Lightning – Property Protection and Preparation

Lightning is a natural phenomenon that happens all across the United States. Severe storms occur more frequently in some parts of the country than others, but every business needs to take precautions. Direct lightning strikes can result in a building fire, but lightning doesn't need to hit a building to cause damage. Tall structures, structural steel buildings, reinforced concrete structures and metal buildings are especially vulnerable, as are flammable liquid and gas tanks.

The fact that lightning strikes cannot be accurately predicted makes absolute safety from their effects almost impossible. However, hazard levels can be determined and adequate protection taken to lessen the potential for loss. A correct assessment of the risk and resulting installation of lightning protection equipment by a qualified contractor are essential aspects of controlling loss of life and property damage. The following information is intended to inform readers of the risks associated with lightning and to familiarize them with the principles of lightning protection systems for protection of buildings and equipment inside the buildings.

LIGHTNING PROTECTION SYSTEMS

Lightning is a frequent cause of fire and damage to electrical equipment due to its instantaneous and seemingly unpredictable nature. Ninety million lightning bolts strike the United States every year. Lightning contains up to 100 million volts of electrical potential and 300,000 amperes of current.

A lightning flash is a very long electrical spark that extends between one center of electrical charge in a cloud and another center of opposite polarity charge in the ground, in another cloud, or even in the same cloud. Most of the destructive energy produced by lightning is delivered by the stroke current. These intense currents produce high over-pressure that can shatter concrete, glass, wood, and other non-conductors. The rapid rate at which these currents rise to maximum intensity can cause high voltages to appear along the conductors carrying them. The rapidly changing magnetic fields accompanying these strokes can also affect electronic systems. The surge voltages lightning induces in wiring and cables may damage these systems.

TRADITIONAL THEORY OF LIGHTNING PROTECTION

The theory of lightning protection is simple. A system is designed to provide a means by which a lightning discharge may enter or leave the earth without damaging the property protected. A lightning protection system has two functions; 1) to intercept a lightning discharge before it can strike the object protected, and 2) to discharge the lightning current harmlessly to earth.

PROTECTION OF BUILDINGS

Electricity travels more easily in some conductors than in others. Metal and water are good conductors, offering little resistance to the current flow and allowing the energy to pass quickly and safely to the ground. Wood, on the other hand, is not a good conductor. That is why a tree struck by lightning will split or crack while a steel flagpole will sustain no damage.

The concept of a lightning rod is based on this principle of conductivity. Some structures are inherently protected against the effects of lightning. Steel frame buildings, along with their associated metal water piping, sprinkler systems, ductwork, and other conductive metal components, offer a low impedance path to the ground and are, therefore, seldom damaged. If damage does result, it is usually because the stroke smashed through a brick or concrete exterior in order to reach the steel framework within. Once lightning contacts the metal, the current is carried safely to the earth.

Structures of wood, brick, or other non-conductive materials may need special protection against lightning. Those structures, which cannot sustain a direct lightning stroke without damage, require some method protection.

A complete lightning protection system for a building or large structure consists of three components:

- Properly arranged air terminals (rods) on a roof or top of the structure.
- Suitable ground terminals, often buried in earth.
- A conductive path or down conductor connecting the air and ground terminals.

LIGHTNING-INDUCED ELECTRICAL SURGES

All new lightning protection systems must be inspected following completion of its installation. In addition, it is very important to make periodic inspection of existing systems or whenever any alteration or repairs are made to a protected structure; and, following any known lightning discharged to the system.

It is recommended that lightning protection systems be visually inspected at least semi-annually. In areas where severe lightning occurs, it may be advisable to visually inspect systems following extreme changes in ambient temperature. An independent contractor should complete inspections of systems every three years. The installing contractor should provide documentation of these inspections.

VISUAL INSPECTIONS

Semi-annual visual inspections are made to ascertain the following:

- The system is in good repair.
- There are no loose connections, which might result in high resistance joints.
- Corrosion or vibration has weakened no part of the system.
- All down conductors and ground terminals are intact (non-severed).
- All conductors and system components are securely fastened to their mounting surfaces and are protected against accidental mechanical displacement as required.
- There have been no additions or alterations to the protected structure that would require additional protection.
- There has been no visual indication of damage to surge suppression (over voltage) devices.
- The system complies in all respects with the current edition of National Fire Protection Association #780 - Lightning Protection Code.

TESTING AND INSPECTION

Every three years, qualified personnel should perform the following tests:

- Perform tests to verify continuity of those parts of the system that are concealed (built-in) during the initial installation and that are not available for visual inspection.

- Conduct ground resistance tests of the ground termination system and its individual ground electrodes if adequate disconnecting means have been provided. These test results should be compared with previous or original results and/or current accepted values for the soil conditions involved. If it is found that the test values differ substantially from previous values obtained under the same test procedure, additional investigations should be made to determine the reason for the difference.

- Perform continuity tests to determine if suitable bonding has been established for any new services or constructions that have been added to the structure since the last inspection.
- Inspection guides or forms should be prepared and made available to the authority responsible for conducting inspections of lightning protection systems. Records of all the inspections should be maintained.

MAINTENANCE OF LIGHTNING PROTECTION SYSTEMS

Maintenance of a lightning protection system is extremely important. Many system components tend to lose their effectiveness over the years because of corrosion factors, weather-related damage, and lightning stroke damage. The physical, as well as the electrical, characteristics of the lightning protection system must be maintained in order to main compliance with design requirements.

A good maintenance program should include the following:

- Inspection of all conductors and system components.
- Tightening of all clamps and splicers.
- Measurements of lightning protection system resistance.
- Measurement of resistance of ground terminals.
- Inspection and/or testing, of surge suppression devices to determine their effectiveness compared with similar new devices.
- Refastening and tightening of components and conductors as required.
- Complete records should be kept of all maintenance procedures and should include any corrective actions that have been or will be taken.

The risks associated with inadequate lightning protection are becoming ever greater, and the costs of repairs are skyrocketing. Prompt inspection and maintenance of lightning protection systems can limit property damage and interruption to operations.

Guidance on shield, surge suppression, grounding and bonding can be found in NFPA 780, IEEE Standard 142. The UL Electrical Construction Materials Director provides guidance on the selection of lightning conductors, air terminals, fittings, and grounding and bonding equipment, and lists contractors who install "Master Label" certified lightning systems for structures.

For more Information on this topic, please contact Alliant Risk Control Consulting at (949) 260-5042 or riskcontrol@alliant.com

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