*A technical reference bulletin by the Risk Control Services Department of the Glatfelter Insurance Group*

Glatfelter Religious Practice℠
A Division of Glatfelter Insurance Group

RISK COMMUNIQUÉ

# *Lightning Protection Guide*

***There are approximately 100 cloud-to-ground lightning strikes on Earth every second. Each of these lightning bolts can contain up to one billion volts of electricity. With the frequency of lightning strikes and the power of lightning, is it any wonder that lightning damage occurs?***

Each year, Glatfelter Religious Practice clients experience loss and disruptions in service from lightning strikes. Not only can the heat generated from a lightning strike start a building fire, but the accompanying electrical surge can damage electrical and telecommunications systems and equipment.

The direct loss may be compounded by loss of services during the time it takes to repair/replace damaged equipment and buildings. The net result can be millions of dollars of damage to property and lost revenue.

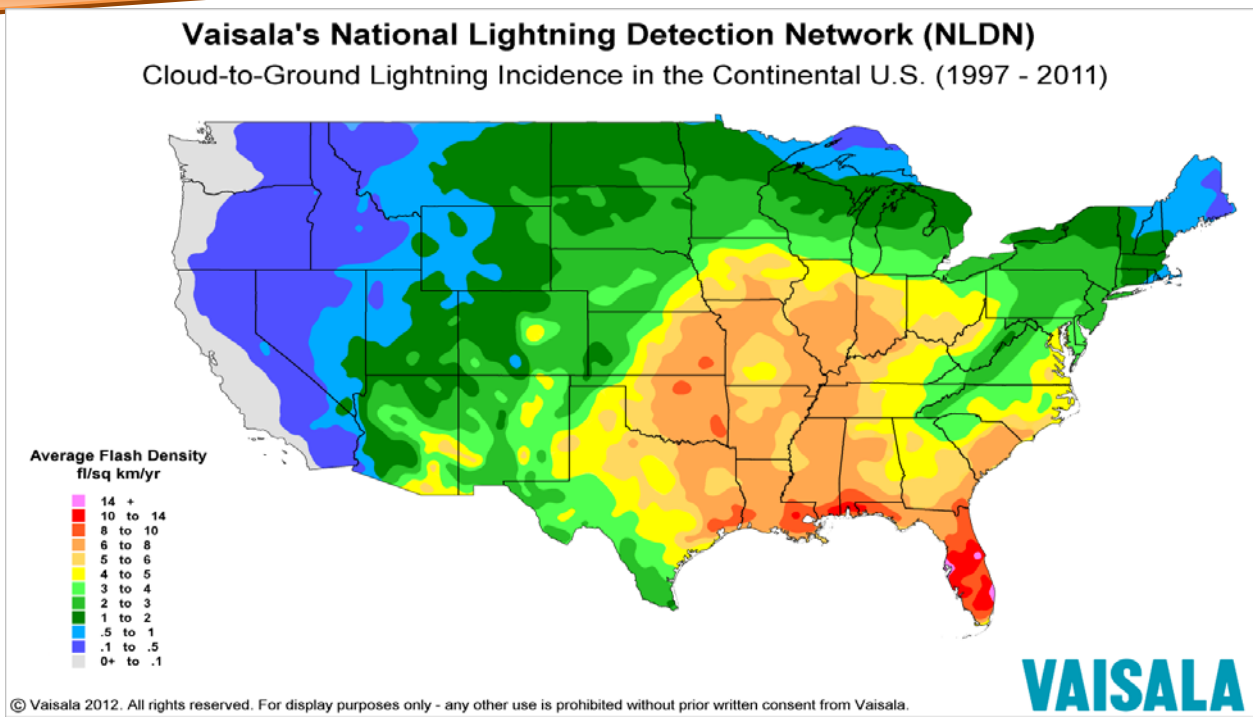
Lightning storms can develop quickly, leaving organizations with limited time to react. Although there may not be a foolproof method of protecting structures and equipment from damage, there are steps that can be taken to reduce lightning exposure. It is important that facility and equipment design incorporate lightning and surge protection. This may help reduce the potential exposure to loss and provide the best chance of limiting the impact of a lightning occurrence.

This communiqué provides an overview of the lightning exposure, loss planning, lightning protection systems and components and the National Fire Protection Association (NFPA) pamphlet NFPA 780 – "Standard for the Installation of Lightning Protection Systems."

**Risk of Lightning Strikes**

Historically, there are regions throughout the United States that have a higher frequency of lightning storms and associated damage.[i]

The lightning occurrence map below identifies the areas of the United States most subject to lightning storms. The highest frequency of lightning strikes extends from Florida to Texas and up north through Nebraska to Ohio and as far east as Virginia. Still, lightning activity can affect every state to some degree.[ii]




Lightning Detection Network: Cloud to Ground Lightning Incidence in the Continental United States (1997 – 2011) [2]

**Protection, Planning and Design**

***Disaster Recovery Planning***

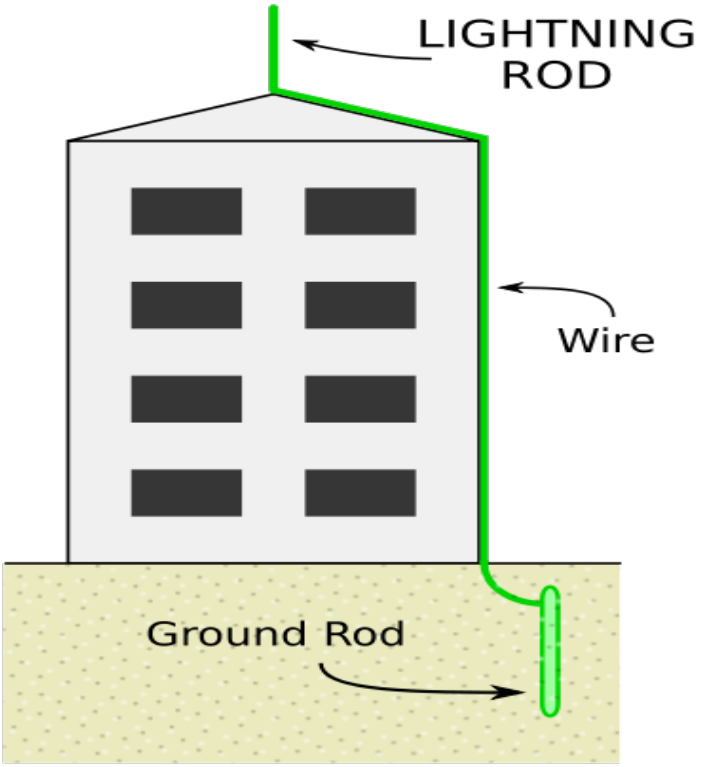
A fire or other damage caused by a lightning strike has the potential to make a facility uninhabitable.

Identifying critical infrastructure and electrical systems as well as determining what and where problems could occur is a part of Disaster Recovery Planning. Assessing the impact on operations allows planning of strategies to reduce the potential for loss such as providing back-up systems and design redundancies to support the continuity of operations. (See attached Lightning Damage Prevention Checklist for additional assistance in this area.) It is important that these engineering controls be built into the infrastructure to help prevent lightning damage. This planning is especially critical in high frequency lightning strike regions.

**Lightning Protection System Concepts**

Lightning protection systems may be used to prevent or lessen damage to structures since they could help mitigate the fire hazard. These systems provide a low-impedance path to ground in order for the lightning's electrical current to reduce the potential for damage to electronic equipment and the heating effect on combustible structural materials. The low impedance path to ground is formed by a network of air terminals (rods), bonding conductors (wire) and ground electrodes. Lightning's electrical current divides to follow every conductive path to the ground. Even so, the divided current may still be strong enough to cause damage. [iii]

*Because of the high energy and current electrical levels associated with lightning as well as the rapid speed of a lightning strike, lightning protection system cannot guarantee absolute safety from lightning.*[3]




Basic Lightning Protection Diagram[3]

**Installation, Design and Systems Specifications – NFPA 780: "Standard for the Installation of Lightning Protection Systems"**

NFPA 780 provides separate requirements for lightning protection regarding different properties.[iv]

The standard excludes lightning protection system installation specifications for electric generating, transmission and distribution systems. Also excluded are early streamer emission systems and charge dissipation systems.[4]

NFPA 780 classifies roof height and design variables, specifies the type of conductor, parameters and wire thickness (for both copper & aluminum) for the lightning rod (air terminal) and conductors (ground wire).[v]

***Building Structure, Height and Location***

Structures may be inherently more or less at risk of lightning strikes depending on the size (area), the height and the number of lightning strikes per year for the region. For example, a small building will be less likely to be struck than a large one and a building in an area with a high density of lightning strikes will be more likely to be struck than one in an area with a low density of lightning strikes.[vi]

Lightning rods (air terminals) are typically arranged at or along the upper points of a roof structure and are electrically connected together by bonding conductors (called down conductors or downleads). These bonding conductors are connected to one or more grounding or earthing terminals.[3] The protection theory is: the lightning will strike the air terminals and be "led" to ground by following the downleads.

***Lightning Protection for Electrical Equipment***

A facility can help reduce the exposure to lightning damage and electrical surges to electrical equipment with a robust surge protection system. Surge protection devices (SPDs) are designed to absorb and divert high current charges to ground, bypassing the equipment. This can help limit the damage a lightning strike or other surge may cause. Details on surge protection equipment installation may be found in the most current edition of NFPA 70 (National Electric Code).

Ideally, surge protection should be installed in three levels or protection zones:[vii]

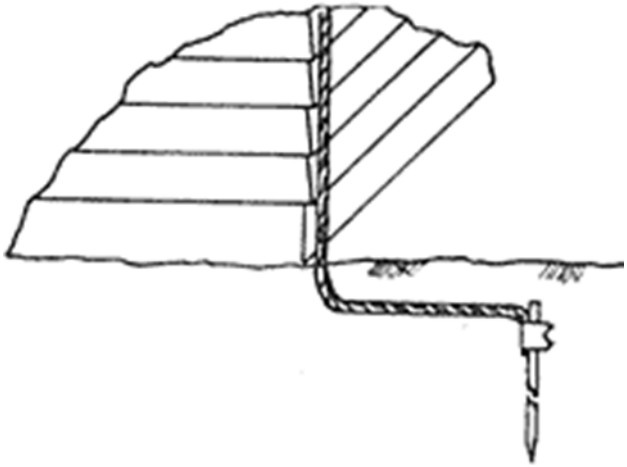
- The service entry to the structure.
- Areas susceptible to surges (switchgears & panel board type of equipment).
- The exposed piece of equipment itself.

***Grounding***

A low resistance grounding system with a single ground reference point to which the grounds of all building systems and SPDs are connected is a critical component of any facility protection plan. Without a proper grounding system there is no way to protect against electrical surges.

Soil content, moisture level and other factors can affect the type of grounding system that is installed. For effective grounding, analysis of the soil conditions provides guidance on the amount of resistance to ground. The results of this analysis help determine the number, spacing and depth of the grounding wires needed.[viii]

## Grounding



**Summary**
A significant amount of the Continental U.S. is at high risk for lightning strikes. Each of these strikes can result in significant damage. Structures, electrical systems and critical equipment may be damaged and this damage may result in the disruption of the services provided by an organization. A popular method of reducing building and equipment damage from lightning exposure is with a properly designed lightning and surge protection system.

Protection from lightning strikes requires pre-planning in building and equipment design, roofing systems, surge protection and other characteristics that are important in the design and implementation of a lightning protection system. With the complexities that are involved, it is strongly recommended that the design of lighting and surge protection systems be done by a qualified electrical engineer.

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**Lightning Damage Prevention Checklist**

The impact of a large electrical discharge can damage buildings, equipment and operations, resulting in service outages. If your facility is located in an area that is prone to lightning storms, use of the following checklist may help you analyze your potential exposure and prepare for this peril.

Rating scheme: A = Adequate, NI = Needs Improvement, N/A = Not Applicable

| Consideration | Precautions | A | NI | N/A |
|---|---|---|---|---|
| Pre-Planning | Has a potential lightning damage preparation plan been established?<br><br>Have critical structures, equipment, operations and other key functions been identified?<br><br>Are there redundancies to help assure continuity of operations? | | | |
| Building Preparedness | Are buildings and critical systems engineered to handle lightning strikes and electrical surges?<br><br>Have existing buildings and other critical locations been provided with surge and lightning protection?<br><br>Does the existing lightning protection system meet NFPA 780 (2011 Edition) standards?<br><br>Is surge protection adequate? | | | |
| Power | In the event of a power outage, are emergency generators and other equipment in place or readily available to keep key functions operating for extended periods? | | | |
| Computer Data | Are computer files backed up and safely stored at a remote location? How often are the backups completed? | | | |
| Response Plan | Is an emergency response plan in place to deal with lightning storms?<br><br>When was the plan last updated? | | | |
| Emergency Contacts | Is contact information for the fire department, ambulance, key suppliers and other emergency responders readily available? | | | |

[i] NFPA 780 Standard for the Installation of Lightning Protection Systems 2011 Edition. Annex L 1.2, L 1.4, Figure L.2

[ii] Vaisala's Lightning Detection Network: Cloud to Ground Lightning Incidence in the Continental United States. (1997 – 2011).

[iii] Lightning Rod. http://en.wikipedia.org/wiki/Lightning_rod

[iv] NFPA 780 Standard for the Installation of Lightning Protection Systems 2011 Edition. Section 1.1.

[v] NFPA 780 Standard for the Installation of Lightning Protection Systems 2011 Edition. Chapter 4.

[vi] NFPA 780 Standard for the Installation of Lightning Protection Systems 2011 Edition. Chapter 4 Tables 4.1111, 4.1112, Annex L 1.2.

[vii] Guidelines for Providing Surge Protection at Commercial, Institutional, and Industrial Facilities.2008. The Hartford Steam Boiler Inspection & Insurance Company.

[8] Carpenter & Lanzoni. Designing for Low Resistance Surface Interfacing (Grounding)- Lightning Eliminators and Consultants, Inc. (March 2004). Evaluating Soil Conditions & Conclusion sections.

[9] Lightning Protection Equipment & Supplies (advertisement). Lightning Rod Parts.