CHUBB

To The Point
Lightning Protection

Lightning protection for electrical systems, equipment, and buildings is complex due to its potential for severe damage. Lightning can travel at 200,000 mph[1] and reach temperatures of 50,000°F[2]. With an estimated 1.4 billion lightning flashes annually worldwide and an average of 44 strikes every second, lightning strikes cause about 2,000 deaths[2] and billions in property damage each year. These costs are increasing due to more sophisticated and delicate electronic devices.

Lightning Myths

There are several myths surrounding lightning. The most common are:

- Lightning never strikes the same place twice.
- Lightning always strikes the highest point.
- Lightning always travels downward from cloud to ground.

Insurance Claims

Insurance claims data figures resulting specifically from lightning are difficult to obtain since many lightning damage claims are often coded as "Electrical Loss." That is why it is important to determine the root cause of the loss. Several websites, including the National Oceanic and Atmospheric Administration, are available to determine if lightning was in the area at the time of the reported claim.

Standards

The National Fire Protection Association (NFPA) 780 is the standard for installing lightning protection systems. Annexes D & E cover these systems' maintenance, inspection, and testing requirements. Testing, inspection, and maintenance of lightning protection systems can also be based on the International Electrotechnical Commission (IEC) 62305-3 Lightning Protection Standard. The Institute of Electrical and Electronic Engineers (IEEE) standard 142 is the Recommended Practice for Grounding of Industrial and Commercial Power Systems. IEEE Standard 1100 is the Recommended Practice for Powering and Grounding Electronic Equipment.

System Installation

A certified lightning protection system must be installed, tested, and maintained by specially trained professionals to protect assets from the devastating effects of lightning. Certification is either from Underwriters Laboratories (UL) or the Lightning Protection Institute (LPI). These systems do not repel or attract lightning but intercept and guide it harmlessly into the earth. These systems are made up of several components:

- **Air Terminals**, also known as lightning rods – slender rods installed on the roof regularly.
- **Conductors** – aluminum or copper cables that interconnect the air terminals and other system components.
- **Ground Terminations** – metal rods driven into the earth to guide the lightning current to the ground.
- **Surge Arrestors and Suppressors** – devices installed with a lightning protection system to protect electrical wiring and electronic equipment.

Protective Measures

It is important to have a documented annual inspection of your lightning protection system. The lightning protection system should have a documented full visual inspection annually and a detailed inspection performed every five years by a certified company to ensure the system will function properly.

Below is a list of building areas of concern that should be evaluated during a risk assessment:

- Conductors are securely connected to the air terminal.
- Conductors, fasteners, and air terminals should never be painted.
- Hardware connections are tight and adhesive fasteners secure.
- Hardware should be inspected at least once per year.

- The downlead cable must be connected to the grounding electrode.
- The grounding electrode should be checked with an impedance device; resistance is expected to be less than 50 ohms with normal soil conditions.
- Minimum of two ground points separated by at least 10 feet.
- A maintenance program is in place to identify and correct potential problems.
- All rooftop-mounted equipment, including A/C units, roof drains, ladders, stairways, stacks/vents, etc., should also be connected to the grounding system.
- Antennas must be protected from lightning since the antenna cables lead directly to electronic equipment. The tower should be grounded separately from the cables.
- Substations/transformers, wind turbines, and solar arrays may need their systems installed.

Surge Protection

Protecting assets such as motors, medical diagnostic equipment, and other electronics inside the building requires additional protection since building systems are not specifically designed to protect them. Modern electronics are particularly vulnerable due to having sensitive microprocessors and solid-state electronic components. These can be damaged with a slight variation in the electrical source voltage, known as a "surge." As such, any lightning protection system should include surge protection devices.

Surge protection should be at the main power source, such as the building power head, while transient voltage surge suppressors should be used at the electrical devices. IEEE recommends three levels of protection for critical equipment: one at the incoming power connection, one coming out of the main switchgear, and one at each piece of "critical" equipment. The definition of "critical" equipment is left up to the owner to decide. During risk assessments, you should ensure all equipment with a high Property Damage (PD), or large Business Interruption (BI) potential is adequately protected from voltage surges. It has been noted that surge protection supplied by some manufacturers as part of the internal circuitry is insufficient to protect equipment due to the allowable "pass-through voltage."

Below is a list of equipment areas of concern that should be evaluated during an assessment:

- Provide surge protection at the main power source for the building.
- Protect each computer, server, or "critical" equipment.
- Protect all communication lines including low-voltage systems.
- Review maintenance policy to ensure all systems are connected and in good working order.
- All electronic protection should be UL-1449 tested and meet ANSI/IEEE/ISO-09000 test standards. It should be labeled if it meets these standards. This label can be found on ground connector cables and other equipment.

Importance of Lightning Protection

Given the common nature of lightning and its devastating effects, every facility should complete a lightning risk assessment and protect its assets accordingly. Even with a certified lightning protection system in place, a loss could still occur. However, with such a system's installation and proper maintenance, the likelihood and severity of a lightning damage loss will be significantly reduced.

Based on NFPA 780, this tool can be used to determine if a lightning protection system is recommended at a location. Please check it out here: https://ecle.biz/riskcalculator/.

References

1. **National Weather Service,** www.weather.gov/safety/lightning-science-negative-charged-flash
2. **National Geographic,** blog.education.nationalgeographic.org/2014/10/29/geography-in-the-news-a-billion-lightning-strikes/

Additional Resources

Institute of Electrical and Electronic Engineers (IEEE), www.ieee.org

National Fire Protection Association (NFPA), www.nfpa.org

Lightning Protection Institute (LPI), lightning.org/lightning-protection-overview/

Underwriters Laboratories (UL), www.ul.com

The National Weather Service, https://www.weather.gov/safety/lightning

National Oceanic and Atmospheric Administration (NOAA), www.nssl.noaa.gov/education/svrwx101/lightning/

Engineering Systems Inc. (ESi), www.engsys.com

Metal Construction News, www.metalconstructionnews.com/articles/lightning-protection-primer

Learn More & Connect

For more information on protecting your business, contact your local risk engineer, visit the Chubb Risk Consulting Library, or check out www.chubb.com/engineering.