Preventive care for medical buildings

BY MICHAEL CHUSID

Lightning causes fire, physical damage, injury and death. For healthcare facilities, however, electrical surges occur more frequently and disable or destroy electronic equipment essential to modern hospital operations. Life support, imaging, safety and security, and communication systems depend on digital circuits that cannot withstand lightning's hundred million or more volts. Lightning often accompanies tornadoes, hurricanes and other severe weather, knocking out critical systems just when a community most needs its hospitals and clinics.

Even an ordinary thunderstorm can cause problems. At a Level I trauma center in Florida, for example, a new 1 megawatt backup generator used to fail as frequently as twice a month, its controller board or other component needing replacement after a thunderstorm. In contrast, there haven't been any failures since the hospital upgraded its lightning protection system.

This does not surprise Jennifer Morgan, co-owner of East Coast Lightning Equipment and education director for the Lightning Safety Alliance. She says, "Many building industry professionals assume electrical systems are protected when grounded according to the National Electric Code. Yet the NEC does not address lightning protection and neither do most building codes."

She advocates that "lightning protection should comply with a triad of standards proven to provide reliable protection." They are: National Fire Protection Association 780 - *Standard for the Installation of Lightning Protection Systems*, UL96A - *Standard for Lightning Protection Components* and Lightning Protection Institute 175 - *Standard of Practice*.

To help a facility owner evaluate the potential for loss due to lightning, NFPA 780 contains a Risk Assessment Guide. It considers regional frequency of lightning, requirements for continuity of operation, and the structure's form, surroundings, construction materials, contents and ease of evacuation. While the risk to a low-rise outpatient facility in a dry region may be less than that of a multi-story hospital in an area prone to frequent thunderstorms, all structures in every region of the country are vulnerable.

Fundamentals

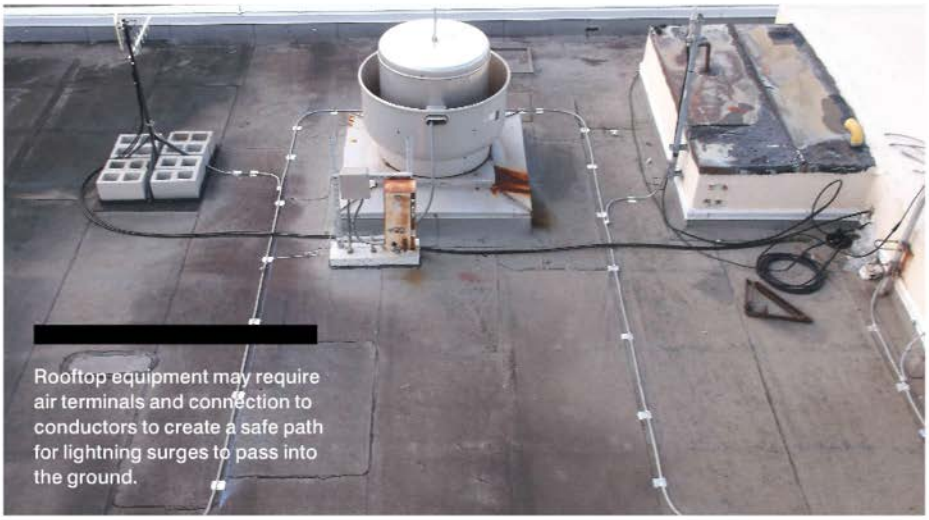
The basic principle of lightning protection is to provide a path that will safely conduct lightning's

Lightning: jovannig/DollarPhotoClub; Rooftop: Bonded Lightning Protection Systems Inc.

electrical charge from the top of a structure into the ground.

Air terminals, formerly known as lightning rods, are required at the ridge or highest spots on the roof of a structure. Most buildings will also require air terminals around the roof perimeter, at designated spacing throughout a roof and mounted on rooftop equipment. Mike Dillon, vice president of Bonded Lightning Protection, says, "Hospitals can have a lot of rooftop equipment, including HVAC units, exhaust fans, plumbing vents, security cameras, lighting fixtures, antennae and even heliports. An air terminal will have to be installed on top of most of them and connected with conductors approved for lightning protection." His firm recently upgraded the lightning protection system at St. Mary's Medical Center in West Palm Beach, Florida.

Some architects are hesitant to install lightning protection devices at visually sensitive areas such as entrance canopies and rooftop terraces. Dillon offers reassurance that, "with planning, we may be able to use metal railings, parapet caps or other architectural elements in lieu of air terminals and disguise or hide the conductors."

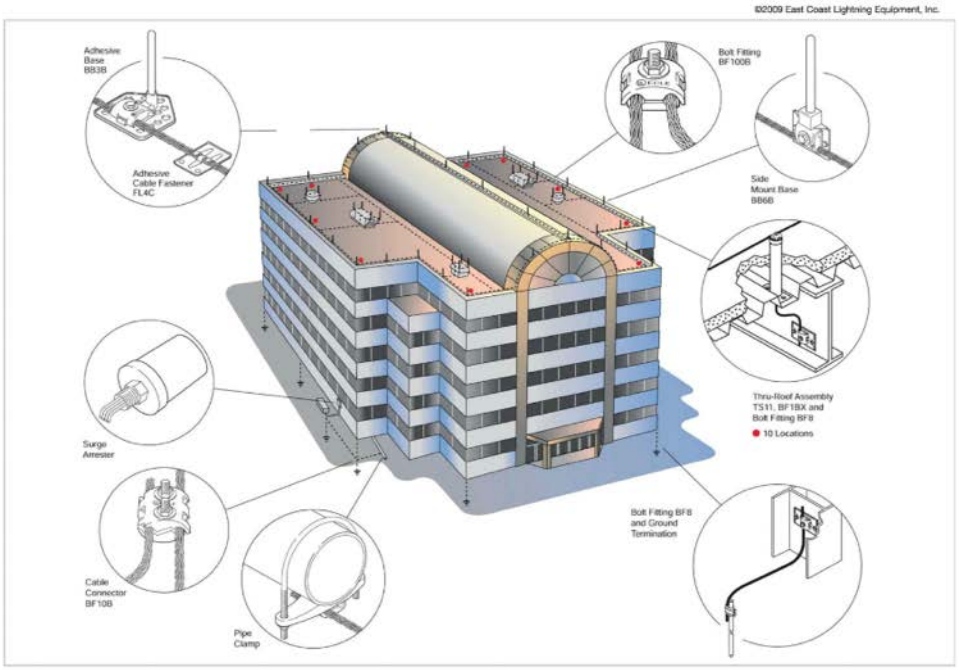


Rooftop equipment may require air terminals and connection to conductors to create a safe path for lightning surges to pass into the ground.

Conductors are either braided copper or aluminum cables that lead from the roof to ground level. They are typically installed in chases or other hidden locations within new construction. If a building has a structural steel frame, columns can be used to provide an electrically continuous path to the ground. In renovations, conductors can be mounted on the exterior face of building walls with minimal disruption to facility operations.

The type of ground terminal used depends on the type of soil and level of protection required. In many instances, copper rods driven 10 or more feet into the earth provide sufficient grounding. Where greater protection is required or the soil has low electrical conductivity (such as sand or rock), a ground ring,

Typical Commercial Lightning Protection System



Protecting a multi-story building such as this costs as little as 30-40 cents per square foot of floor area based on a survey of lightning protection contractors. Components of the lightning protection system should be produced by a UL-listed manufacturer.

also known as a counterpoise, will be created by burying a cable in a shallow trench all around a structure.

It is also necessary to create equipotential bonds between the lightning protection system and other building systems to prevent transient charges from side flashing into equipment that offers a lower-resistance path into earth. Morgan explains, "electricity finds the path of least resistance, and you don't want that path to be through your building's wiring or plumbing."

In addition to direct lightning strikes, a building is subject to electrical surges due to strikes that occur outside the building.

"Surges send high-voltage current spikes through power, telephone and other utility lines entering buildings," said Morgan. "We have to provide approved surge protectors to every service entrance."

Surge protectors often have indicator lights that change from green to red if tripped, and maintenance crews should know to inspect them after lightning storms.

Ongoing protection

To ensure their lightning protection system is functioning properly, Morgan and Dillon advise building owners to require an independent inspection and compliance with LPI's Master Installation Certificate. Buildings should then be reinspected at least every three years to maintain certification.

Dillon says most of his healthcare clients don't wait until recertification to check on the condition of their lightning protection. "They have me on service contracts," he says, "because hospitals are constantly doing work on their facilities that could compromise protection." He cites, as an example, that changing a filter on a rooftop HVAC unit can damage the air terminal-to-conductor connection if the maintenance crew is not properly trained.

Learn more

For more information, visit LightningSafetyAlliance.org.

Risk-to-benefit

Morgan encourages architects to discuss lightning risks with clients early during design so it can be included in a project's budget. While some electrical engineers design lightning protection systems, the layout and shop drawings are frequently specified as part of the services to be provided by a qualified lightning protection installer.

To better understand the cost of lightning protection and create a preliminary budgeting tool, ECLE recently asked installers from across the U.S. to bid on lightning protection for a five-story building. The average price is $1.52 per square foot of roof area, the most significant variable in low-rise and mid-rise installation costs.[1] In other words, lightning protection costs as little as 30-40 cents per square foot of floor area in the five-story property. This is about a 10th of a percent of a typical hospital's construction budget that, as reported in 2013 by RS Means, can be upwards of $300 per square foot of floor area.

It may be possible to recoup some of the cost of lightning protection when it comes time to negotiate property insurance. But the final decision about lightning protection ultimately depends on an organization's priorities. As one hospital facility manager summarizes, "losing crucial services due to lightning is not a risk we are willing to take when someone might be on an operating table."

Michael Chusid, RA FCSI CCS, an architect and Fellow of the Construction Specifications Institute, is an innovation consultant on projects that improve building products, architectural design and construction practices. He can be reached at chusid.com.

[1] *Depending on regional practices, local soil conditions and other factors, prices per square foot of roof area vary from $1.17 for an aluminum installation in the South to $1.91 for a copper installation in the Midwest. Prices include installer's overhead and profit but not the general contractor's mark-up. For cost study details, visit ecle.biz.*

Graphic: East Coast Lightning Equipment, Inc.