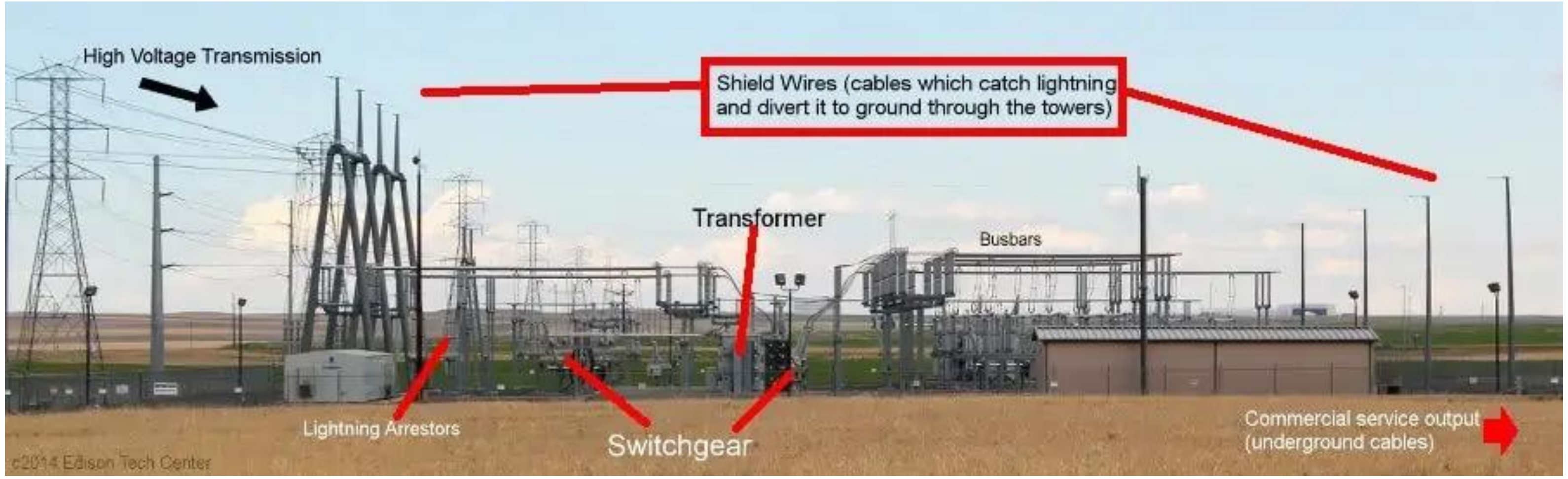
❖ Substation protection is critical for maintaining grid reliability, with **shield wires**, **ground grids**, and **surge arresters** forming a comprehensive defense system against lightning and high-voltage surges.



Substation grounding



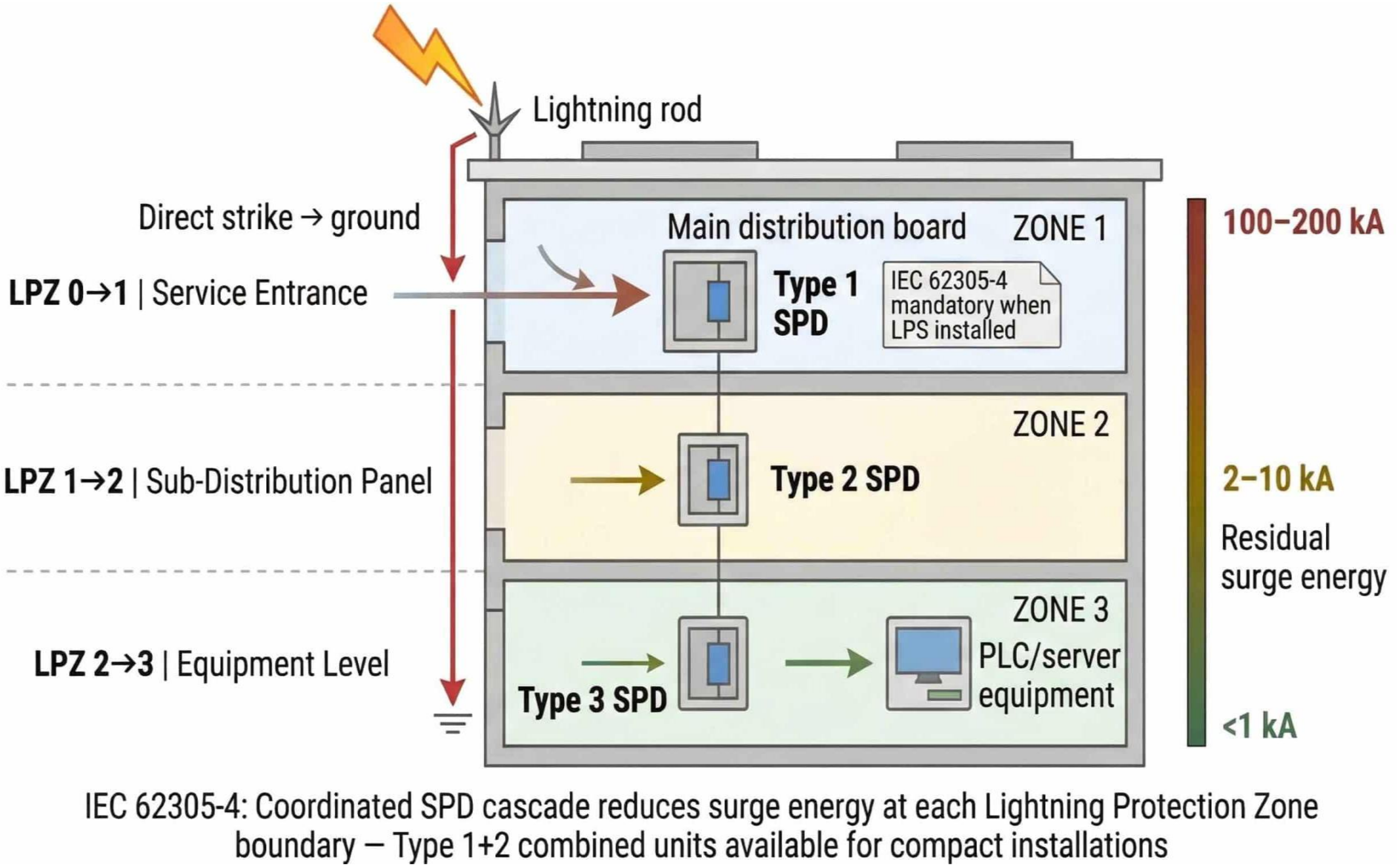
HV bushings, lightning arrestors, and DLLs in a certain HV substation.

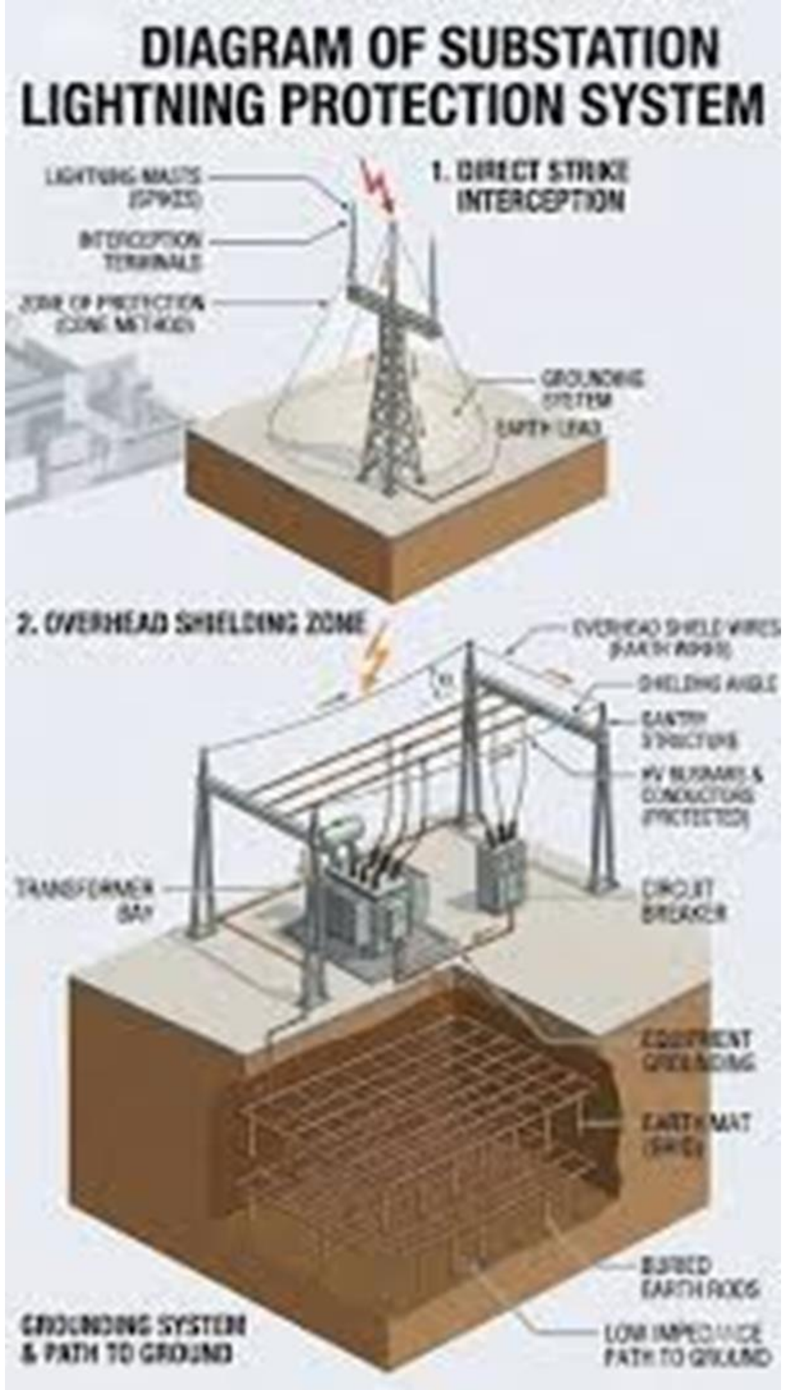


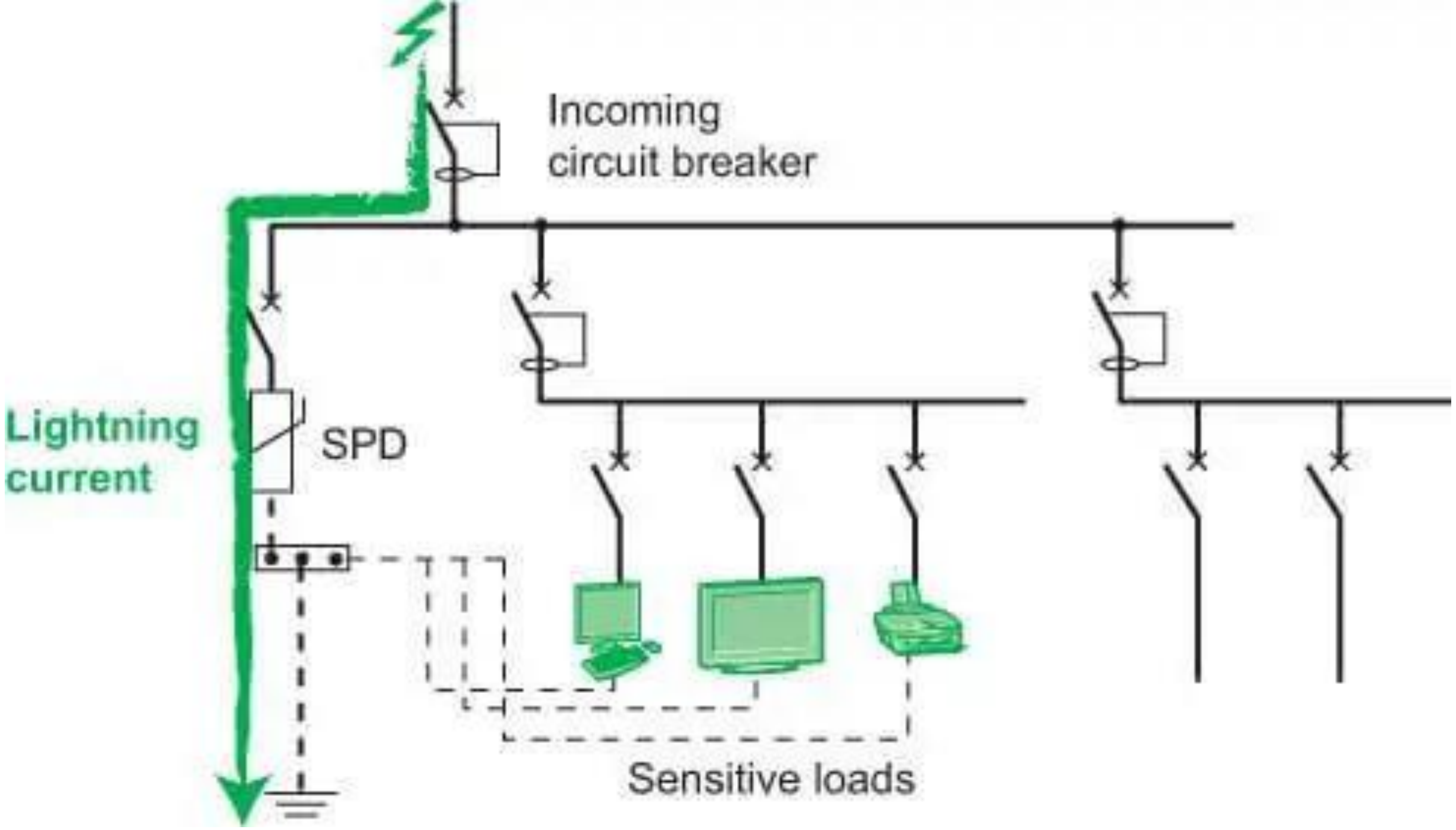
Lightning protection wires

Surge arresters

Lightning rods







Installation of LV surge protector

LV Over voltages Protection

LV (Low Voltage V ≤ 1 kV) equipment, namely electronic and informatics equipment, may suffer severe damages due to lightning discharges through the cables or through the building structure.

To prevent those damages it is usual to install in LV switchboards 'power surge protectors' (SPD), with standard nominal discharge currents of 5 kA, 10 kA and 20 kA, although some models may reach values of 30 – 70 kA.

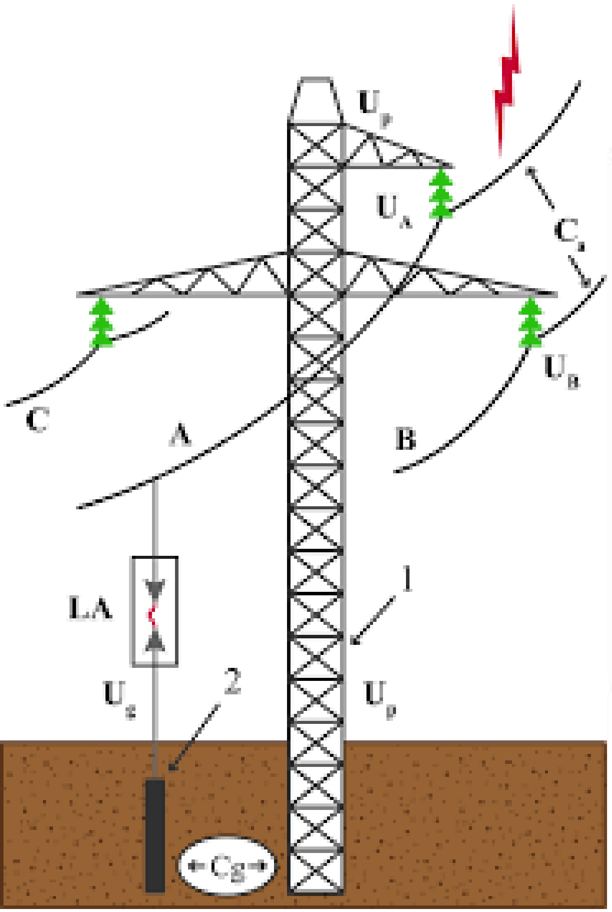
Surge Arrester Classifications per IEC 61643-11

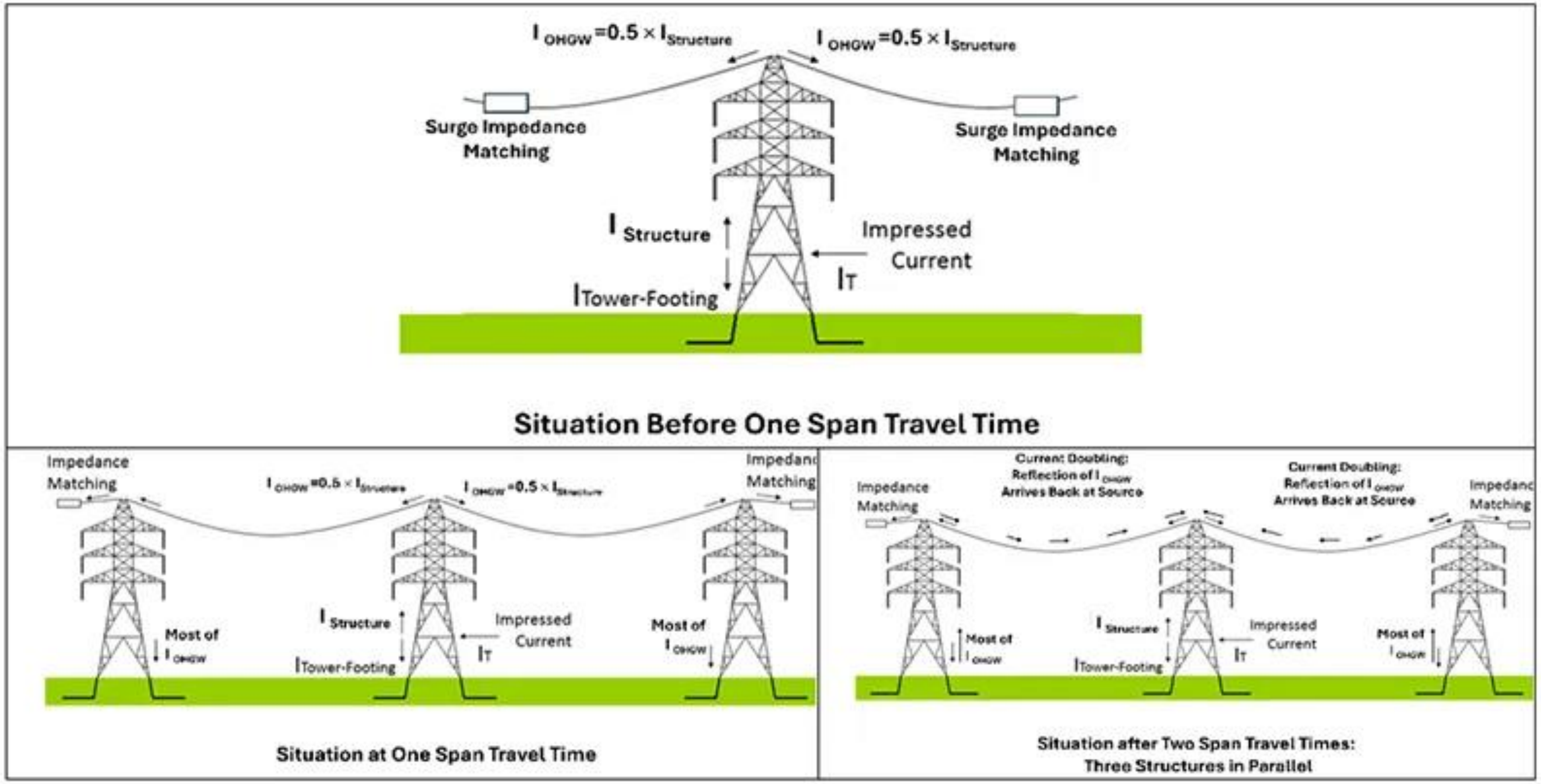
Type	Test Waveform	Impulse Current	Installation Point	Required When
Type 1	10/350 µs	Iimp ≥ 12.5 kA	Main service entrance (LPZ 0→1)	External LPS installed — mandatory per IEC 62305-4
Type 2	8/20 µs	In: 20–40 kA	Sub-distribution panels (LPZ 1→2)	Standard equipment protection — always recommended
Type 3	8/20 µs (combined)	Imax: 5–10 kA	Equipment terminals (LPZ 2→3)	Sensitive electronics, >15 m from Type 2
Type 1+2	10/350 µs + 8/20 µs	Iimp ≥ 12.5 kA	Main service entrance	Space-saving single device for LPZ 0→2

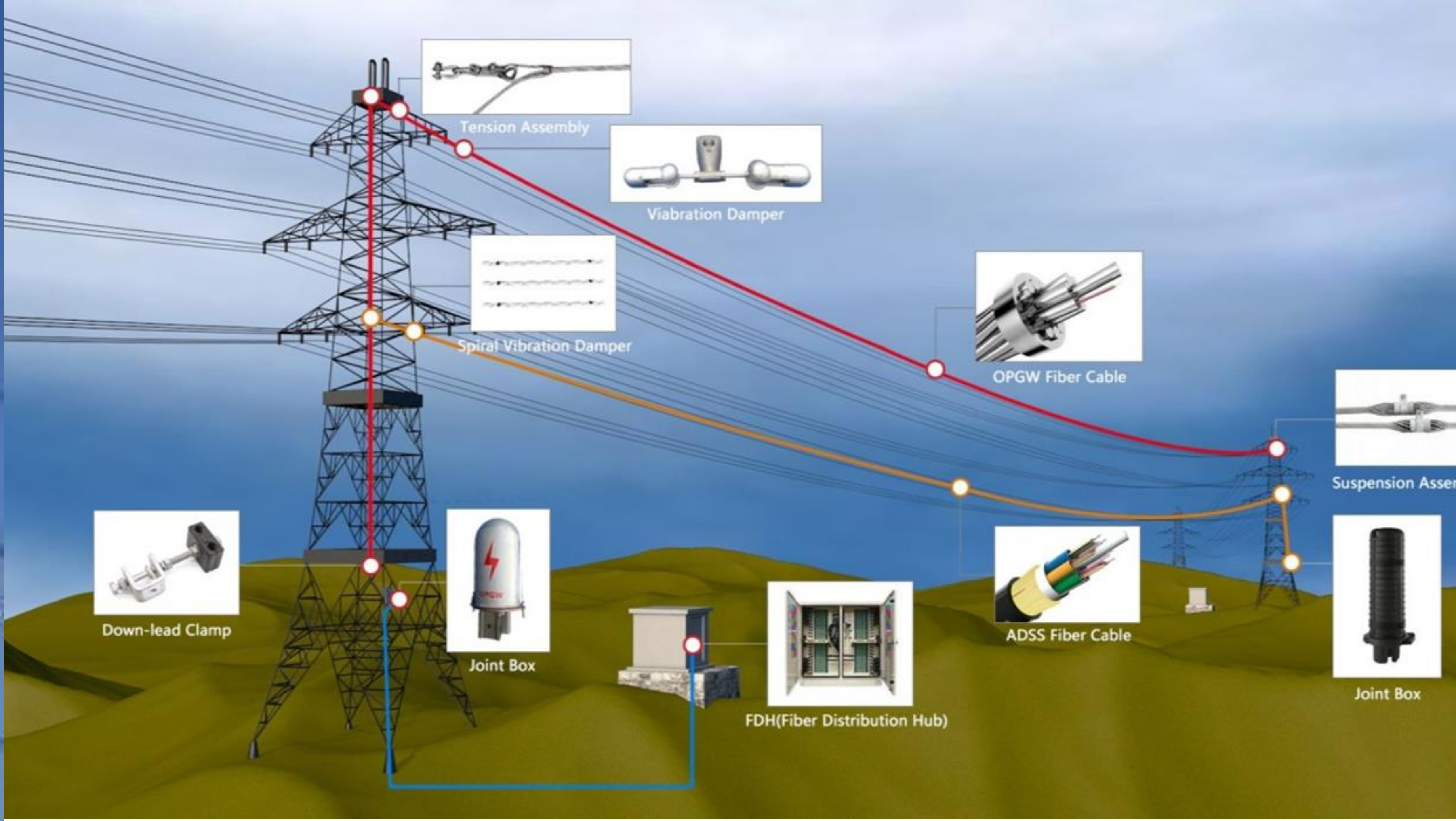
- Overhead ground wires
- Tower footing resistance
- Insulation coordination

Transmission Line Protection

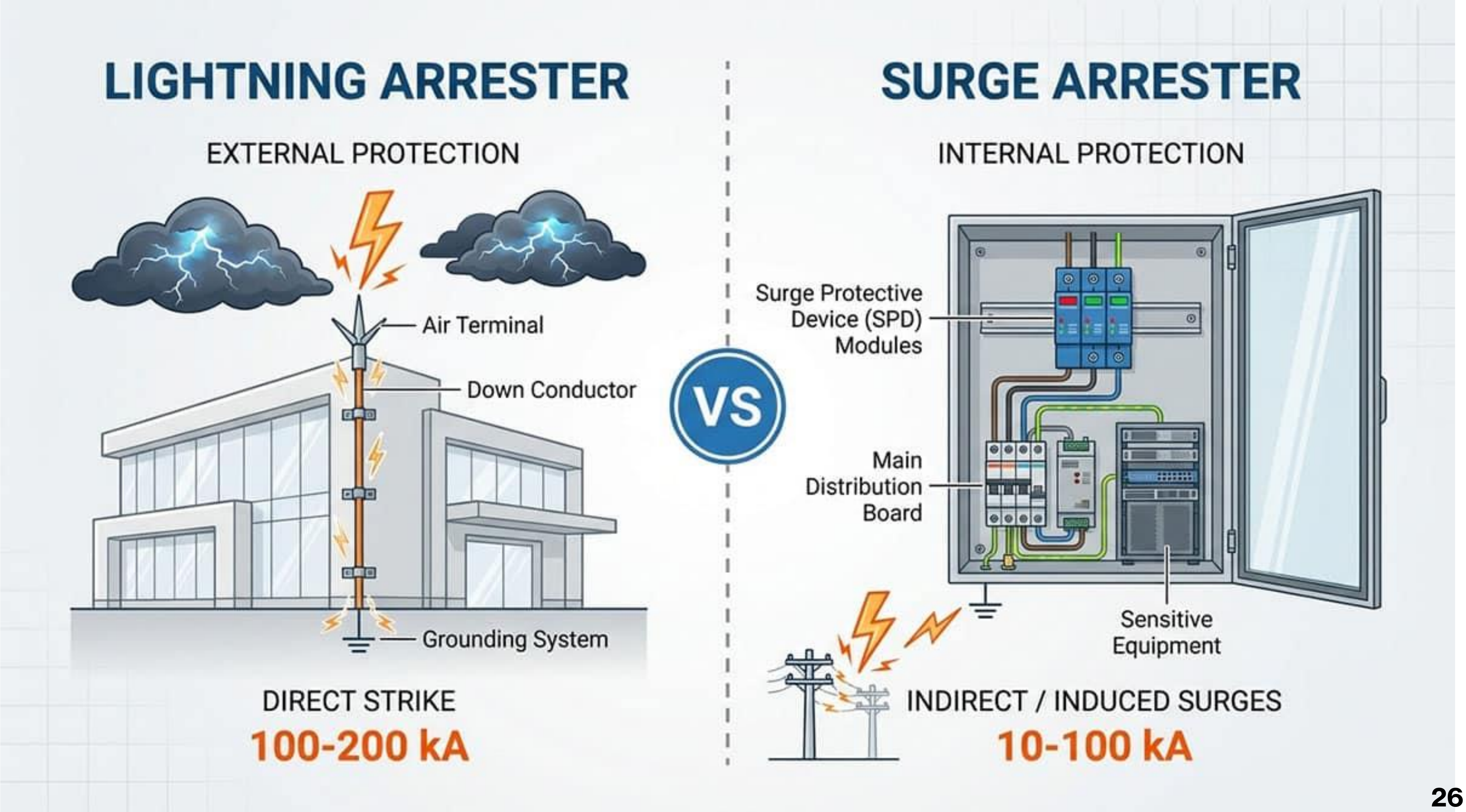
- Transmission line lightning protection utilises overhead ground wires (shield wires) to intercept strikes, directing surge currents through towers to the earth, aided by low tower footing resistance (<5–10 Ohms)to prevent back-flashover.
- Insulation coordination ensures line insulation withstands these surges, supplemented by surge arresters (TLSAs) to reduce voltage stress and improve reliability.







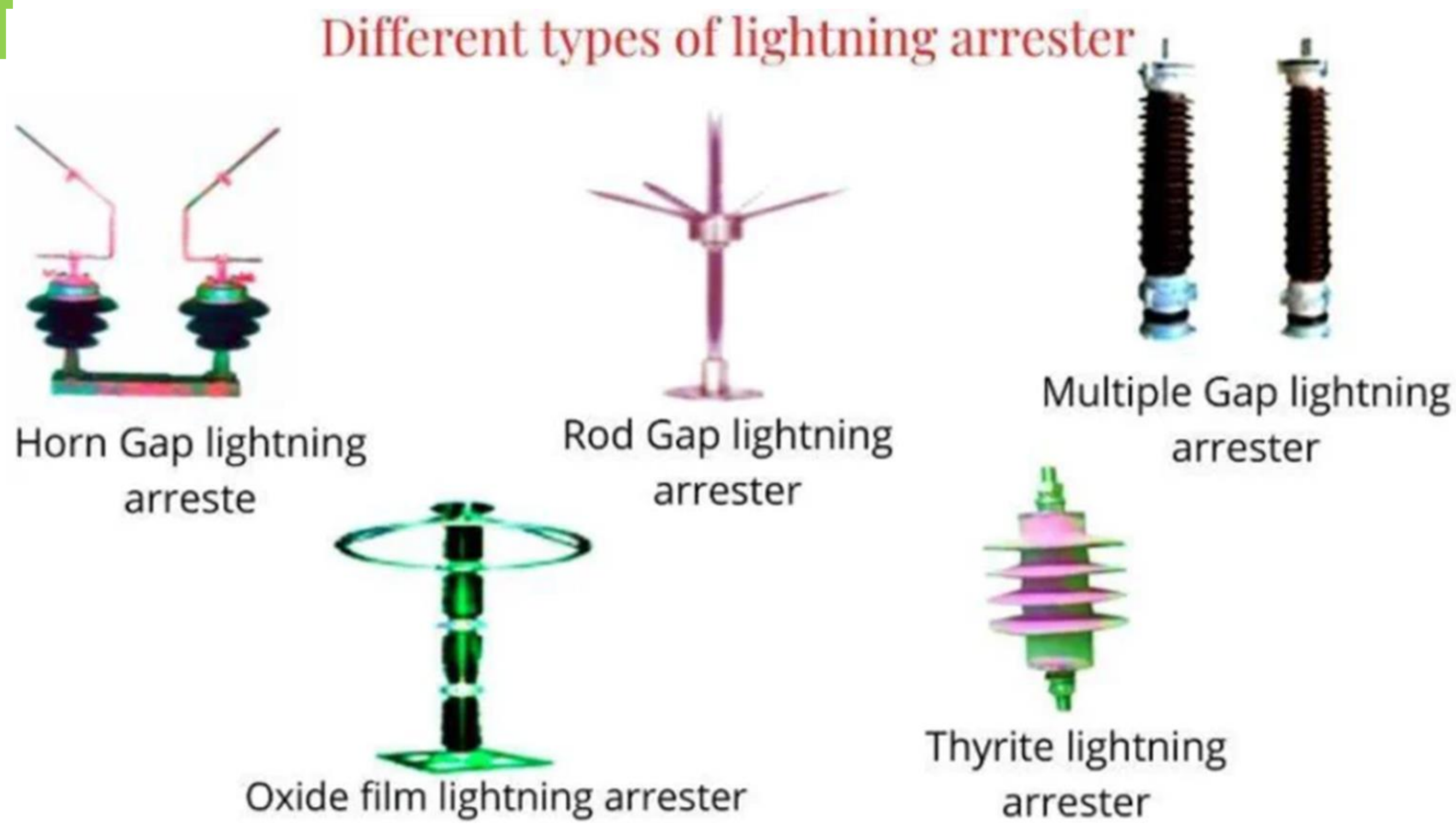
The ground conductor (shield wire) in high-voltage transmission lines

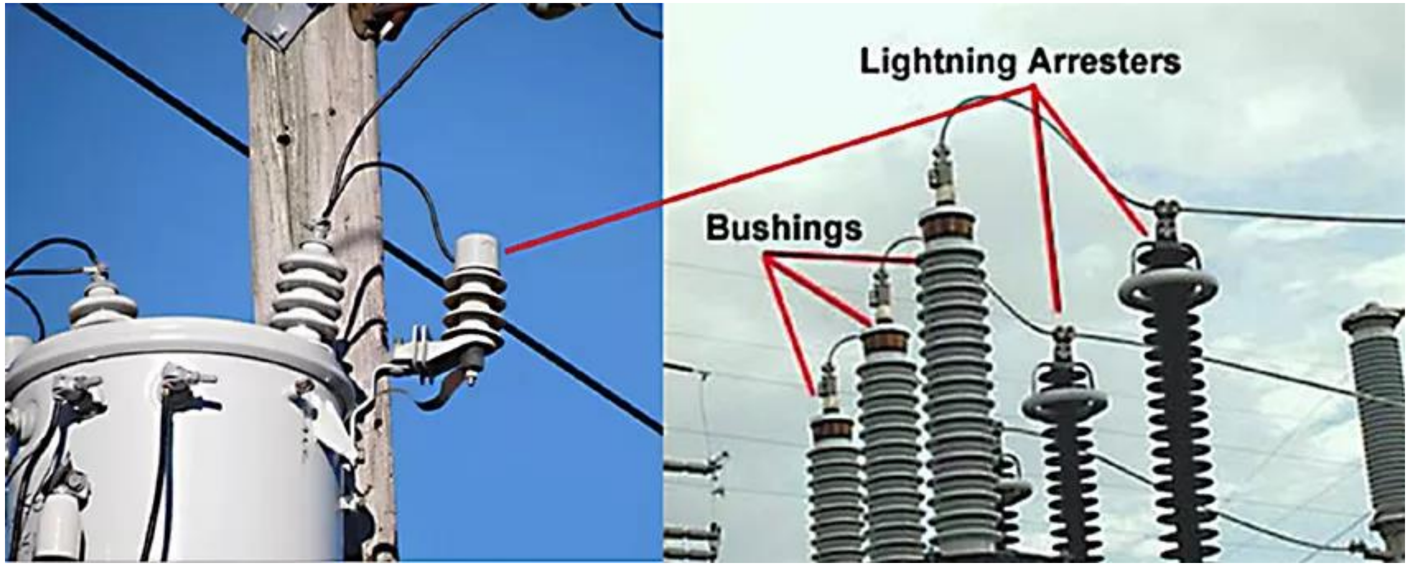

LIGHTNING ARRESTER
EXTERNAL PROTECTION
Air Terminal
Down Conductor
Grounding System
DIRECT STRIKE
100-200 kA
VS
SURGE ARRESTER
INTERNAL PROTECTION
Surge Protective Device (SPD) Modules
Main Distribution Board
Sensitive Equipment
INDIRECT / INDUCED SURGES
10-100 kA

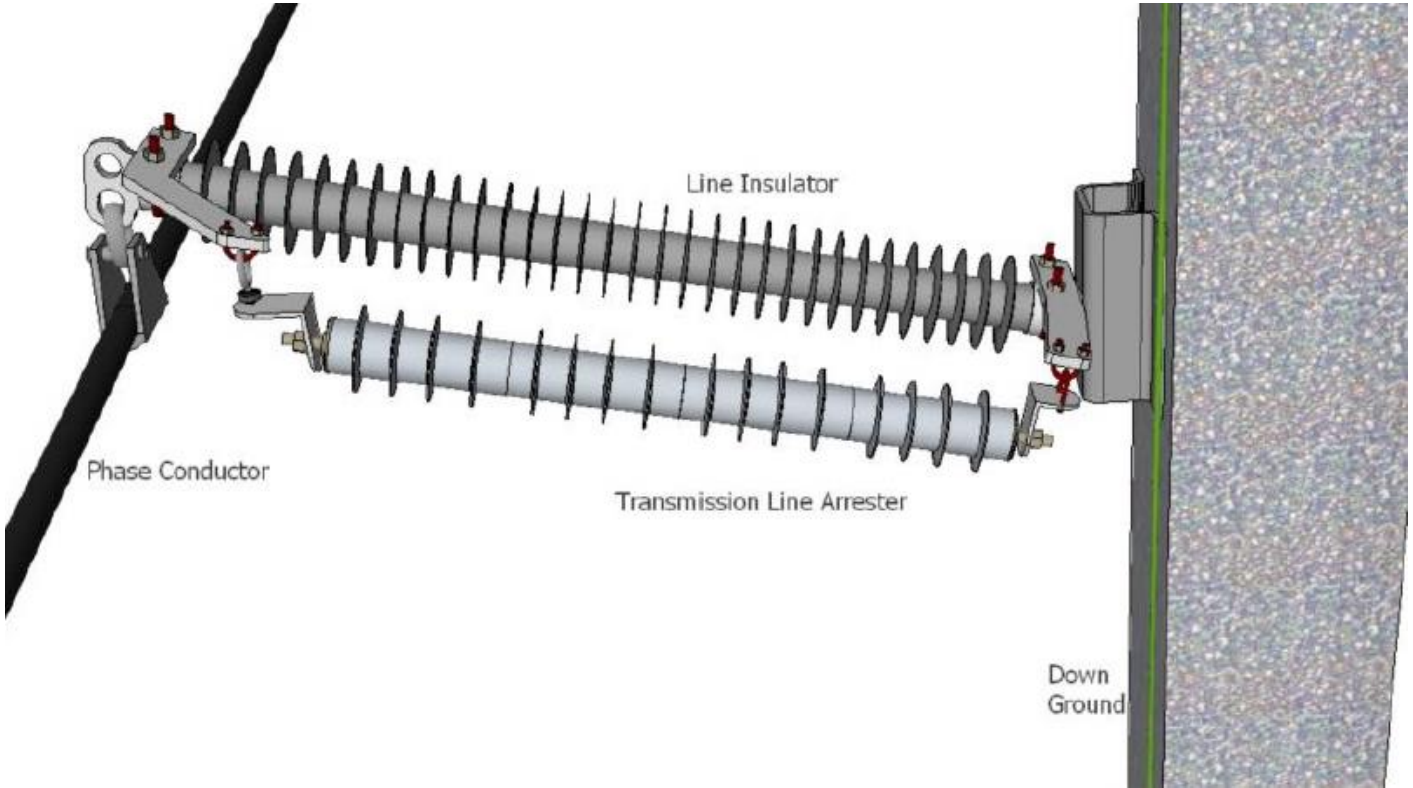
Distribution System Protection

- An engineered safety framework designed to intercept high-voltage strikes, redirect massive surge currents, and safely dissipate the energy into the earth.
- By providing a controlled, low-impedance path to the ground, these industrial systems actively prevent cataclysmic component failure, grid blackouts, and electrical fires

•Line arresters

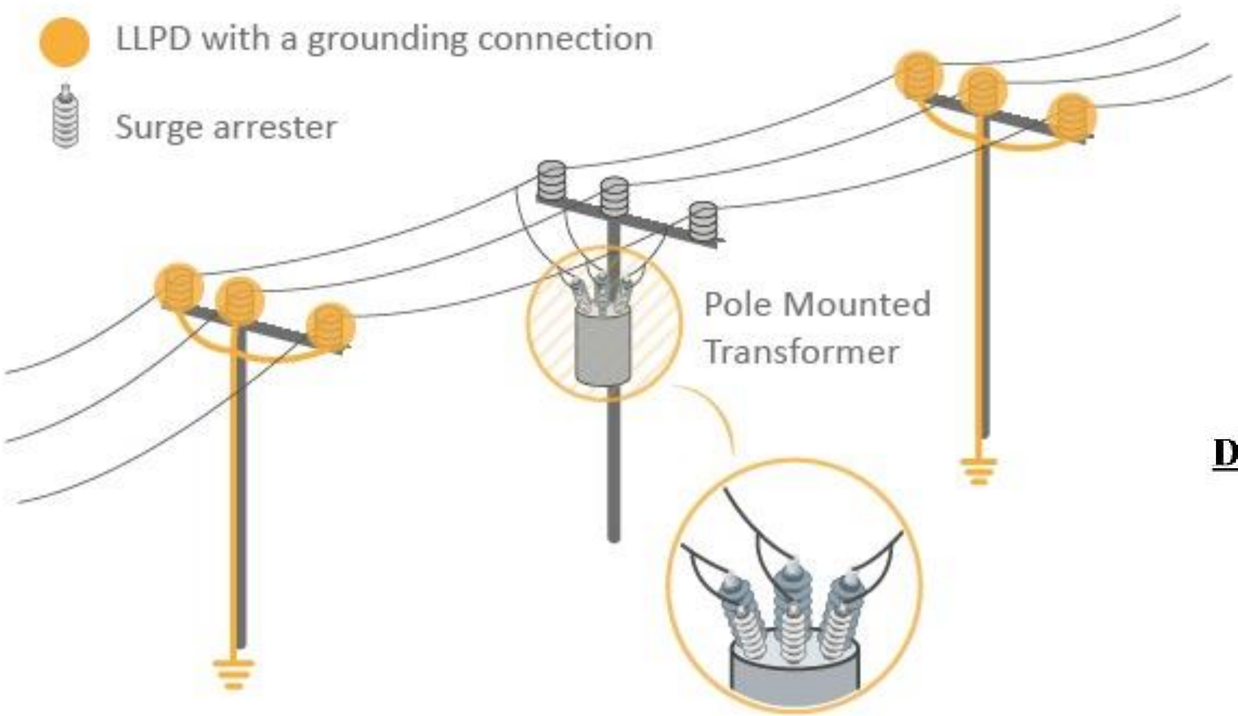


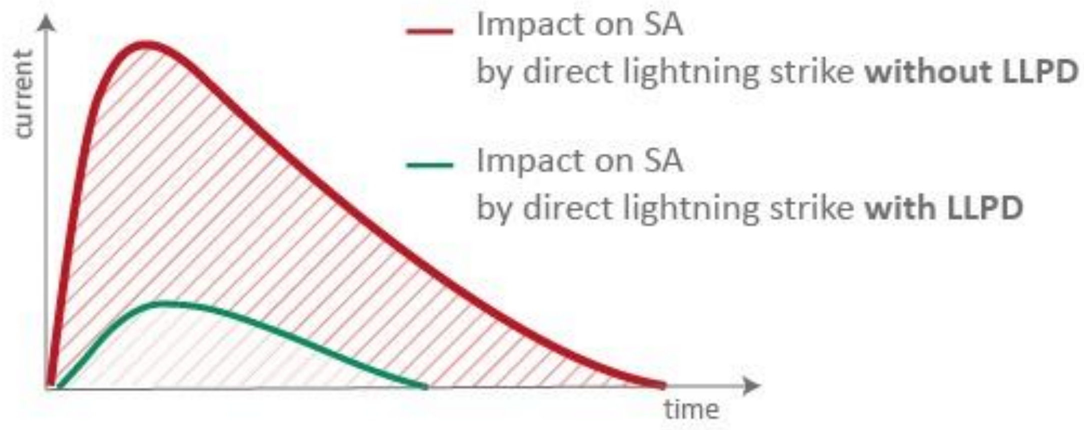

Lightning Arresters
Bushings

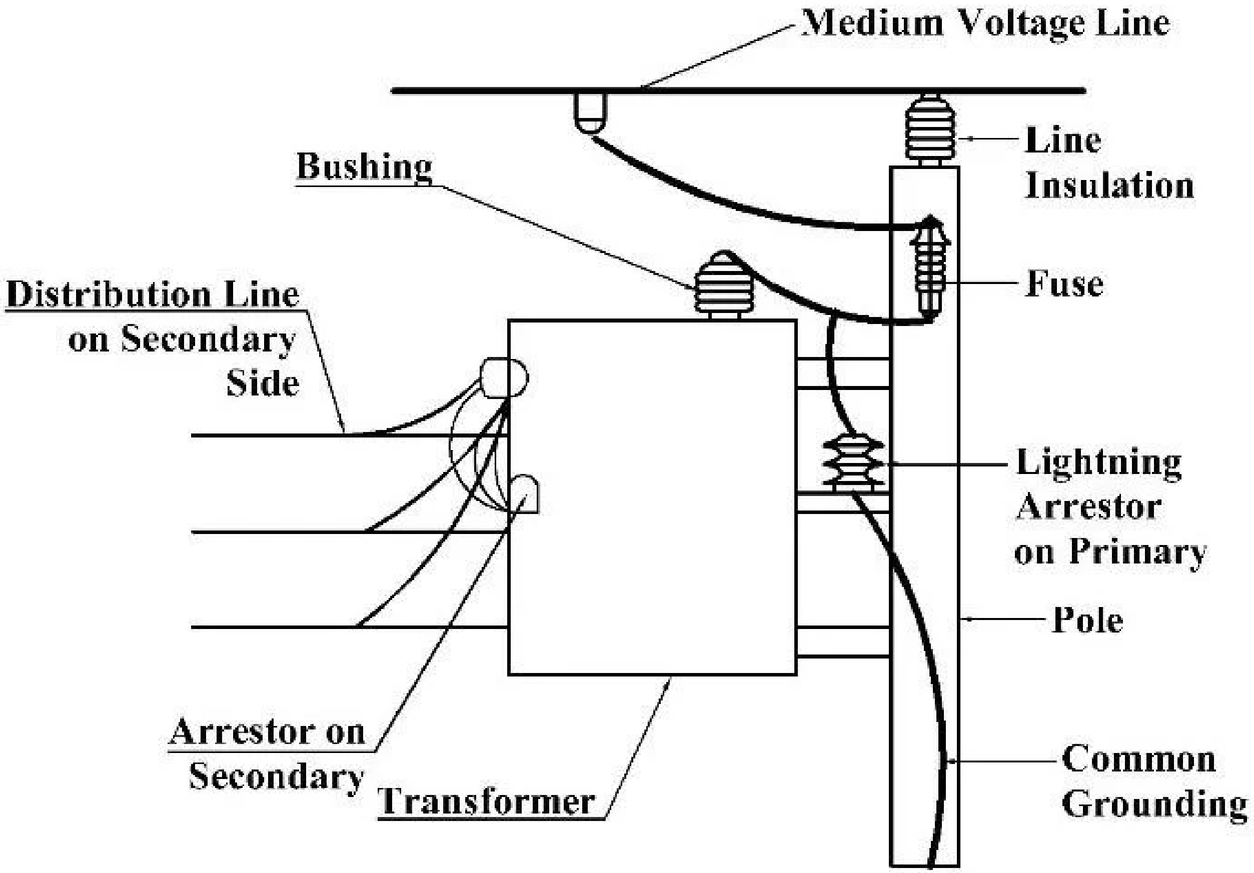

Line Insulator
Phase Conductor
Transmission Line Arrester
Down
Ground

Transformer protection

- Transformer lightning protection prevents high-voltage surges from destroying insulation and windings by diverting excess energy to ground.
- Key measures include installing metal-oxide varistor (MOV) surge arresters near bushings, ensuring low-resistance grounding, and shielding the system with overhead ground wires


LLPD with a grounding connection
Surge arrester
Pole Mounted
Transformer


current
time
Impact on SA
by direct lightning strike without LLPD
Impact on SA
by direct lightning strike with LLPD


Medium Voltage Line
Line
Insulation
Bushing
Fuse
Distribution Line
on Secondary
Side
Lightning
Arrestor
on Primary
Pole
Arrestor on
Secondary
Transformer
Common
Grounding

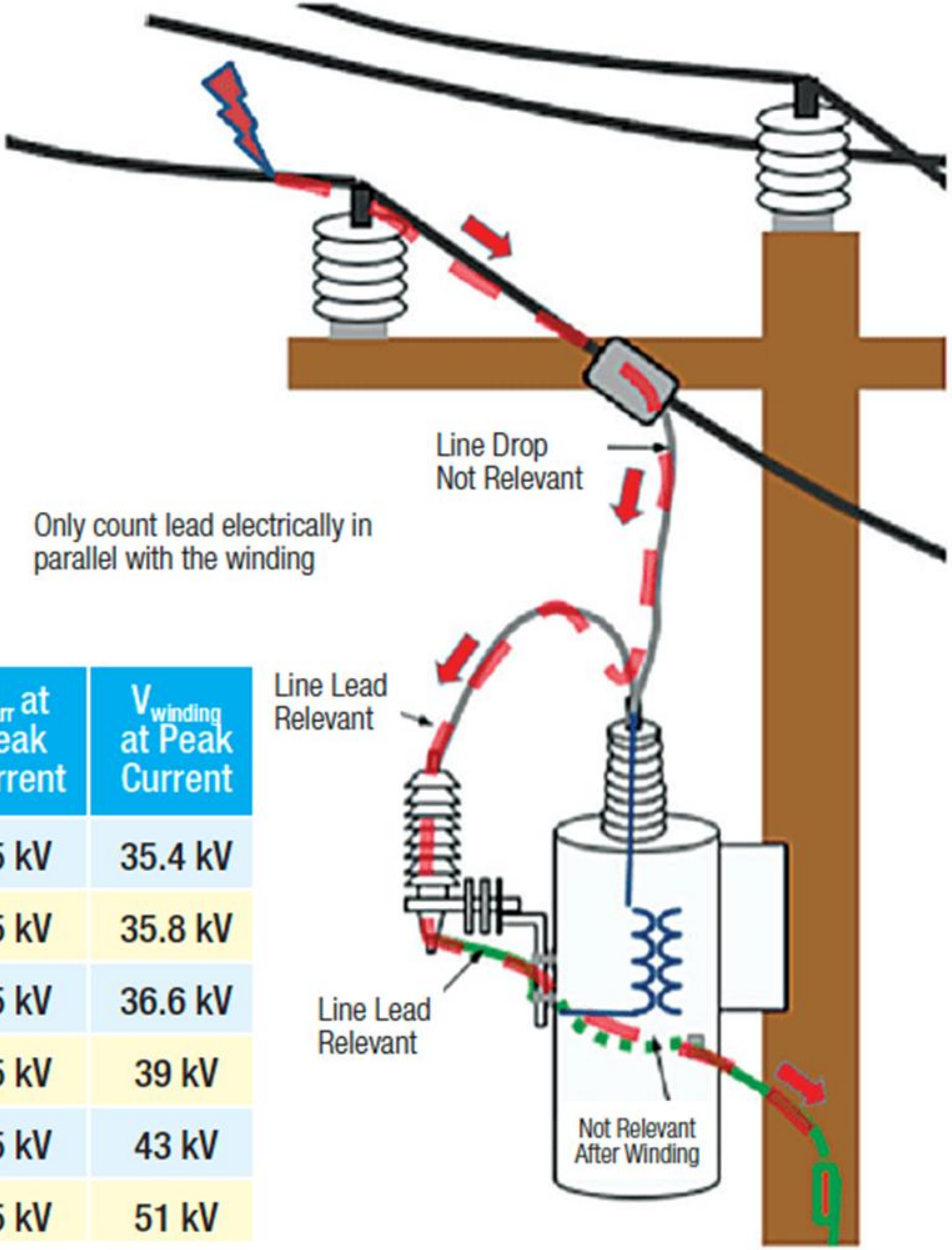
When lightning current flows through a lead, it creates a voltage that is proportional to the inductance of the conductor and the rate of rise of the current.

The resistance and capacitance of the conductor are not relevant parameters in this transient analysis.

$V_{lead} = L \times d_t/d_t$

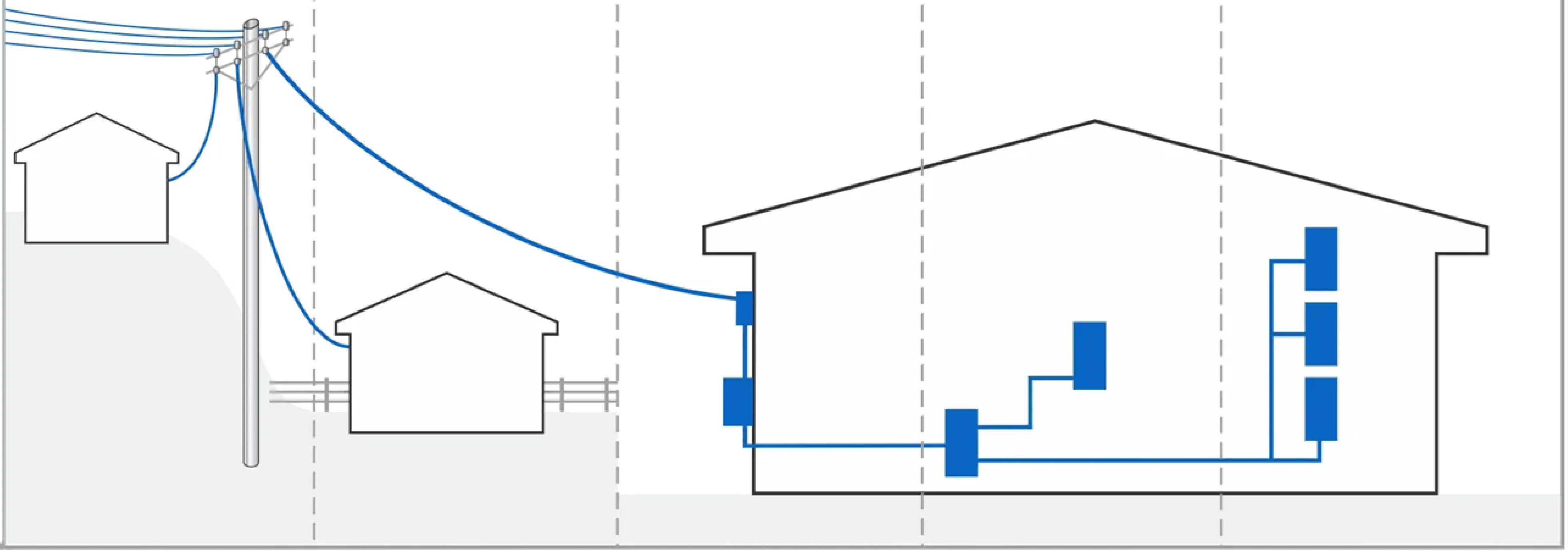
$V_{winding} = V_{arr} + V_{lead}$

Length of Lead	Lead Ind (L)	Peak Current (d_t)	Time to Peak Current (d_t)	V_{lead}	V_{arr} at Peak Current	$V_{winding}$ at Peak Current
.5 m	.5 uh	10 kA	8 us	.4 kV	35 kV	35.4 kV
1 m	1 uh	10 kA	8 us	.8 kV	35 kV	35.8 kV
2 m	2 uh	10 kA	18 us	1.6 kV	35 kV	36.6 kV
.5 m	.5 uh	10 kA	1 us	4 kV	35 kV	39 kV
1 m	1 uh	10 kA	1 us	8 kV	35 kV	43 kV
2 m	2 uh	10 kA	1 us	16 Kv	35 kV	51 kV

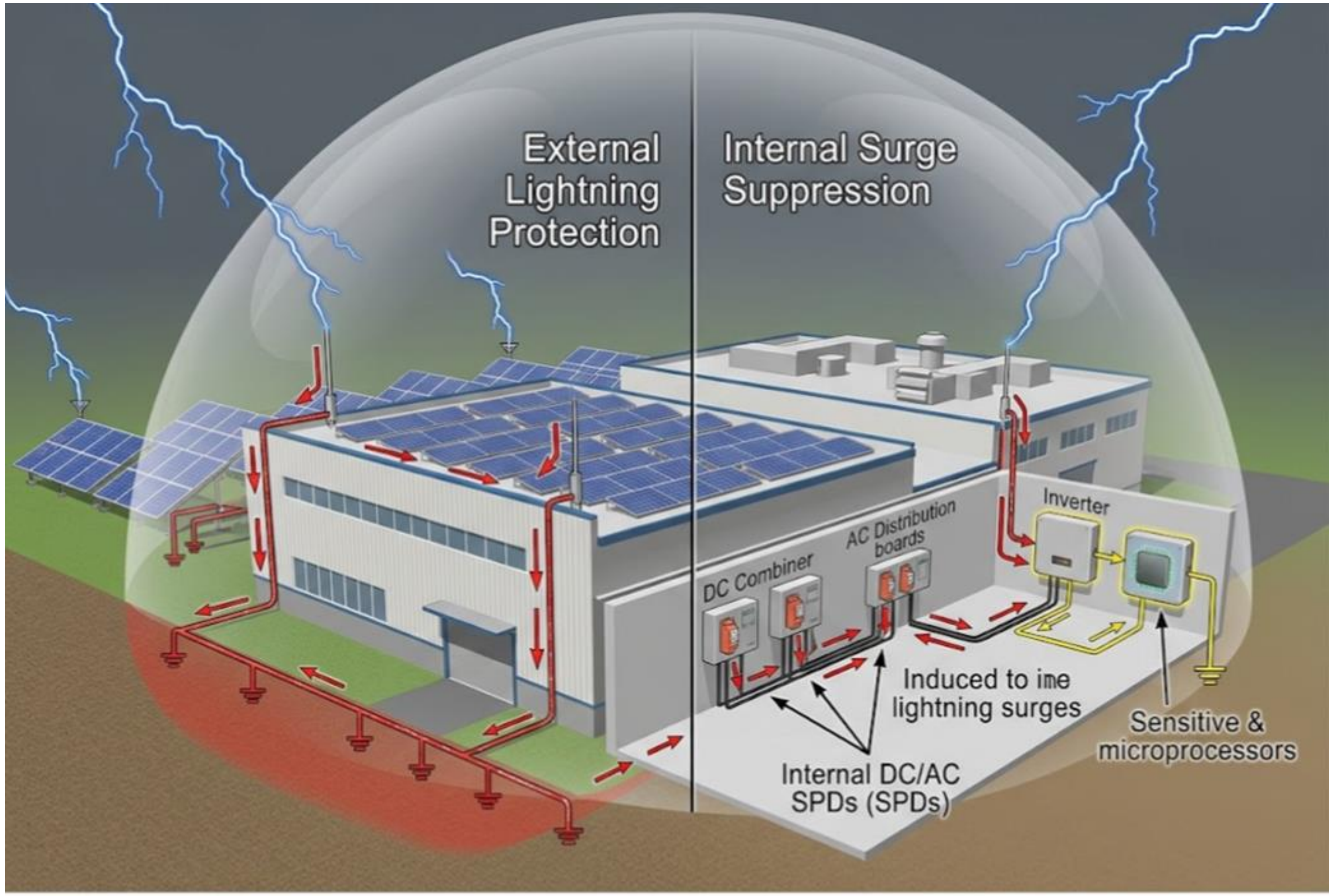


SPD CLASSES AND CATEGORIES

IEC 61643-11	I		I, II	II	III
EN 61643-11	Type 1		Type 1, Type 2	Type 2	Type 3
VDE Classification	A		B	C	D
	POINT-OF-ENTRY HIGHLY EXPOSED OR CRITICALLY IMPORTANT SITES	POINT-OF-ENTRY EXPOSED OR RURAL SITES	POINT-OF-ENTRY INNER CITY SITES	SUB CIRCUITS OR NEAR TO POINT-OF-ENTRY	DISTRIBUTED CIRCUITS, POWER OUTLETS, CIRCUITS REMOTE FROM POINT-OF-ENTRY

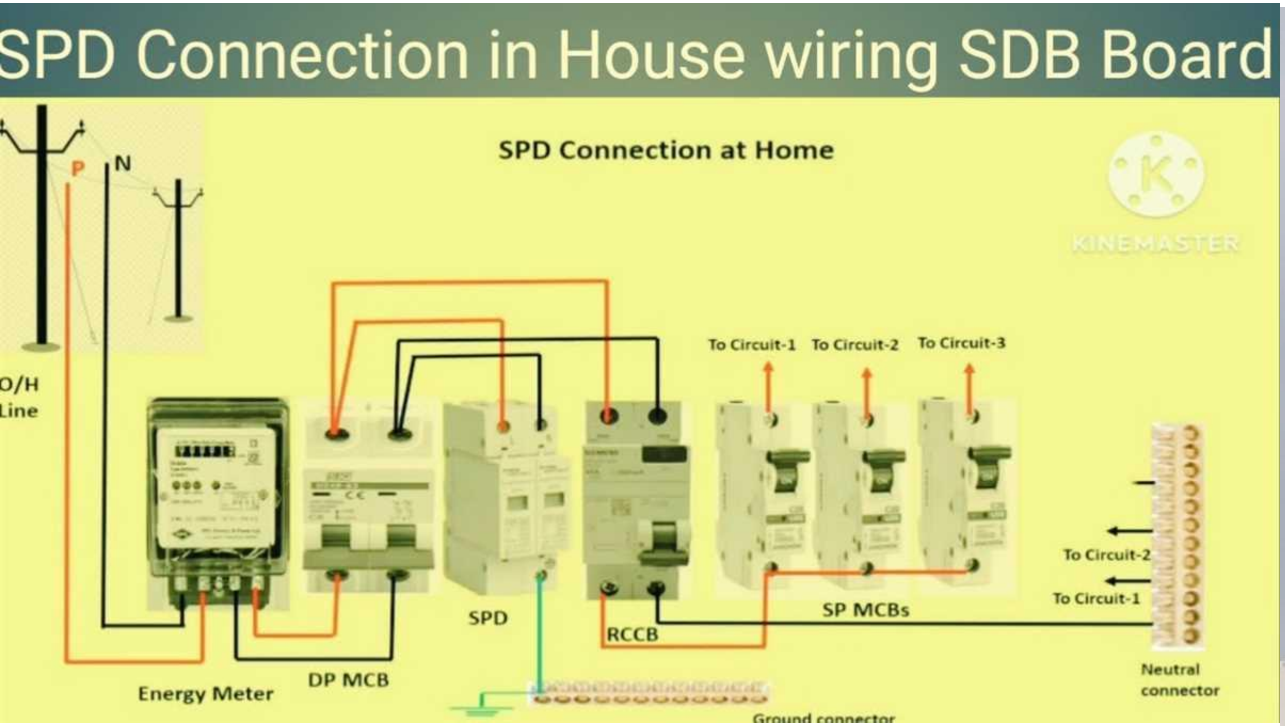


Service entrance SPD



SURGE PROTECTION DEVICES

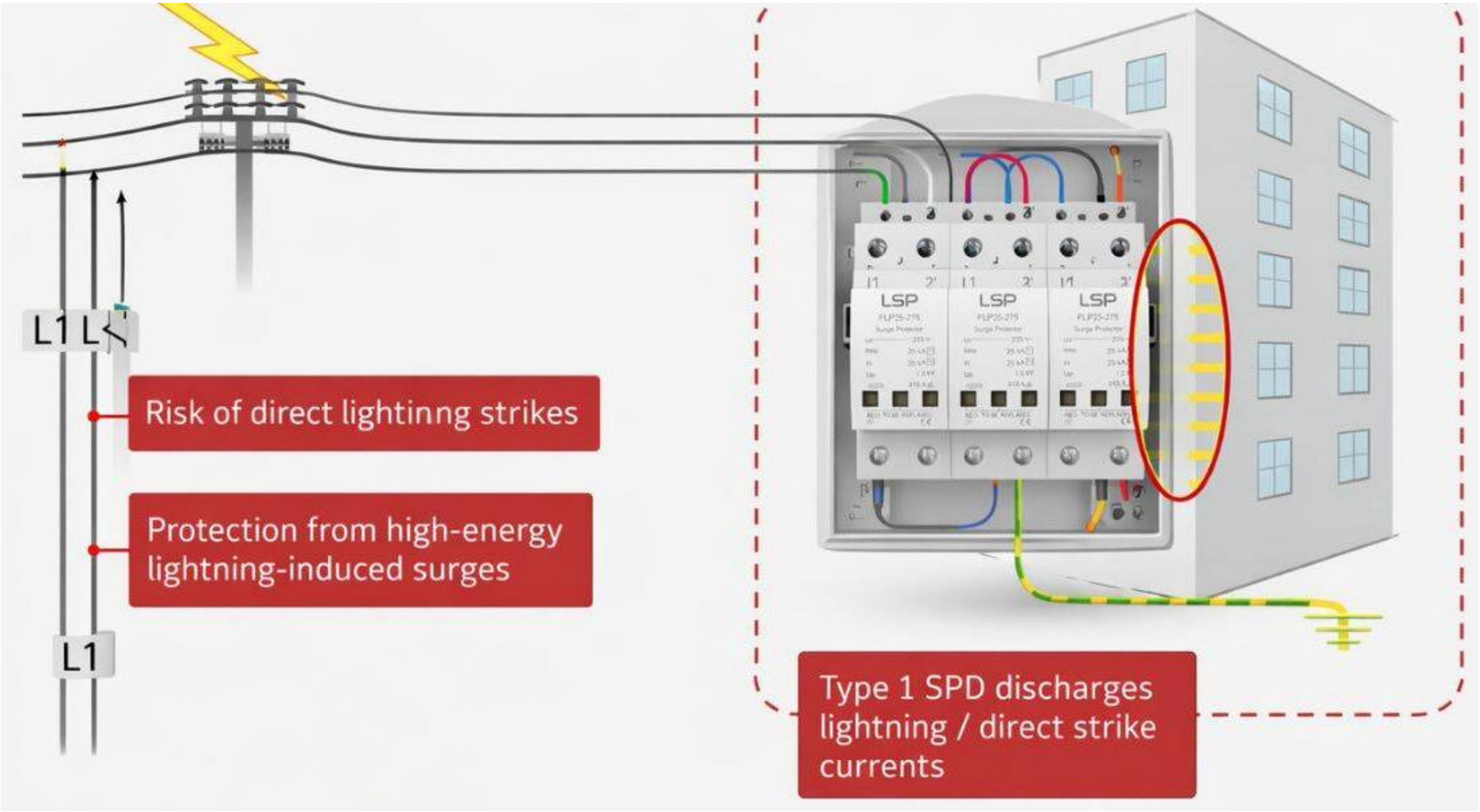
Type 3 SPD Surge Protector TLP-60/2S



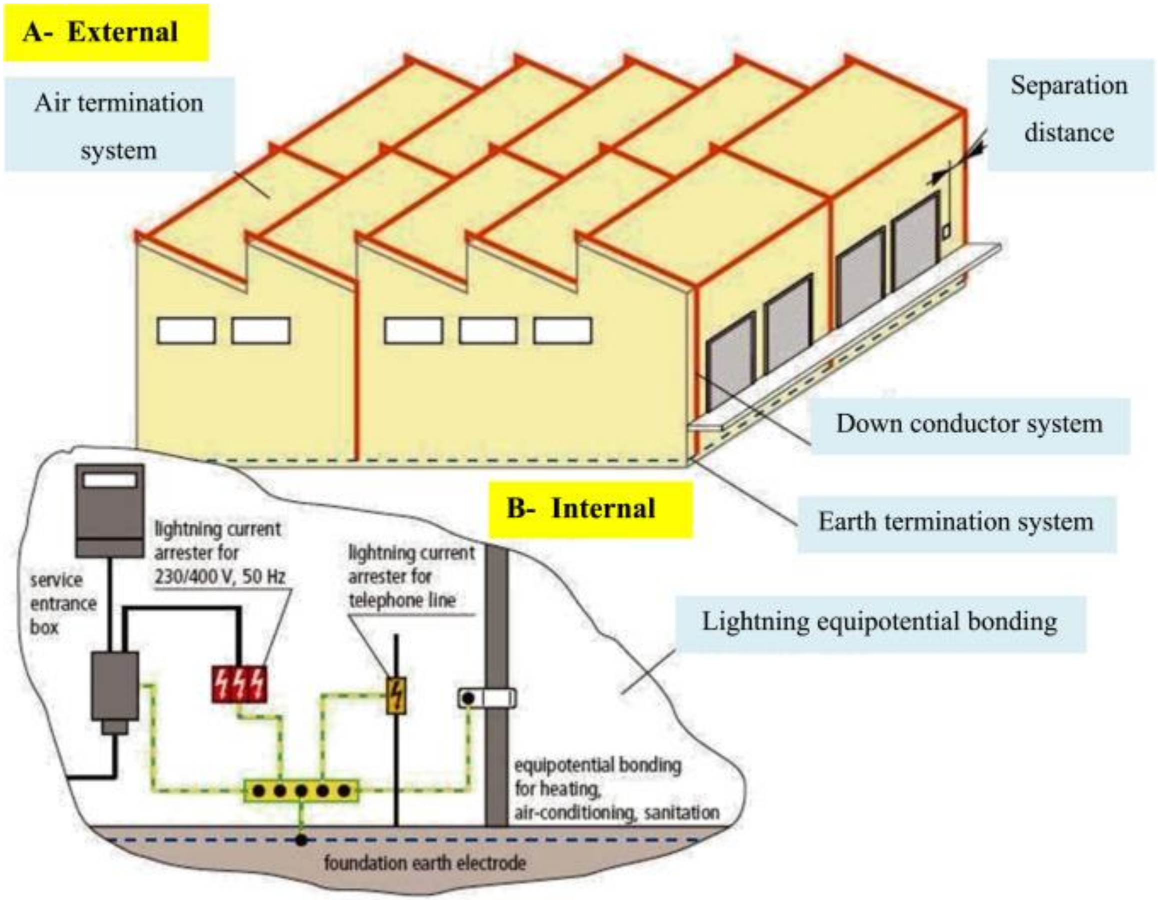
What is SPD?
Protects against transient overvoltage

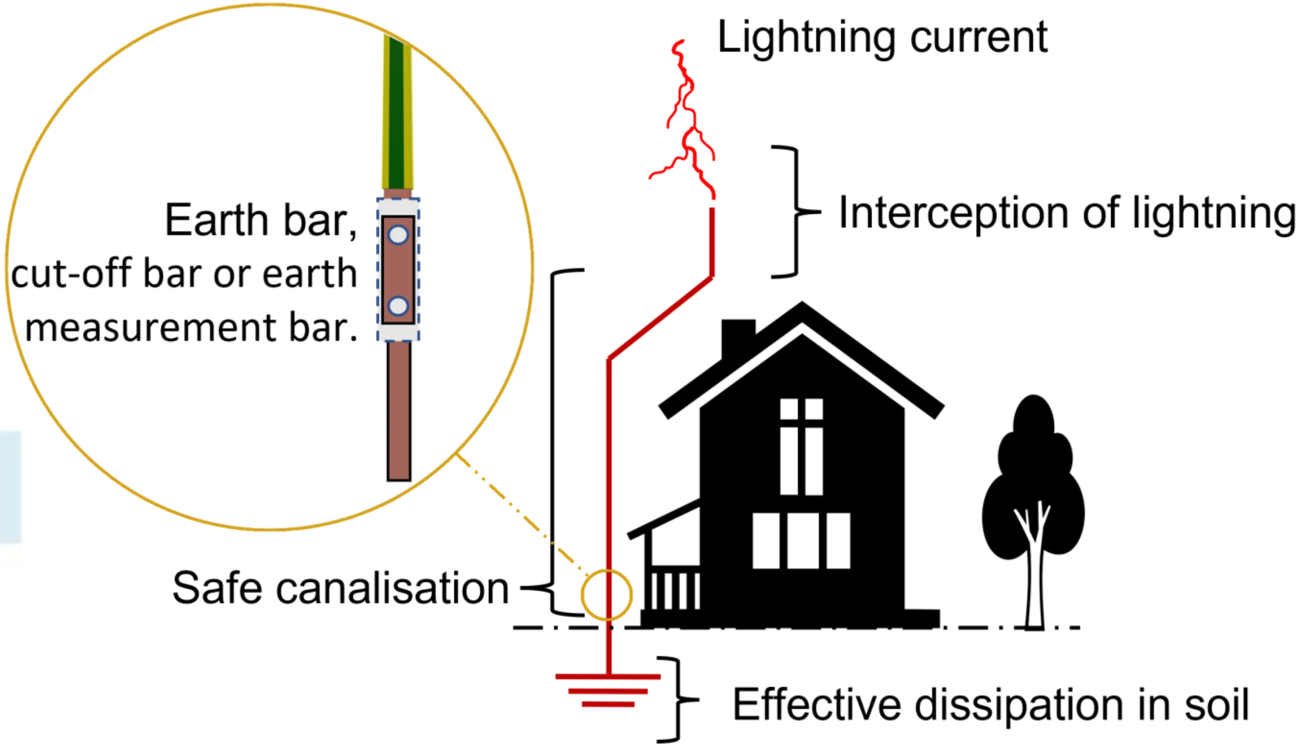
Industrial & Plant Protection

- Control panel SPD
- Sensitive equipment protection



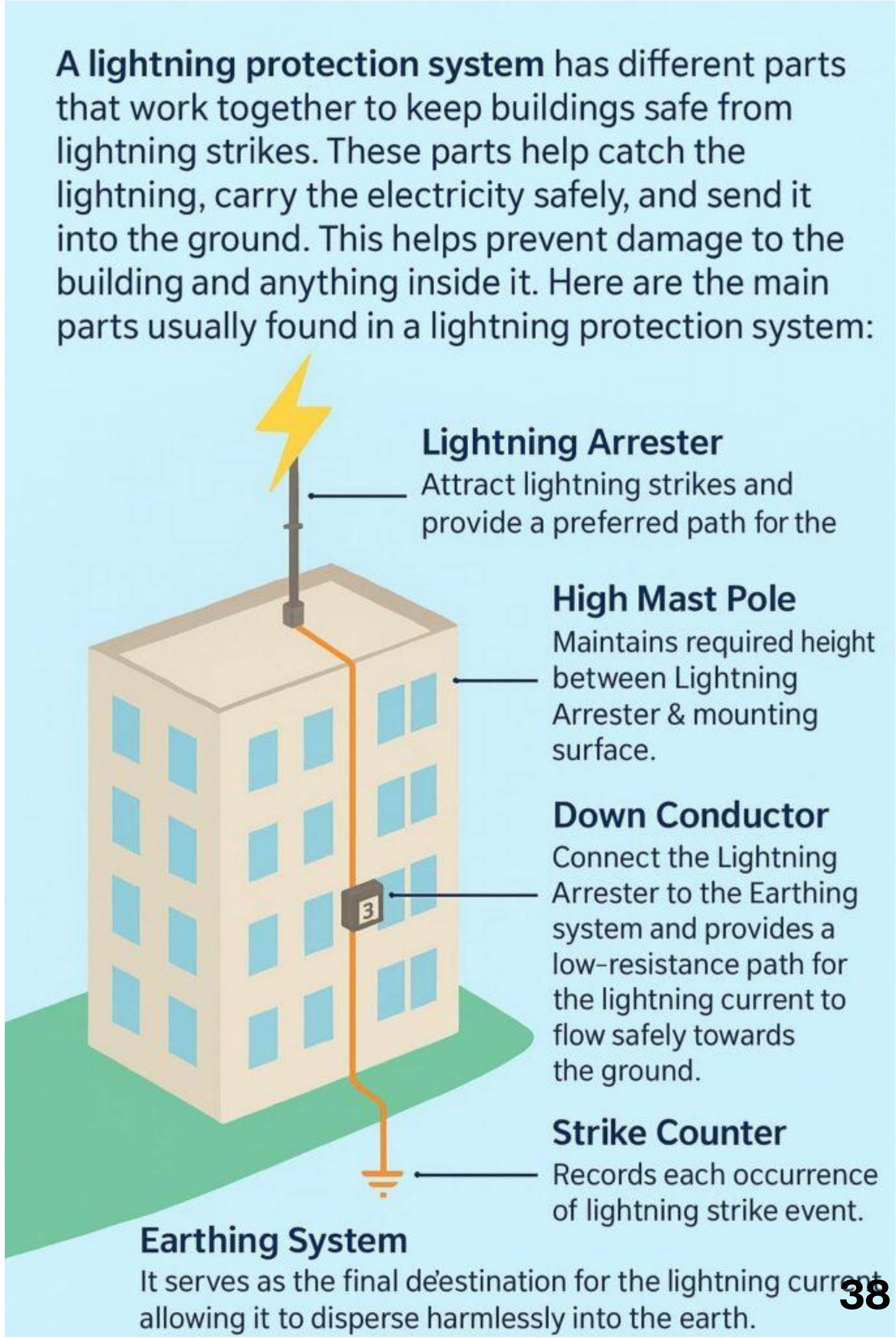
❖ Internal LPS





Building Protection

- ➢ High-rise lightning rods
- ➢ Earthing systems
- ➢ Equipotential bonding

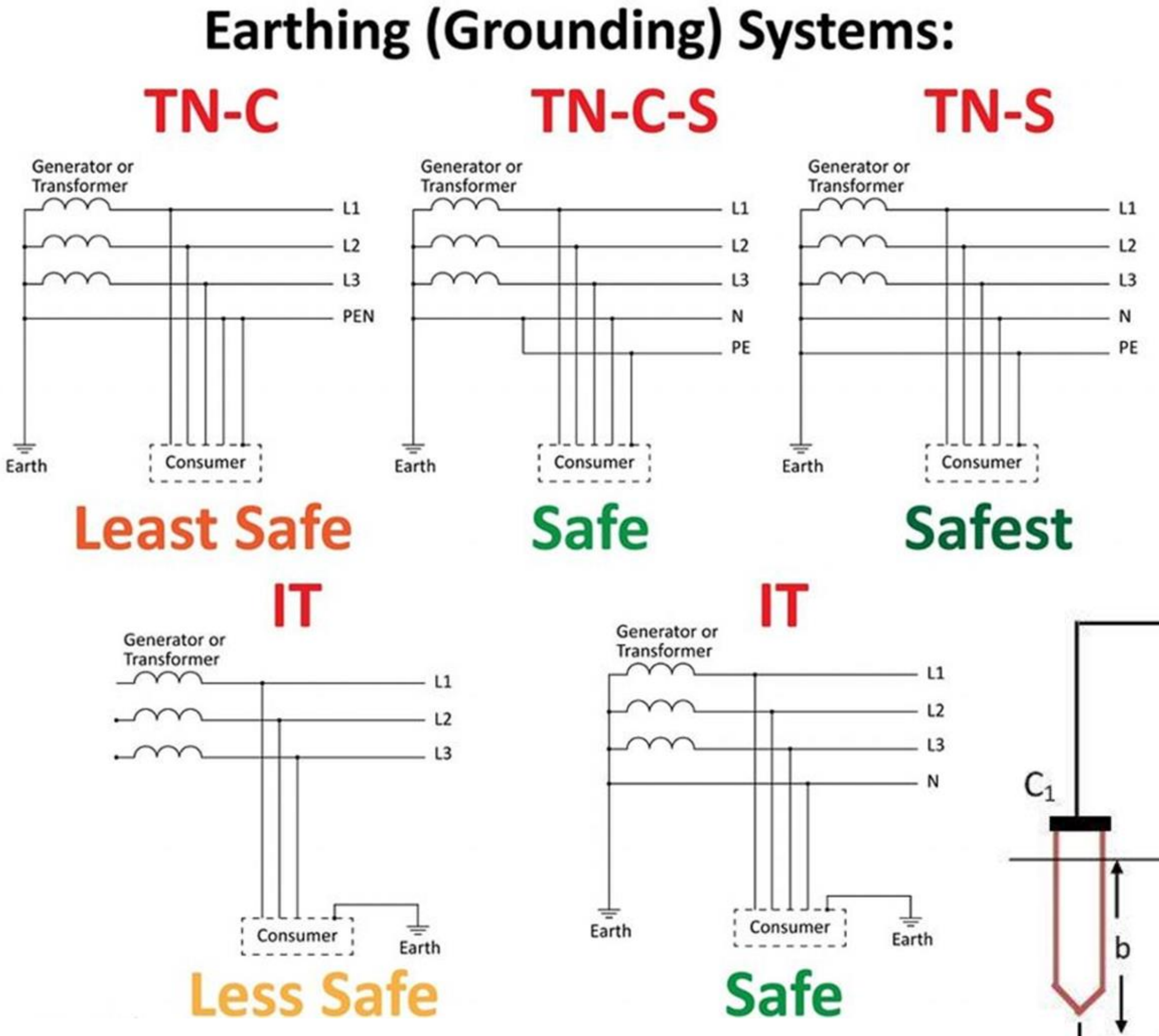


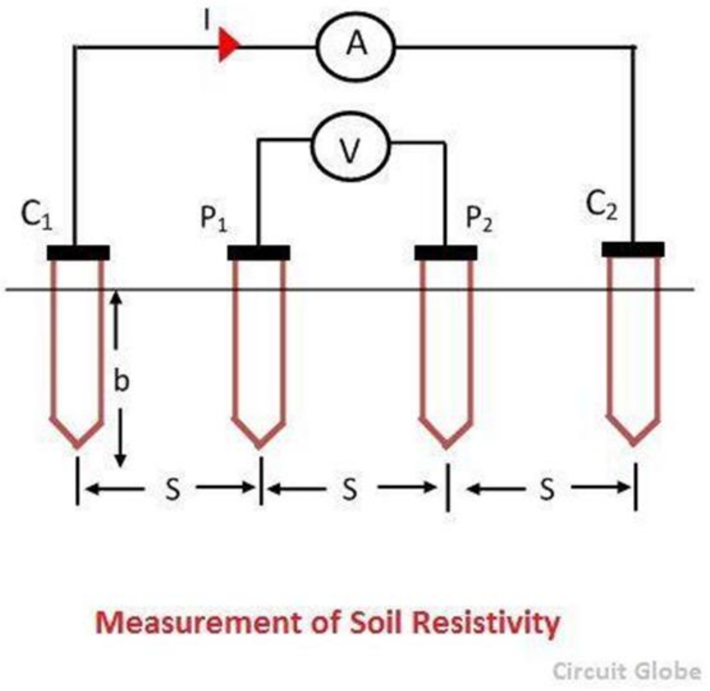
Importance
- Dissipates lightning energy
- Reduces step & touch voltage

Grounding Types
- TT, TN, IT systems

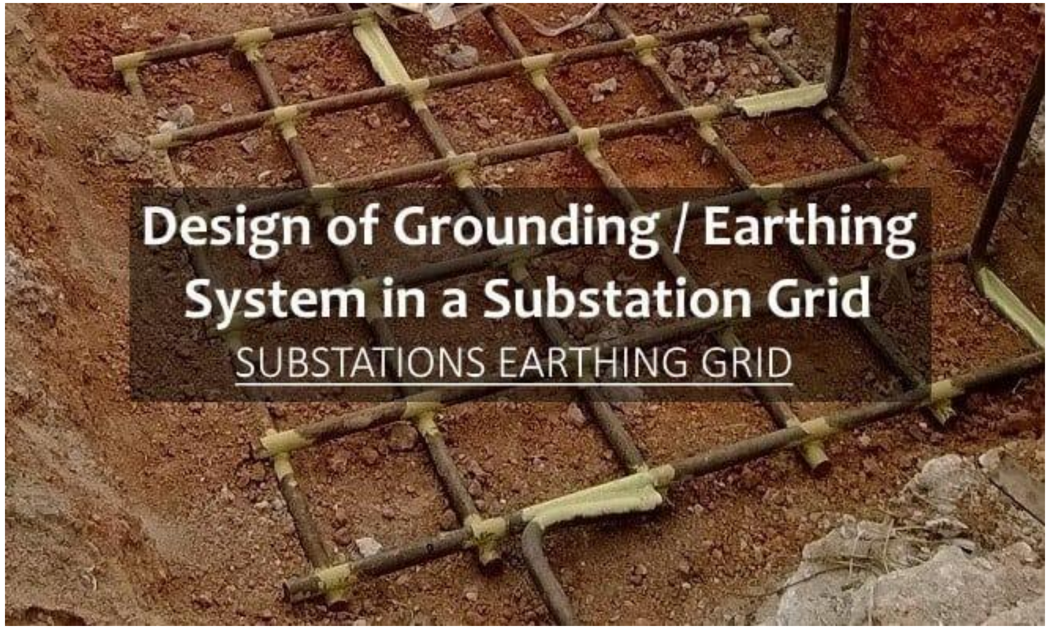
Design Considerations
- Soil resistivity
- Electrode depth
- Grid design

Best Practices
- Earth resistance < 5 ohm
- Regular testing
- Bonding

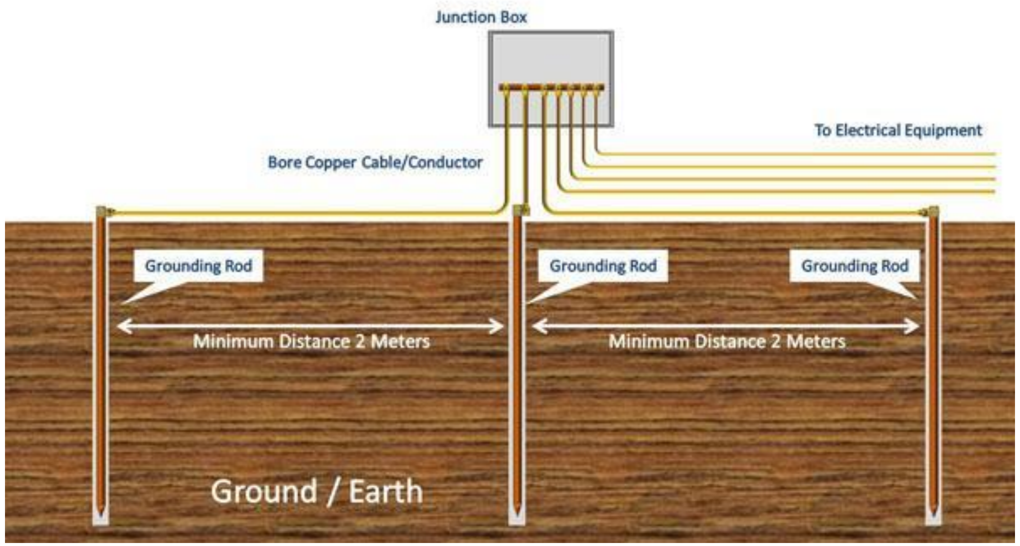


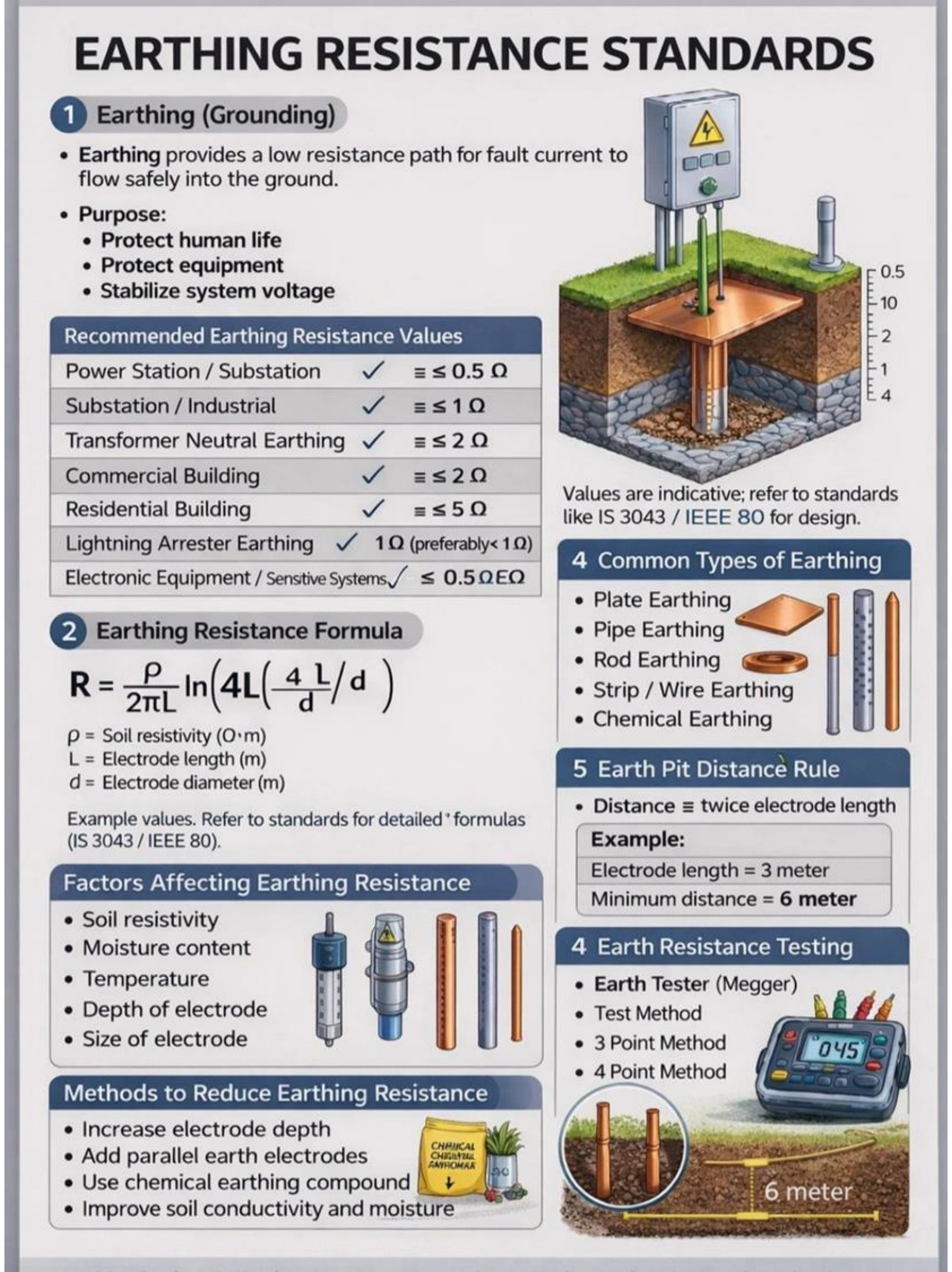


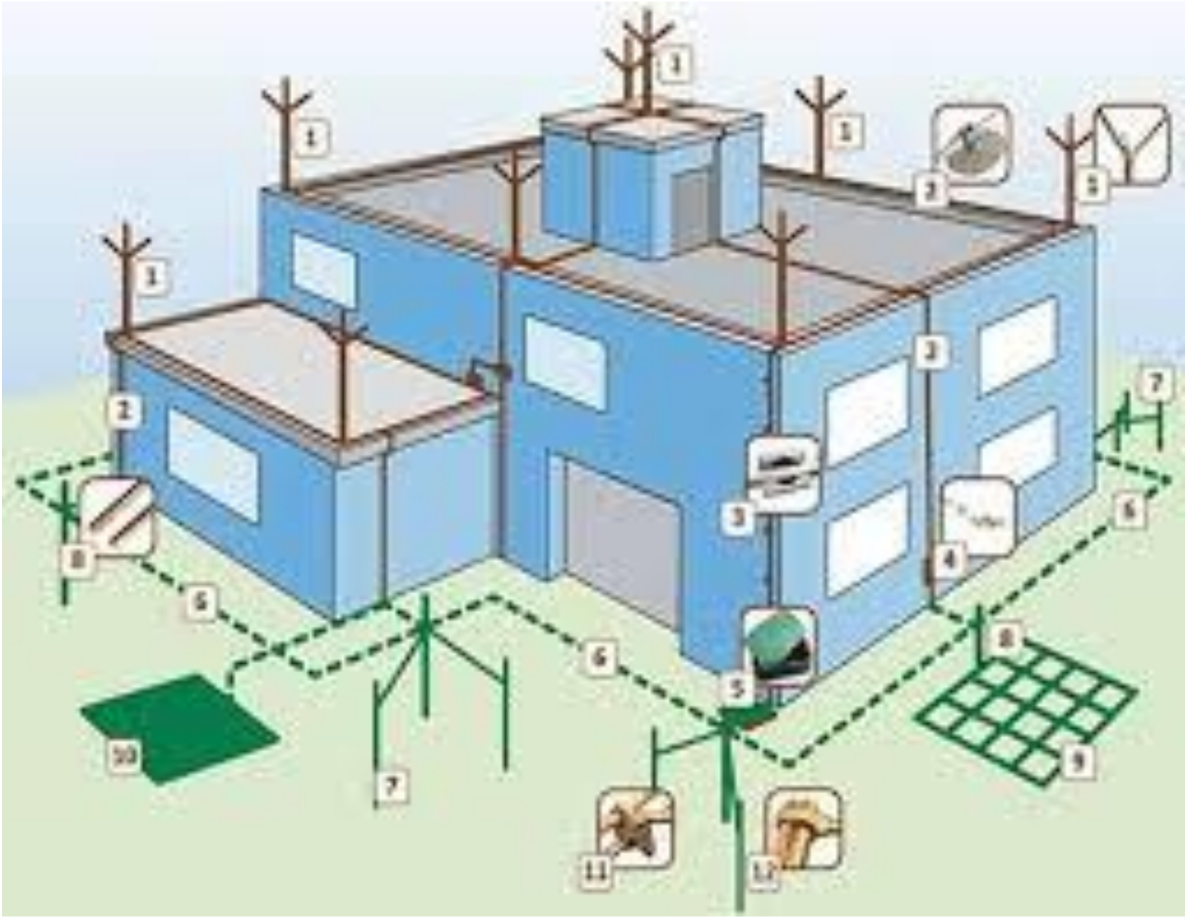
GROUNDING SYSTEM



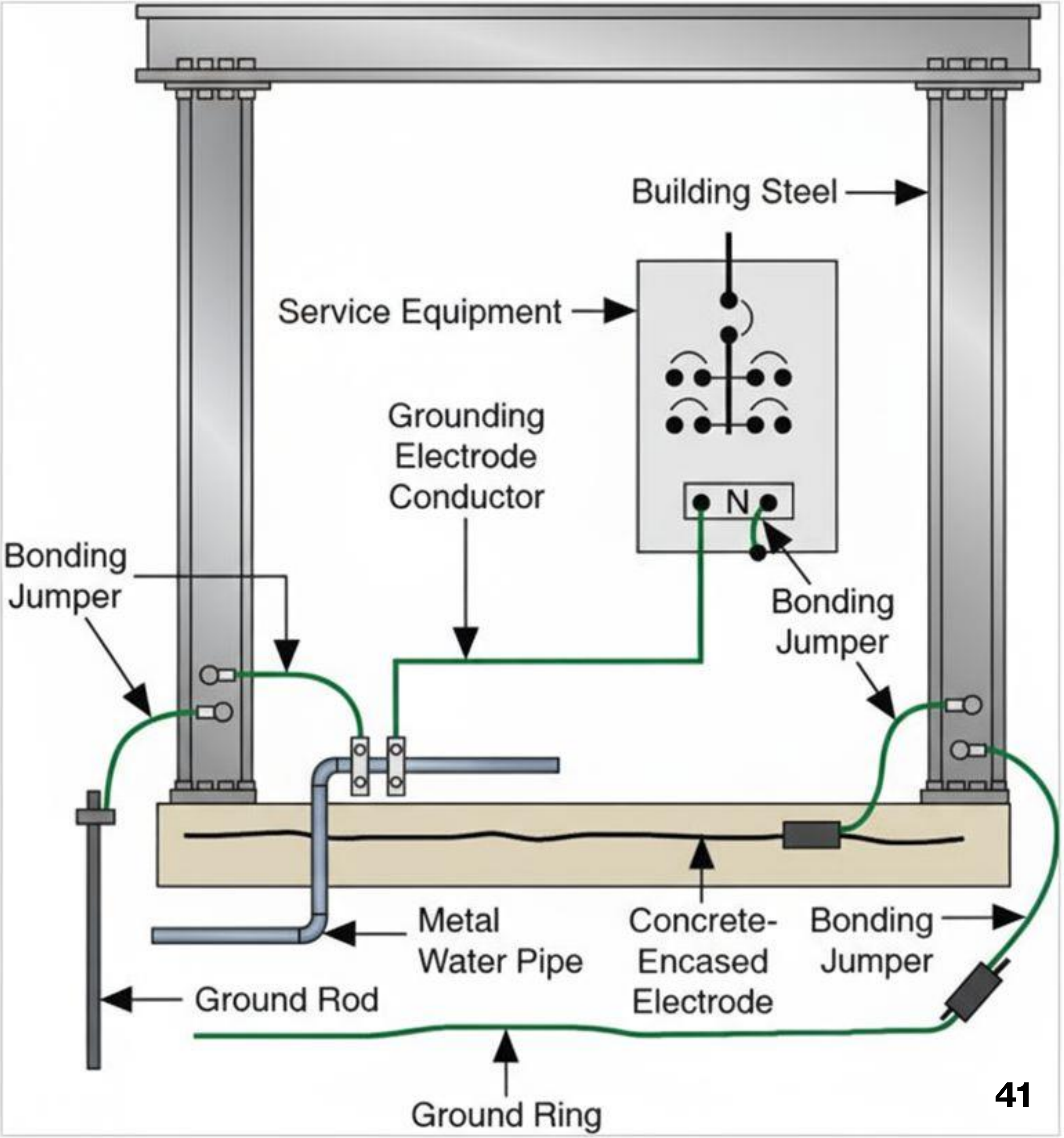
Planting 3 Points of Grounding Rod







Equipotential Bonding



What Is a Lightning Protection System?
5 Key Components

- ❖ A network of components installed on a building to safely intercept, conduct, and dissipate direct lightning strikes into the ground.
- ❖ It protects structures from fire, structural collapse, and electrical damage.
- ❖ The 5 core components per IEC 62305 are: air terminals, down conductors, grounding electrodes, bonding connections, and surge protective devices (SPDs).

1. Air Terminals (Lightning Rods)

- ➢ Air terminals are vertical metal rods installed at the highest points and edges of the roof.
- ➢ Through geometric field enhancement, the pointed conductor concentrates the electric field during a thunderstorm, promoting upward streamer formation that intercepts the downward lightning leader.
- ➢ Per NFPA 780, copper air terminals must be a minimum 1/2 inch (1.27 cm) in diameter and 10–24 inches tall.
- ➢ Placement follows the rolling sphere method or mesh/grid method to ensure complete coverage of the roof surface.

2. Down Conductors

- Down conductors are the primary current-carrying cables connecting air terminals to the grounding system.
- NFPA 780 specifies a minimum of AWG #2 copper (220 mm^2) or AWG #1/0 aluminium (350 mm^2).
- Installations require at least one down conductor every 100 feet of building perimeter, routed as directly as possible with minimal bends.
- Where mechanical damage is possible, conductors are protected in PVC conduit.
- Multiple conductors reduce the current carried by each individual path, limiting the voltage rise at the grounding electrodes during a strike event.

3. Grounding System

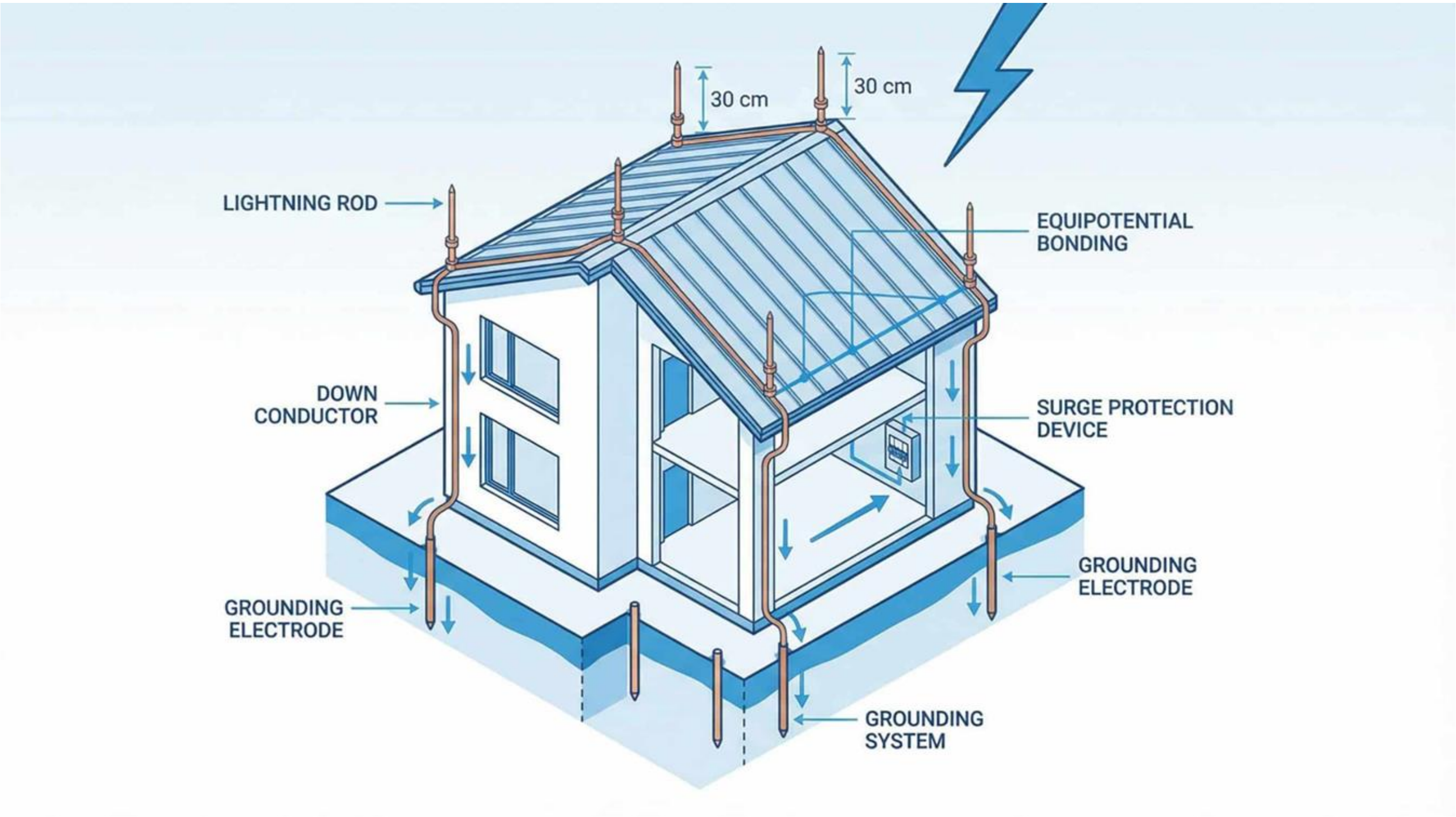
- The grounding system is where lightning energy is safely transferred to the earth.
- A compliant system consists of copper-clad steel ground rods driven a minimum of 8 feet (2.4 m) deep — preferably 10 feet (3 m) — at each down conductor termination.
- IEC 62305-3 and NFPA 780 both require a ground resistance target below 10 Ω.
- In rocky or sandy soils with high resistivity, achieving this target may require multiple rods, longer rods, or chemical ground enhancement.
- Ground resistance is verified by professional testing during commissioning and every 3–5 years thereafter.

4. Bonding Connections

- Bonding connects all large metallic objects on the building — HVAC units, metal roofing, plumbing vents, satellite dishes, structural steel — to the lightning protection system through equipotential bonding conductors.
- Without bonding, the voltage difference between the lightning protection system and nearby metallic objects during a strike can cause a dangerous side flash: a secondary arc discharge that can ignite fires or injure occupants. IEC 62305-3 Clause 6 defines the bonding requirements.
- Bonding is required at every level where metallic objects are present.

5. Surge Protective Devices (SPDs)

- SPDs are the internal component of a complete lightning protection system.
- Installed in the electrical panels, they use Metal Oxide Varistors (MOVs) that switch from high-impedance (>1 MΩ) to low-impedance (<1 Ω) in under 25 nanoseconds when voltage exceeds the protection level.
- A coordinated three-tier strategy is required per IEC 62305-4:



- Lightning strikes Earth approximately 8 million times per day — around 6,000 strikes per minute.
- Strike carries up to 1 billion volts and generates temperatures of 30,000 Kelvin, five times hotter than the sun's surface.
- Without a properly engineered **lightning protection system**, that energy seeks the nearest conductive path to ground: your building's structural steel, electrical wiring, plumbing, or gas lines.

How Lightning Protection System Works

A lightning protection system manages the energy of a lightning strike through a four-step sequence. Each step is handled by dedicated components working in coordination:

Step 1 — Interception: Air terminals (lightning rods) installed at the highest points of the roof create preferred strike points. When a downward lightning leader approaches, the air terminal intercepts it before it reaches vulnerable areas such as chimneys, vents, roof edges, or HVAC equipment.

Step 2 — Conduction: Down conductors — heavy-gauge copper or aluminium cables bonded to the air terminals — carry the full lightning impulse current (100–200 kA) safely down the exterior of the building. Multiple parallel paths distribute the current and provide redundancy.

Step 3 — Dissipation: The current reaches the grounding system — an array of electrodes driven deep into the earth. These electrodes dissipate the lightning energy into the ground, away from the building, its occupants, and all connected utilities. IEC 62305-3 requires ground resistance below 10 Ω.

Step 4 — Surge Protection: Even when the external system performs perfectly, electromagnetic induction from the strike can generate transient overvoltages within the building's wiring. Surge protective devices (SPDs) installed at the electrical service entrance and distribution panels suppress these induced voltages before they reach sensitive equipment.

Why Step 4 Is Non-Negotiable: Steps 1–3 handle the direct strike. Step 4 handles the electromagnetic consequence of that strike – induced surges that propagate through every cable in the building at near-light speed. IEC 62305-4 makes coordinated SPD installation mandatory when external lightning protection is present. A system without SPDs is an incomplete system.

Complete Lightning Protection System — 5 Required Components

Per IEC 62305 Series and IEC 61643-11

5 Surge Protective Devices (SPD)

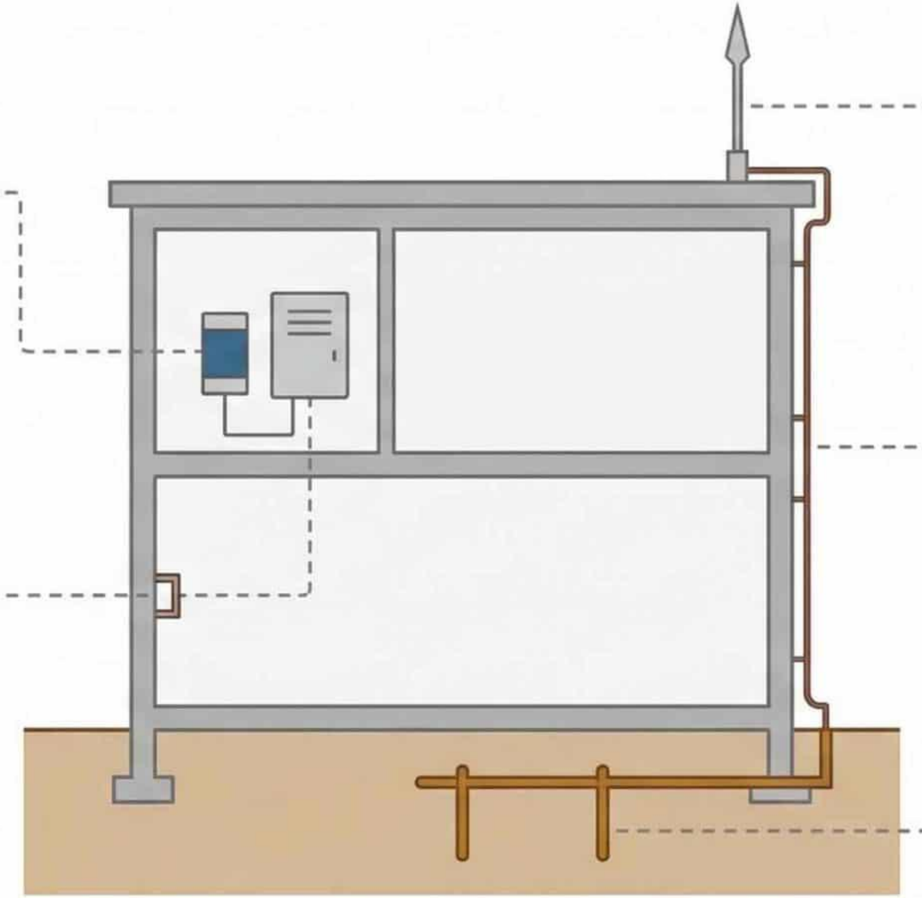
Suppress induced transient overvoltages in circuits

✓ **Mandatory per IEC 62305-4 when LPS is installed**

4 Bonding Connections

Equalises potential across metal structures

IEC 62305-3 Clause 6



1 Air Terminals

Lightning rods intercept direct strikes

IEC 62305-3

2 Down Conductors

Carry strike current safely to ground

Copper / aluminium cable

3 Grounding System

Dissipates current into earth

Resistance < 10 Ω

Without all 5 components, the Lightning Protection System is incomplete — SPDs protect equipment from induced surges that lightning rods cannot stop

SPD Type	Installation Point	Waveform Rated	When Required
Type 1	Main service entrance	10/350 μs	Mandatory when LPS is installed
Type 2	Sub-distribution panels	8/20 μs	Recommended for all installations
Type 3	Equipment terminals	8/20 μs	Sensitive electronics, >15m from Type 2

For a full technical breakdown of SPD selection, see our Type 1 vs Type 2 vs Type 3 SPD guide.

Types of Lightning Protection Systems

System Type	Protection Method	Best For	Standard Recognition
Franklin Rod (Conventional)	Rolling sphere / protective angle method	Residential, small commercial	✅ NFPA 780, IEC 62305, UL 96A
Faraday Cage (Mesh)	Conductive grid across entire roof	Large commercial, complex roofs, critical facilities	✅ NFPA 780, IEC 62305, UL 96A
ESE (Early Streamer Emission)	Claimed extended protection zone	–	⚠ Not recognised by LPI / NFPA / UL

- ❖ The Franklin Rod system and Faraday Cage system are both fully recognised under NFPA 780 and IEC 62305.
- ❖ The ESE system remains controversial in North America — major standards bodies do not certify ESE devices, and their claimed extended protection radii are not validated by independent testing under IEC 62305.
- ❖ Verify local code acceptance before specifying ESE technology.

ENGINEERING + PRACTICAL

Risk Assessment (IEC 62305)

- Lightning risk calculation

SCHIRTEC

Lightning Risk Assessment
(Calculation of Protection Level - NFC 17-102)

Tel: +43 1 270 33 47 11
Fax: +43 1 270 33 47 49
E-Mail: info@schirtec.at

Dimensions of the structure

Maximum Length	L	50	m
Maximum Width	W	30	m
Maximum Height	H	15	m
The distance between the lightning rod and the farthest point to be protected from lightning.			m

C3 - Structural Coefficient

Non flammable	0,5
Flammable	(●) 1
Valuable or partially flammable	2
High value, highly flammable, explosive	3

C1 - Environment Coefficient

Surrounded by structures or trees of the same height or higher	0,25
Surrounded by smaller structures	0,5
No other structures within a distance equal to the height	(●) 1
Isolated on top of a hill	2

C4 - Structure Occupancy

Unoccupied	0,5
Occupied	(●) 1
Difficult evacuation	3

C2 - Structural Coefficient

Structure / Roof	Metallic	Common	Flammable
Metallic	(●) 0,5	1	2
Common	1	1	2,5
Flammable	2	2,5	3

C5 - Lightning Consequences

Service continuity not required	1
Service continuity required without consequences	(●) 5
Consequences on the environment	10

Annual Average Thunder Days

Dimensions of the structure

Maximum Length	L	50	m
Maximum Width	W	30	m
Maximum Height	H	15	m
The distance between the lightning rod and the farthest point to be protected from lightning.			m

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Structure / Roof	Metallic	Common	Flammable
Metallic	(●) 0,5	1	2
Common	1	1	2,5
Flammable	2	2,5	3

C5 - Lightning Consequences

Service continuity not required	1
Service continuity required without consequences	(●) 5
Consequences on the environment	10

Annual Average Thunder Days

Annual Average Thunder Days (World Map)	30

Exit | Clean | Example | Calculate

•Protection levels (LPL I–IV)

Lightning Protection Levels (LPL I–IV) Parameters

The calculation defines the **Lightning Protection Level** (LPL I to IV), imposing maximum (current) and minimum (virtual sphere radius) technical parameters.

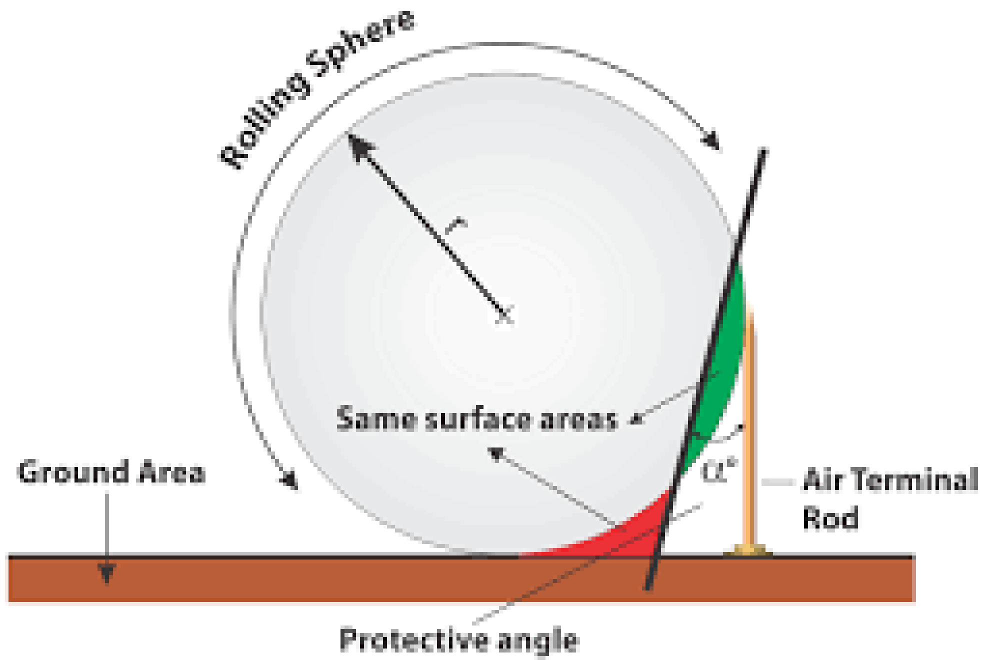
The choice of LPL determines the required efficiency

Protection Level (PLL)	Effectiveness of protection	Radius of the fictitious sphere (m)	Maximum peak current (kA)
LPL I	98 %	20 m	200 kA
LPL II	95 %	30 m	150 kA
LPL III	90 %	45 m	100 kA
LPL IV	80 %	60 m	100 kA

For an LPL I site, the **characteristics** device's ELLIPS offers extended coverage areas and certified reliability, protecting **structures** and **electrical**

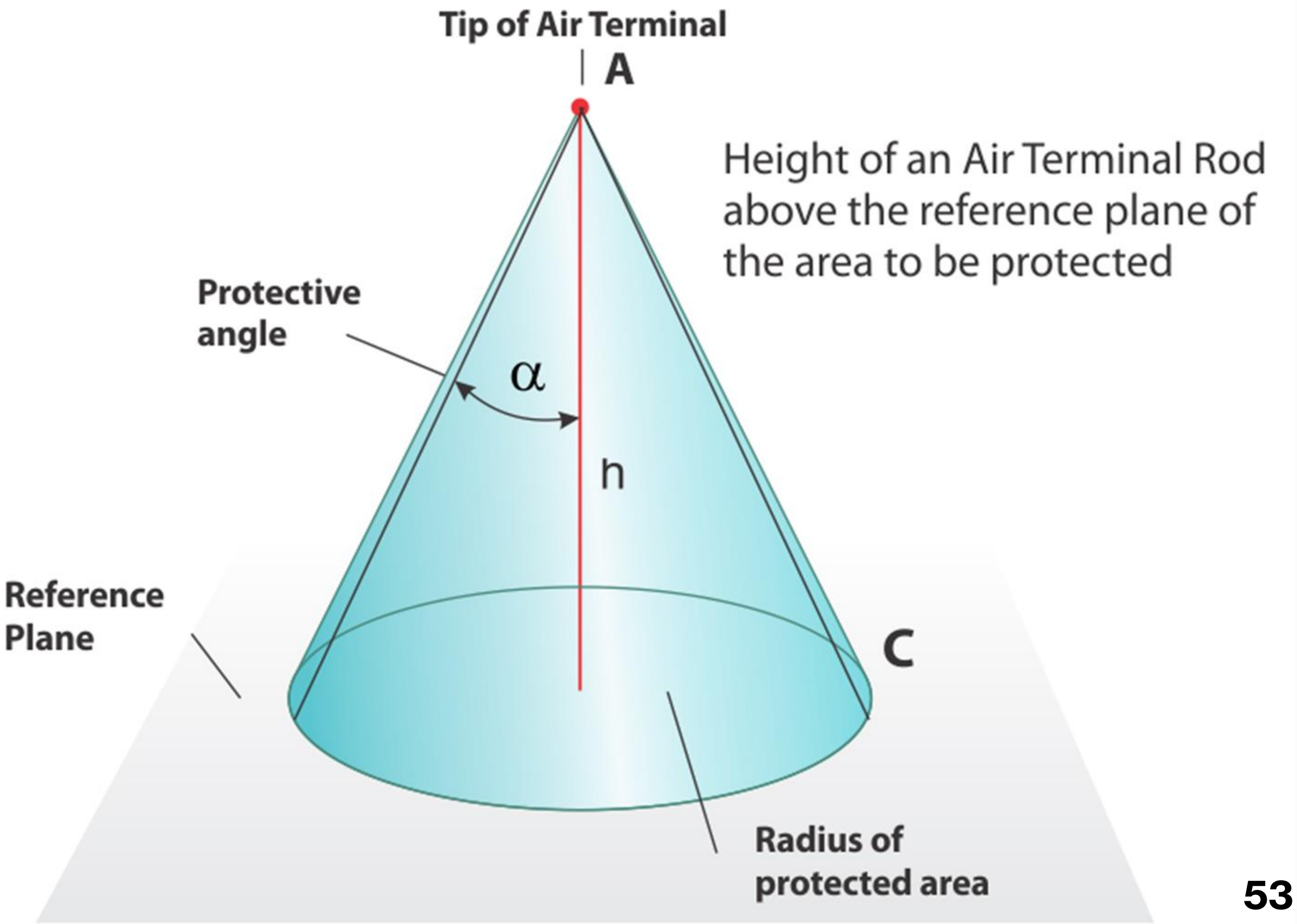
Design Methods

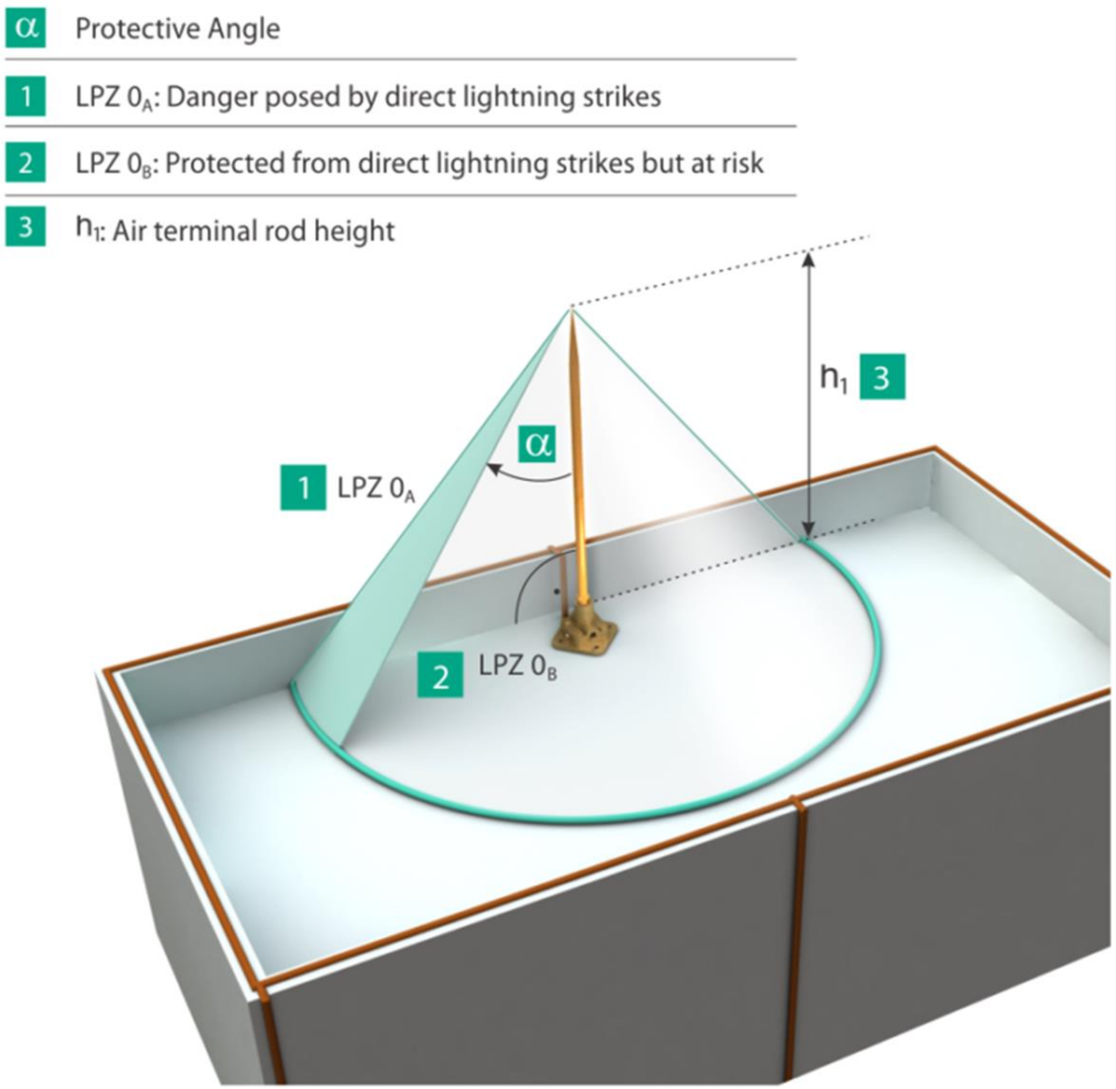
- Rolling Sphere Method
- Protective Angle Method
- Mesh Method



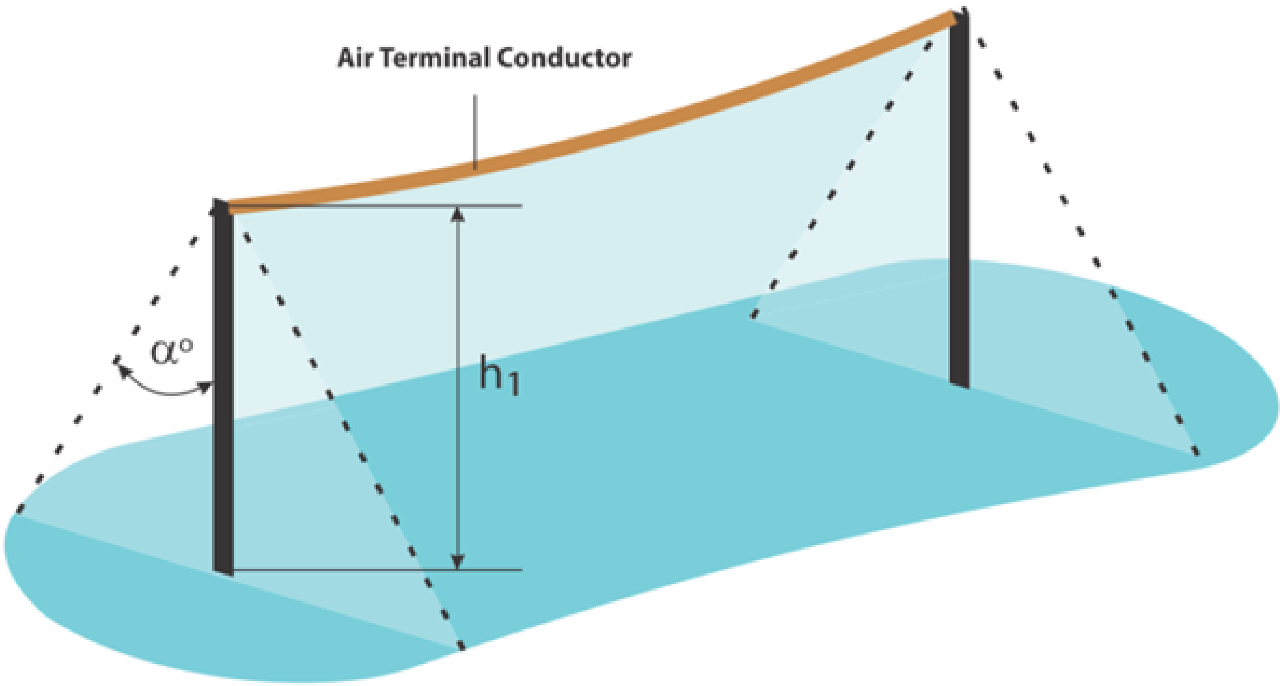
Protective angle and comparable radius of the rolling sphere

Protective angle method for a single air rod





Protected area of an Air Termination rod calculated with simplified protective angle method

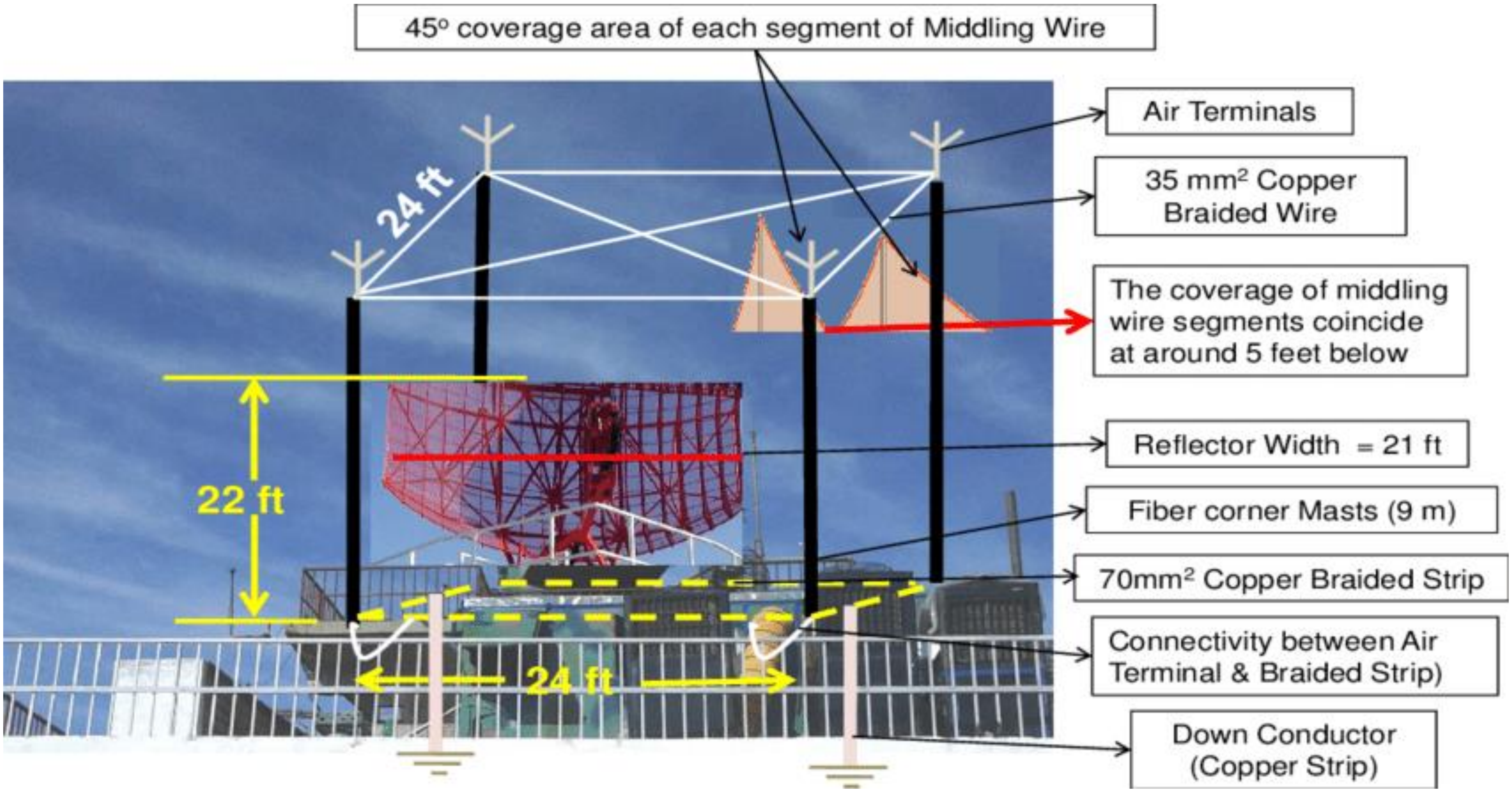


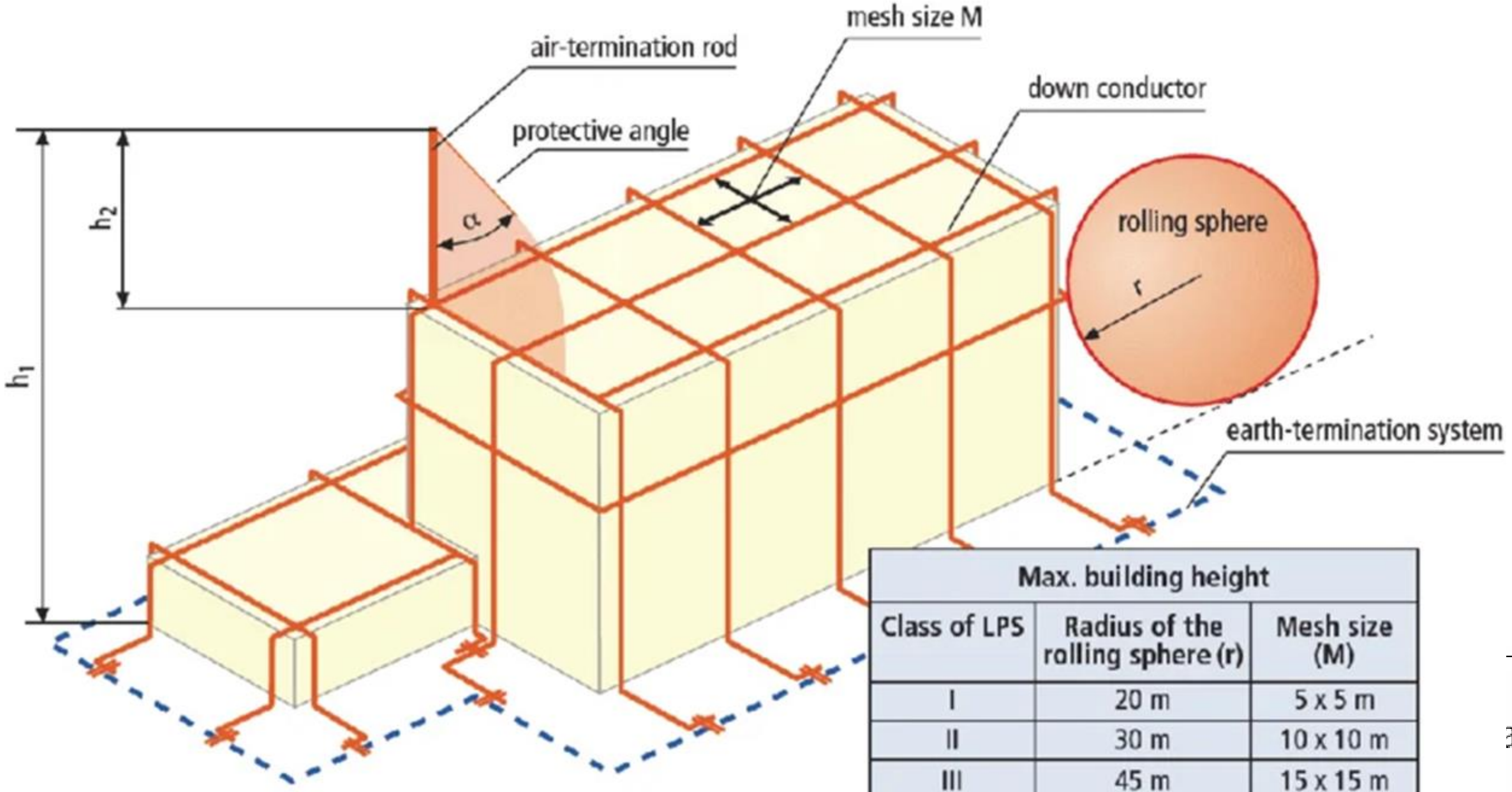
Angle α depends on class of LPS and height of the Air Termination conductor above ground

Volume protected by an Air-termination conductor

Lightning protection class	Protective angle α for air-termination roads up to 2 m in length
I	70°
II	72°
III	76°
IV	79°

Protective angle based on lightning protection class according to IEC 62305-3 (VDE 0185-305-3) for air-termination rods up to 2 m in length


45° coverage area of each segment of Middling Wire
Air Terminals
35 mm² Copper Braided Wire
The coverage of middling wire segments coincide at around 5 feet below
Reflector Width = 21 ft
Fiber corner Masts (9 m)
70mm² Copper Braided Strip
Connectivity between Air Terminal & Braided Strip)
Down Conductor (Copper Strip)
24 ft
22 ft
24 ft



Max. building height		
Class of LPS	Radius of the rolling sphere (r)	Mesh size (M)
I	20 m	5 x 5 m
II	30 m	10 x 10 m
III	45 m	15 x 15 m
IV	60 m	20 x 20 m

ass of LPS	Mesh Size [m]	Minimum Current Standards [kA]	Critical height of mesh above the structure [m]
I	5 x 5	3	0.15
II	10 x 10	5	0.42
III	15 x 15	10	0.63
IV	20 x 20	15	0.84

STANDARDS

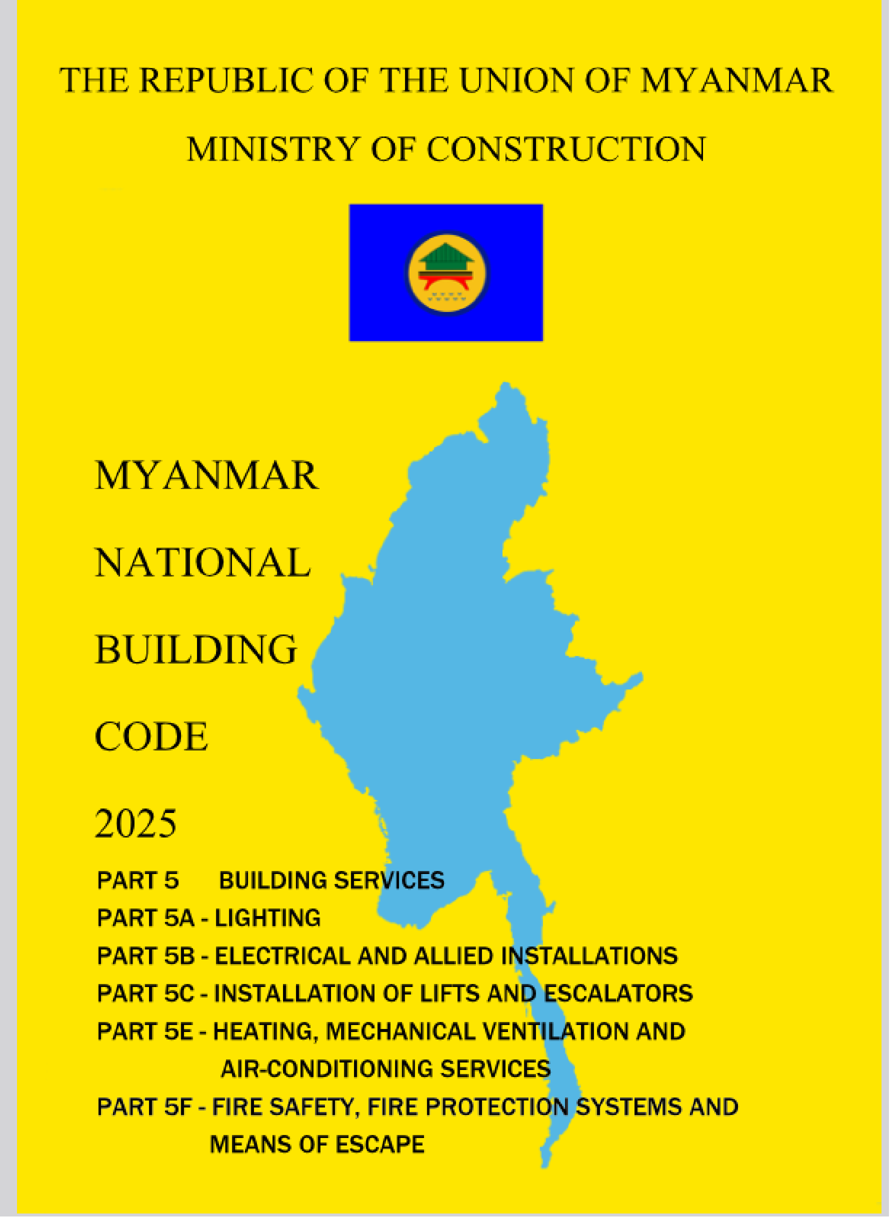
International Standards

- ❖ IEC 62305
- ❖ IEEE Std 998
- ❖ IEEE C62 series
- ❖ IEEE Std 80

1. IEC 62305 - Protection Against Lightning
2. IEEE Std 998 - Direct Lightning Stroke Shielding of Substation
3. IEEE C62 Series - Surge Protection (North America)
4. **IEEE Std 80** - Safety in AC Substation Grounding

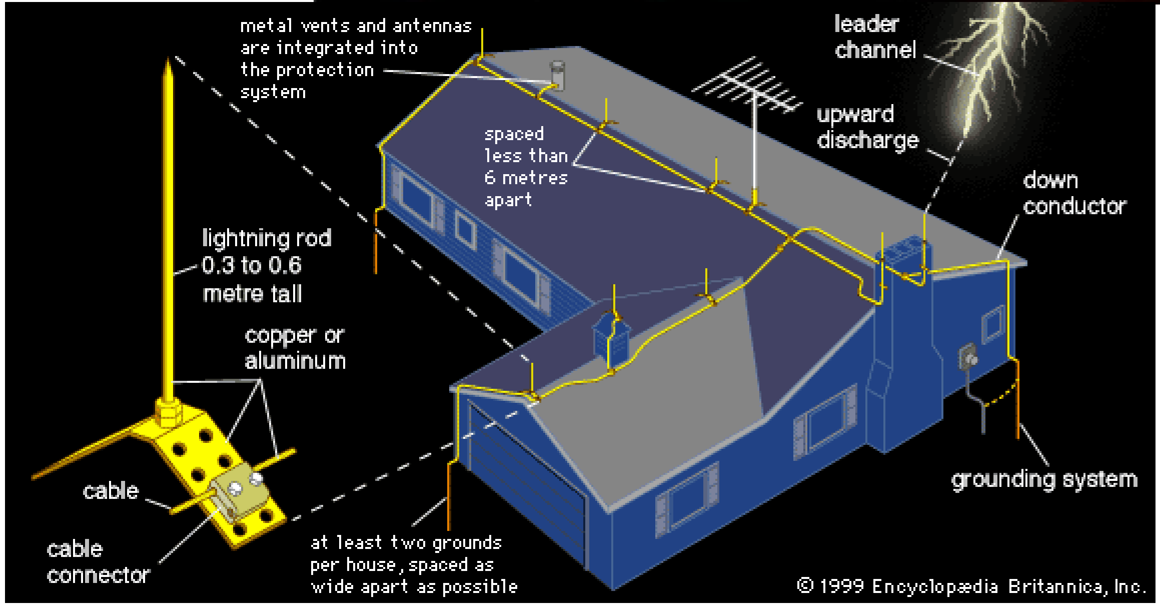
Need for Local Adaptation

- ❖ Myanmar conditions (MNBC-2025)
- ❖ Climate & soil



Case Study

- Lightning damage example
- Cause: poor grounding
- Solution: SPD + earthing upgrade



Common Problems in Myanmar

- High earth resistance
- No SPD installation
- Poor maintenance

Engineering Solutions

- Proper grounding design
- SPD coordination
- Regular inspection

Economic Impact

- Equipment replacement cost
- Downtime losses
- Protection is cost-effective

Future Trends

- Smart grid protection
- Monitoring systems
- Advanced surge protection

CHALLENGES & RECOMMENDATIONS

- **Challenges**
  - Poor grounding
  - Lack of awareness
  - Maintenance issues

- **Recommendations**
  - Proper design
  - Training
  - Regular inspection

Key Takeaways

- Lightning protection is essential
- Multi-layer protection required
- Design + maintenance = success

Do You Need a Lightning Protection System?

Not every building requires external lightning protection. IEC 62305-2 provides the formal risk assessment methodology.

The key inputs are structure height, geographic keraunic level (average thunderstorm days per year), occupancy type, and consequence of failure.

Structures that exceed the calculated risk threshold require a compliant lightning protection system.

As a practical guide, the following buildings should be assessed and typically require external protection:

- Industrial facilities with PLCs, VFDs, SCADA systems, or process control equipment — see our industrial surge protection guide
- Structures over 20–30m in height or taller than surrounding buildings
- Buildings in regions with more than 25 thunderstorm days per year
- Isolated structures on hilltops, open fields, or near water
- Data centres and critical infrastructure — see our data centre surge protection guide
- Agricultural structures: barns, silos, and processing facilities
- Historic buildings and structures with irreplaceable contents
- Facilities storing flammable or explosive materials

Even where external lightning protection is not mandated by code,

SPD installation is always recommended — switching transients from the utility grid and nearby lightning strikes cause equipment damage independently of direct strike risk.

Conclusion

- Improve safety
- Increase reliability
- Support sustainable power system
- Lightning protection = reliability + safety
- Essential for modern power systems

Related Resources

- Lightning Arrester vs Surge Arrester: Why Facilities Need Both
- Type 1 vs Type 2 vs Type 3 SPD — Selection Guide
- Power Panel Surge Protection: Service Entrance SPD Guide
- Air Terminal Selection Guide — IEC 62305-3 Compliance
- IEC 61643-11 Surge Protective Devices Standards Reference
- When to Replace a Surge Protector: 5 IEC-Based Criteria


Q&A

Thank you