

Don't Get Zapped

Mitigation and Risk Assessment Strategies for Reducing Lightning Losses

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Natural disasters have plagued man since the dawn of time. The approach for many is to cross their fingers and hope for the best outcome. Others see prevention and mitigation as the best approach. Mounting losses in human casualties and property damage motivated the United Nations to declare the 1990s as the *International Decade for Natural Disaster Reduction (IDNDR)*. The focused attention provided by the UN also meant promotion of actions to reduce the impact of such hazards. During this decade, disaster managers and other U.S. officials increased emphasis on mitigation relative to response and recovery, especially seen in programs of the Federal Emergency Management Agency. As the decade closed, the program recommended that continuing efforts be focused on improving risk assessments, implementing mitigation strategies, supporting warnings and response, and improving the basis for natural disaster insurance.

Ranking among Mother Nature's more awe-inspiring feats is lightning. As one of the more frequently occurring natural disasters, lightning strikes the earth roughly 1,800 times at any given moment. It is five times as hot as the sun in every one-inch diameter bolt. In the United States, lightning kills more people than hurricanes and tornadoes combined. Only floods are more deadly.

"Lightning is usually the most dangerous and frequently encountered weather hazard that people experience each year," said John Jensenius, warning coordination meteorologist for the National Weather Service. "Too often people wait too long before seeking safe shelter from a thunderstorm and find themselves caught outside in a very dangerous and sometimes deadly situation." Jensenius has tracked statistics over a 30-year period (ending in 2004) which revealed that lightning remains the second greatest storm-related killer in the U.S.—second only to flooding.

In 2001, the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service launched an annual Lightning Safety Awareness campaign to increase public awareness of the dangers of lightning. Several members of NOAA's Lightning Safety Awareness Team, including the Lightning Safety Alliance (LSA), the Lightning Protection Institute (LPI) and Struckbylightning.org have collaborated in educational efforts. The campaign most recently included a television public service announcement (PSA) to educate children about the dangers of lightning and promote the 2007 campaign slogan, "When Thunder Roars, Go Indoors."

The PSA introduced the mascot, "Leon the Lightning Lion," a cartoon character designed to spread lightning safety and preparedness messages to the public. Other elements of the lightning safety awareness campaign include posters, safety stickers, teacher tools and a Web site kid's page which features an interactive computer lightning safety game. These and other items about the nationwide Lightning Safety Awareness Week campaign can be found at www.lightningsafety.noaa.gov.

"Because lightning is such an underrated killer, NOAA's Lightning Safety Awareness Team is constantly challenged to create new tools to help educate both children and adults about lightning and its dangers," explained Jensenius, who was awarded the National Weather Association's 2005 Public Education Award and, more recently, a Department of Commerce Silver Medal in 2006.

In addition to the toll lightning takes on human life, thousands of properties are damaged or destroyed by lightning each year. According to Underwriters Laboratories (UL), lightning also accounts for more than one billion dollars annually in structural damage to buildings in the U.S. For property owners who don't want to play the odds and take their chances, an investment in a lightning protection system makes good sense.

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While LPI, NFPA, and UL are all not-for-profit organizations publishing safety information and installation standards for lightning protection, LPI is the only organization which was founded specifically to study lightning protection. LPI started promoting lightning protection education, awareness and safety in 1955. LPI membership is comprised of manufacturers, contractors, scientists, engineers and safety directors, all of whom are interested in improving the science of lightning protection and promoting lightning safety. In addition to publishing the LPI Standard of Practice to help ensure the best possible quality in lightning protection materials and installation techniques, the institute offers certification and education programming. The LPI's "Master Installer" program qualifies competence and quality control in the lightning protection industry.

LPI also collects and reviews statistical information and scientific data on the nature and behavior of lightning on a routine basis. The organization presents an “information warehouse” on the Web at www.lightning.org.

Lightning Protection and Risk Assessment

The issue of risk assessment in terms of lightning protection was reviewed by the General Accountability Office (GAO). In May of 2005, the GAO released results of a five month evaluation of the Federal Government’s approach to protecting its facilities from lightning strikes. The study focused on four Federal agencies which, according to the GAO, represent over 80 percent of the government’s property. The agencies included in the study were the General Services Administration (GSA), the United States Postal Service (USPS), the Department of Defense (DoD) and the Veterans Health Administration (VHA). The GAO found that all of these agencies require installed lightning protection systems to conform to the requirements of the National Fire Protection Association (NFPA) Standard 780 and Underwriters Laboratories (UL) Standard UL96 and UL96A. The GAO also noted that the referenced standards not only provide material and installation guidelines, but also mandate the use of certified lightning protection installers.

Typical Commercial Lightning Protection System Components:

Adhesive Base/Adhesive Cable Fastener—Holds the air terminal assembly in place while connecting and fastening the cable conductor to the structure.

UL Master Label—Signifies that the lightning protection system was inspected to comply with UL installation standards. (Note: UL automated its inspection services in 2003 and began issuing certificates via the Internet to replace the metal Master Labels. Effective 4/12/07, UL revised wording to the “UL Lightning Protection Inspection Certificate.”)

Surge Arrester—A protective device for limiting surge voltages by discharging or bypassing surge current.

Cable Connector—Fittings used for the bonding or connection of down conductors and/or grounding equipment. (Bimetallic connectors must be used for splicing or bonding of dissimilar metals.)

Pipe Clamp—Used to connect underground metallic piping systems.

Bolt Fitting—A parallel cable connector which ensures continuity.

Side Mount Base—Adhesive cable fastener used to side mount air terminals for placement on a structure’s wall.

Thru-Roof Assembly—Used to achieve a thru-roof connection to the grounded steel framework.

Bolt Fitting & Ground Termination—Used for steel column grounding connections.

The GAO’s objectives in evaluating lightning protection systems for federal buildings focused on:

1. To what extent these selected federal agencies use applicable lightning protection standards to help protect buildings they own from lightning strikes.
2. How these selected federal agencies assess the need for lightning protection systems on their buildings
3. What practices and lightning protection standards the GSA uses when leasing privately owned buildings

4. What data exists related to the financial impact of lightning protection and damage to the federal government.

The GAO report also noted that while the Army and the Air Force do not currently follow NFPA-780's risk assessment and decision-making methodology, these entities have identified related variables for assessing risk and making decisions to install lightning protection systems when designing new buildings or renovating existing ones.

Additional Focus on Risk Assessment

When considering lightning protection, federal agencies such as the Navy, VHA, GSA and USPS do typically use the NFPA's Risk Assessment Methodology, found in the Annex L section of the *NFPA's 780 Standard for the Installation of Lightning Protection Systems, 2008 Edition*. The Risk Assessment Methodology evaluates whether or not lightning protection should be installed for both new construction and renovation projects. The NFPA's Risk Assessment Methodology is a guide that takes into account lightning and the following factors:

- The building environment
- Type of construction
- Structure occupancy
- Structure contents
- Lightning strike consequences

The risk index compares the expected direct strikes to the structure with the occupancy and contents to give an evaluation of whether lightning protection should be applied, or may be considered optional. The NFPA's Risk Assessment Methodology traditionally has been used to assist the building owner or architect/engineer in determining the risk of damage due to lightning. Once the risk has been determined, deciding on the need for protection measures is much easier. While the Risk Assessment Methodology is a good rule of thumb, sometimes the presence of a single risk factor is enough to render a structure a significant risk worth protecting. Historic buildings, healthcare facilities, industrial plants, schools and churches are often considered to be at high risk in terms of susceptibility to lightning losses. Often the cost of installing lightning protection is considered minimal as compared to the potential for risk.

In Florida, the so-called Lightning Capital of the U.S., state building codes already mandate the installation of lightning protection systems for hospitals, healthcare facilities and nursing homes. Educational facilities in Florida are required to do a risk assessment. Lightning protection is also routinely installed on correctional facilities, EMS buildings, schools, hotels and telecommunications structures in Florida. Lightning protection systems are critical in protecting our national infrastructure, and various governmental agencies rely heavily on nationally recognized specifications for lightning protection. For more information, visit the Lightning Protection Institute (LPI) at www.lightning.org or the Lightning Safety Alliance (LSA) at www.lightningsafetyalliance.org.

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Lightning Protection Glossary of Terms

(As defined by the Lightning Protection Institute Standard of Practice—LPI-175/2004 Edition)

Authority Having Jurisdiction — The organization, office, or individual responsible for approving equipment, materials, and installation or procedure.

Bonding — The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.

Cable — A factory assembly combining multiple conductor strands.

Conductors — Devices defined by the Standard as suitable to carry lightning current. These may include strike termination devices, cables, lightning protection fittings, ground terminals, or metallic structural members.

Fastener — A component or set of components used to securely attach materials to the structure. A fastener may also be a mechanical device, such as a rivet, bolt, screw, or pin that is used to securely hold two or more components together.

Ground Terminal — The portion of a lightning protection system, such as a ground rod, ground plate or ground conductor that is installed for the purpose of providing electrical contact with the earth.

Labeled — Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Lightning Protection System — A complete system of strike termination devices, conductors, ground terminals, interconnecting conductors, surge suppression devices and other connectors or fittings required to complete the system.

Listed — Equipment, materials or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

Strike Termination Device (Air terminal) — A component of a lightning protection system that intercepts lightning flashes and connects them to a path to ground.

Surge Protective Device (SPD) — A device composed of any combination of linear or nonlinear circuit elements intended for limiting surge voltages on equipment by diverting or limiting surge current.

Transient Voltage Surge Suppressor (TVSS) — A surge protective device listed for connection on the load side of the main over current protection in circuits not exceeding 600 volts rms.

Zone of Protection — The space adjacent to a lightning protection system that is substantially immune to direct lightning flashes.