The Following “LIGHTNING PROTECTION” Presentation is for Information ONLY.

The choice of taking any actions identified in this presentation is yours and yours alone.
LIGHTNING PROTECTION

What every Florida resident and their friends need to know associated with protecting their Personal Property, their Computer and their Home from Lightning Damage

By
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LIGHTNING PROTECTION

AGENDA:

• Lightning Myth
• Lightning can be beautiful and frightening…but…
• Myths
• Protective Measures appropriate to protect home and property:
  – Protection of sensitive small appliances
  – Protection for your computer
  – Protection of major appliances
  – Protecting your home
    • Bonding and Grounding
    • Lightning Protection Systems
• APPENDIX
Before I start this program, I would like to dispel one common myth and concern associated with “lightning rods.”
MYTH:

• MYTH - Lightning rods attract lightning.
  – Truth: Lightning rods do **NOT** attract lightning. The direction lightning takes is purely random.
  
  However, consider that the presence of a properly installed lightning protection system (lightning rods and associated systems) **can** help dissipate and ground any electrical energy that is present in the immediate area and the atmosphere near your home.
Lightning Protection

Lightning Can Be Beautiful & Frightening

BUT…
To begin with, there are two common types of lighting that may affect you and your home – the most dangerous form being cloud-to-ground (on the left), and the less common form being ground-to-cloud (on the right). You can differentiate the difference by looking at the direction of the leaders.

Do not forget you can not “see” electricity – what you see is ionized air.

(NOTE: Photos from “The Art and Science of Lightning Protection” by Martin A. Uman.)
Lightning can be a wondrous and beautiful visual sight when viewed from a safe distance and in a safe environment.
BUT…

this is what might happen when lightning hits home (literally).
This home on Blenheim Trail in the Village of Sunset Ridge at Sunset Pointe was struck on July 25, 2008.

In The Villages alone during the previous 6 years, we have also witnessed similar catastrophic direct lightning damage to homes on Covington Circle, Golden Ridge Drive, Hibernia Lane, and Kensington Place.
The Family Care Center at Sumter Landing suffered a minor lightning strike in early 2008. This building, nor any of the other buildings in this medical complex, have no Lightning Protection Systems installed.
A more recent incident of lightning damage is this home on Pelican Path in the Village of Sunset Pointe on August 21, 2009.

The Villages District Public Safety Department reported that they have received several fire/potential lightning damage calls to date during the 2009 rainy season.
Lightning Facts and Myths

• The following slides address various facts (thoughts and concerns) associated with lightning.

• The following slides also provide a brief response to myths/truths associated with Lightning Protection Systems.

(More Myths are addressed in the attached Appendix.)
Lightning

• It needs to be understood that Florida is the “lightning capital of the United States,” and that Central Florida has the historically highest incidences for lightning strikes. (Africa is the “lightning capital” of the world.)

• With this in mind, this presentation will attempt to calm your fears and provide means for protecting your home (by this is meant the structure) and its contents from lightning damage using time-tested and scientifically proven methods of protection.

• The attempt will be to give you the tools that can provide you peace of mind.
Lightning

- While no detailed figures are available on the geographical distribution of lightning, the map below, shows the yearly average number of days with thunderstorms based on observations from all U.S. Weather Bureau first-order stations and gives an approximation of the lightning distribution in the United States.
Lightning

• According to estimates, lightning is striking somewhere on this earth an average of 100 times every second.

• While lightning may occur at anytime of the day, it is more likely in the late afternoon and evening when thunderstorm activity is normally the most active time.
  – Also, July and August are the months with the greatest number of thunderstorms over most sections of the United States, while December and January have the least number.
  – It might also add a noted that even though “snow-birds” are here in Florida during the months of least activity, their homes are here full time, so what we will be talking about still needs their attention and consideration. Their homes can not escape the potential for lightning damage just because they are vacant.
MYTHS:

- **MYTH** - Lightning Protection Systems/Lightning Rods (henceforth referred to as “LPS”) are not effective and/or are not guaranteed to ensure that your house is not struck and damaged by lightning.

  – **Truth:**

    - First of all, *there is no absolute guarantee about anything in life.* The only absolute perfect protection from a lightning strike would be to totally enclose your house in a metal structure (preferably made of copper) with an appropriate wall thickness (mathematically determined) and with no holes or openings in the walls, including openings associated with wall penetrations by metallic conductors such as those carrying power and communication signals. This is normally referred to as a **Faraday Cage**, and obviously not very practical.

    *With the above established, it has been empirically proven that a lightning protection system installed in full conformance to **NFPA-780 requirements** **DOES** prevent damage to structures.*
MYTHS:

– Truth:

• Many Villages buildings are protected by LPS. Have we lost any of these buildings to lightning strikes?
MYTHS:

– Truth:

• All hospitals, emergency care centers and like buildings are required by Florida law to be protected by LPS. Regardless of what you may think about our law makers in Tallahassee, do you think they would have enacted this requirement if there wasn’t evidence that LPS does in fact work?

• In addition, many building construction plans for government buildings, large industrial structures, museums, structures of cultural value, and buildings containing explosives or flammable materials mandate the installation of an LPS conforming to NFPA-780.

• All buildings located at Cape Kennedy are protected by LPS. Has NASA lost any of these buildings or launch vehicles to lightning damage?
MYTHS (continued):

– **Truth** (continued from previous slide):
  
  • Anyone having doubts about the effectiveness of LPS need only research the Camp Blanding Research Facility under the direction of the Department of Electrical & Computer Engineering at the University of Florida in Gainesville. Dr. Vladimir Rakov, Professor and Co-Director of the International Center for Lightning Research & Testing (ICLRT) directs the research carried on at this site.

  – The University built a house that has been protected by lightning rods (installed to NFPA-780 requirements) and have instrumented the house to detect and record lightning strikes. This structure has been struck by lightning many times with no recorded damage.

  – See the **Appendix** at the end of this presentation for a copy of an LSA (Lightning Safety Alliance) article on this house and an article on Professor Rakov, plus additional “Myths.”
Lightning Protection

• Protective Measures to take to Protect Home and Property

Before this portion of the presentation begins, let it be understood that there is no absolute guarantee.

However, you can take advantage of years of experience and empirical testing to eliminate or at least greatly reduce the probability for serious damage.
TYPES of LIGHTNING STRIKES

• During any thunder/lightning storm, a “direct” lightning strike will be of extremely low probability of occurring, but when it does happen, a “direct” lightning strike will have an exceptionally high severity.

In many cases, a “direct” lightning strike of an unprotected home (one without a “LPS” installed) will most likely result in total home destruction.

It has also been shown that a home with lightning rods installed failing to meet requirements of NFPA-780 have a higher probability of having severe damage.
TYPES of LIGHTNING STRIKES

• During a lightning storm, there is an **extremely high probability** of a lightning strike occurring somewhere away from your home.
  – This type of strike can be just doors away from your home and you hear it, or it could be miles away and you have absolutely no idea that it occurred. This is the most common occurring form of lightning-induced damage to homes.

This is considered a “proximity” (or an “incidental” or “indirect”) lightning-induced electrical surge, and will have a **low severity** (especially when compared to a “direct” lightning strike).
TYPES of LIGHTNING STRIKES

• “Proximity” lighting damage can be caused by an electrical surge due to electrical energy entering your home via:
  
  – the electrical system,
  
  – the gas line,
  
  – the telephone and/or television lines,
  
  – water lines if they are metallic or other conductive material,
  
  – and other external potentials (external satellite television and amateur radio antennas, trees in close proximity to the home (10 feet of less), flag poles (within 10 feet of your home), etc.).
The following are examples of actions that every resident should take under consideration as possible preventive measures that should be taken to eliminate or minimize potential damage to homes and personal property before lightning strikes should occur:
Lightning Protection

• Protective Measures appropriate to Protect Home and Property
  – Protection of Sensitive Small Appliances
1. **Plug-In and Strip Surge Suppressors**

Protect all sensitive electrical appliances (coffee makers, radios, telephones, televisions, etc.), tools, entertainment systems and the like by using surge suppressors.

- These units are rated in “**Joules**” (this is shown on the package) which indicates the level of energy they are capable of protecting against.
  
  You don’t need to be an Engineer, just look for the highest “**Joule**” number displayed (the higher the number the better).

- Also, ensure that these units are “**UL**” certified (look for the UL Stamp on the package and/or directly on the part).
Selection of surge suppressors will be dependent upon the number of appliances and/or electronic products needing protection at a given electrical outlet.

Small plug-in units should be purchased and installed for one or two appliances such as corded or cordless telephones, garage door openers, lawn sprinkler system controllers, table-top TV’s, and other individual sensitive electrical appliances or equipment. Belkin and Tripp-Lite are two of the most common and reliable manufacturers of such units. Some electrical utility companies also supply these units.

The shown unit is capable of also protecting a cordless telephone.
• Below are examples of small surge suppressors protecting a garage door opener, a TV set, and a lawn sprinkler system controller.
You can purchase strip-type surge suppressors for protecting four, six or more appliances, for use on home entertainment systems, sound systems, telephones and TV’s, etc.
Lightning Protection

• Protective Measures appropriate to Protect Home and Property
  – Protecting Your Computer
2. **Uninterruptable Power Supply (UPS)**

The preferred way to protect your computers is by installing a UPS. Units from APC and Belkin are two of the better known UPS manufacturers.
• A UPS is a unit with an internal battery that allows a computer to run even during brownouts/blackouts, as well as providing special protection characteristics.

• A UPS should be selected by size based on the amount of electrical load that will be placed on it due to what is plugged into it. Units generally run from 350VA (Volt/Amps) to 1500VA and higher.
  – NOTE: You can consult retailers and/or manufacturers for assistance in determining the proper size for your specific circumstances.

• Also, select a UPS that provides sufficient battery-backup connections for your needs.
Lightning Protection

• Protective Measures appropriate to Protect Home and Property
  – Protection for Major Appliances
This device protects your incoming electrical system by installing a primary electrical service lightning arrestor (commonly but erroneously referred to as a “whole-house” surge suppressor).

This is a device installed on your power panel or power meter that clamps excessive instantaneously large electrical energy before it enters your house system.

NOTE:
These devices are only designed to be capable of protecting major appliances such as air conditioning systems, stoves, microwave ovens, refrigerators, washer and dryer, dish washing machine, and other major appliances from lightning-generated electrical surges, or electrical surges from other sources.
• SECO, as an example, provides a meter-installed unit (black or gray ring behind the meter). These units can be paid for by a monthly charge, or bought outright. SECO also provides several plug-in surge suppressors for small appliances and/or electronic/electrical items such as coffee makers, radios, telephones, TV’s, and the like. SECO strongly advices installing these, as well as purchasing additional suppressors to protect all sensitive items in your home.
Licensed electrical contractors can supply and install effective units made by Cutler-Hammer, Diversified Technology, Intermatic and other well known and reputable companies. These units are attached to the inside power panel.
Lightning Protection

• Protective Measures appropriate to Protect Home and Property
  – Protecting Your Home
    • Bonding and Grounding
4. BONDING AND GROUNDING

• Every resident should give careful consideration for having this installed on their homes, especially homes with gas appliances. This will provide the “best bang-for-the-buck” in protecting homes from “proximity” lightning strikes as the first defense.

– REMEMBER – you still need to install the surge suppressors previously discussed for the more direct defense in protecting your valuable personal sensitive electronic hardware and electric appliances.
4. BONDING AND GROUNDING

• “Bonding” is the technique of tying all of the incoming utilities (electrical; gas; telephone; cable and satellite TV; and any additional services present at the home) to a common ground, and having all services at the same electrical potential. This will eliminate or at least reduce the possibility for arcing/sparking.

– NOTE:
All Standards and installation guides specify that bonding of incoming services shall be “near the service’s entrance to the building.”
4. BONDING AND GROUNDING (continued)

- An example of the LPS installer’s bonding of gas service as it enters the home.
  Other services (electrical, telephone, TV, etc.) are to be treated in a similar manner.
4. **BONDING AND GROUNDING**

- For the absolutely most effective installation, the “bonding” should be done by a contractor “qualified” to install “Lightning Protection Systems.”

- A good Bonding System requires an absolutely effective ground.
4. BONDING AND GROUNDING (continued)

- Section 3.13. of NFPA-780 defines the requirements for ground rods, and states that “electrical system and telecommunication electrodes (generally short pieces of rebar) shall NOT be used in lieu of lightning grounds electrodes.”
  - NFPA-780 specifically states that lightning protection system ground rods shall be copper-clad steel, solid copper, hot-dipped galvanized steel, or stainless steel.
  - The National Electric Code (NFPA-70) allows the use of a short section of rebar for grounding the electrical system, which is adequate for electrical safety but does not take into consideration the energy level of a lightning strike, or soil conditions.
4. **BONDING AND GROUNDING** (continued)

- **NFPA-780** also defines that “Bonding” shall be where the services enter the structure (outside the home) and **NOT** after the service has entered the interior of the structure.

This statement is aimed directly at the locally common practice of “bonding” gas service at the manifold that is located in the attic area above the garage.
4. BONDING AND GROUNDING (continued)

- Appendix I of NFPA-780 also defines the means for taking measurements of ground resistance to ensure that the ground rods have sufficient conductivity for proper grounding of the system.

NOTE:
The National Electric Code does NOT even consider the need for this level of measurement for ensuring a “good” electrical ground.
4. BONDING AND GROUNDING  (continued)

• Those homeowners with gas service should give wise consideration for “bonding and grounding” due to the use of CSST (corrugated stainless steel tubing) gas lines. *CSST is used throughout nearly all newer homes, most especially in the southern USA.*

– CSST is flexible thin-wall stainless steel tubing (may or may not be encased in a plastic jacket) (commercially introduced in 1988), in contrast to black pipe that most of us from up north would be familiar with.

– This tubing is susceptible to failure (from pin holes to larger openings) as a result of poor installation practices, damage by careless home-owners, or lightning-induced electrical energy invading this thin-wall tubing (most likely by the lightning energy entering the home via the gas line).
4. **BONDING AND GROUNDING** (continued)

- This photo gives an example of the visual difference between CSST gas lines and the black metal piping most of us may be familiar with:
Lightning Protection

• Protective Measures appropriate to Protect Home and Property
  – Protecting Your Home
    • Lightning Protection System
4. **LIGHTNING PROTECTION SYSTEM (LPS)**

- If your tolerance for sustaining the loss of your house and all of its valuable contents is low, then you should consider installing a “Lightning Protection System.”

- Performing a “Risk Assessment” (see next slide) will help in this matter.

- A complete LPS may cost between $1,800 to $3,000 or higher for a standard home, possibly less for a villa, and more for a large Custom/Premier Home.
4. LIGHTNING PROTECTION SYSTEM (LPS)

- To assist in establishing a “RISK ASSESSMENT,” simply add up the replacement costs for your computer; cordless telephones; dish washer; garage door opener; laundry washer and dryer; lawn sprinkler controller; microwave oven; radios; refrigerator; stove; TV’s; other electric appliances and electronic equipment; golf carts and automobiles (including any restored or valuable antique auto’s); replacement cost for personal valuables; and other irreplaceable possessions.

Now compare the total cost of the above items to the cost for a legitimate LPS installation. This will provide a guide in establishing your financial risk due to loss from a direct lightning strike.

(NOTE: Legitimate contractors can not provide estimates via telephone. Homes must be visually reviewed.)
4. LIGHTNING PROTECTION SYSTEM (LPS)

• If this is your choice, you will want to ensure that the contractor is competent to design and install a system in compliance with **NFPA-780** as mentioned earlier.
4. LIGHTNING PROTECTION SYSTEM (LPS)

- **UL** Statistics state that a properly installed LPS (installation per NFPA-780) is **99% effective** and this protection can be furnished for less than 1% of the cost of your home!
4. LIGHTNING PROTECTION SYSTEM (LPS)

• The major means for having a reasonable confidence that the contractor is competent:
  – being certified and listed on the Lightning Protection Institute (LPI) web site.

    An alternative that does not provide the same level of confidence is:
  – being listed on the Underwriters Laboratory (UL) web site.
4. LIGHTNING PROTECTION SYSTEM (LPS)

- **LPI instructs, tests and certifies** contractor employees under one or more of the following four classifications regarding their knowledge and competency associated with **NFPA-780, LPI-175, and UL-96A**:
  - Journeyman
  - Master Installer
  - Master Installer/Designer
  - Designer/Inspector

- **Contractors that are LPI-certified in Florida** can be found at: [http://www.lightning.org/?page=directory&subnav=Installers#SWC1V_FL](http://www.lightning.org/?page=directory&subnav=Installers#SWC1V_FL).
4. LIGHTNING PROTECTION SYSTEM (LPS)

- **UL** lists contractors who claim acceptable knowledge of the requirements of **NFPA-780** and **UL-96A** (although there is no testing involved) and have pledged to have a certain number of their installations each year reviewed and certified by a **UL** inspector to be in compliance with **NFPA-780** (scheduled at the contractors whim and fancy). **UL** does not conduct surprise/unscheduled inspections for this purpose.

- Contractors **UL**-registered in Florida can be found at: [www.ul.com/lightning](http://www.ul.com/lightning); go to “Find a Listed Installer” under “Related Links” on the lower right side of this web page, further refine the search by identifying contractors located in Florida.
4. LIGHTNING PROTECTION SYSTEM (LPS)

- A “Lightning Protection System” (LPS) installed by qualified contractors will include the following:
  - **Lightning rods** - sufficient to completely protect the structure’s roof, gables, vents, and other necessary areas as defined in NFPA-780.
  - **Down-leads** - from the top-most lightning rod(s) to each corner of the structure and down to the ground rods.
  - **Attachments** - ensure that all lightning rods attached to gables, vents, fans and other metallic objects on the roof, etc. are properly attached to the down-leads.

(Continued on next slide)
4. LIGHTNING PROTECTION SYSTEM (LPS)

– **Primary Electrical Surge Arrestor** - will install, or ensure that a primary electrical source surge suppressor/surge arrestor approved by *Underwriter Laboratories (UL)* has been installed.

– **Surge Suppressors throughout the home** - will verify (but not necessarily install) appropriate surge suppressors have been installed in the house to protect high-value electrical/electronic appliances/equipment.

– **Ground Rods** - will ensure that ground rods have been driven to a depth adequate to provide proper grounding predicated on the specific soil condition around and under the structure.

**NOTE:** LPS Contractor for John Wright’s home had to drive **30 feet of copper ground rod** down at each corner of the house to obtain sufficient grounding measurements due to clay soil under and around the house.
NOTE: Expert consensus opinion is that it is better to **NOT** install any *lightning protection system* if the system does not conform to **NFPA-780**.

*There is a greater probability that an inferior system will cause “more” physical and catastrophic damage than a home with no system at all.*
4. LIGHTNING PROTECTION SYSTEM (LPS)

- The following Figure 3.4 from "The Art and Science of Lightning Protection" by Martin A. Uman provides a clear illustration of what the physical exterior LPS installations should look like.

  Note: All gables have lightning rods installed:
4. LIGHTNING PROTECTION SYSTEM (LPS)

• One significant consideration that anyone selecting a contractor should take under advisement is to request that the contractor agrees to have his/her installation inspected by UL for certification that the system fully complies with NFPA-780 and will make any necessary corrections found by UL at his/her cost.
  – The contractor may not be willing to pay for the UL inspection, passing this cost on to the home owner (which would be a normal practice).
  – If you do not agree to pay for the inspection at the time of installation completion, find out if he/she will accept UL findings some time after the installation completion, and likewise make corrections at his/her cost and agree to this in writing?
  – If you get blank stares, **RUN**.
4. **LIGHTNING PROTECTION SYSTEM (LPS)**

- For anyone that is skeptical of the effectiveness of lightning rods, allow me to offer this example of an historical fact:

  - The 340 foot high Campanile at St. Marks Square in Venice is located in an area which experiences many thunderstorms. Nine recorded instances of severe lightning damage over time has been recorded. It was severely damaged by lightning in **1388**, when it was a wooden building. In **1417** it was set on fire by lightning and destroyed. In **1489** it was again reduced to ashes. In **1548**, **1565**, and **1653** it was damaged more or less severely, and in **1745** lightning practically ruined the whole tower, and in **1761** and **1762** it was again severely damaged. In **1776**, a simple “Franklin” lightning rod was installed and **no trouble from lightning has ever been recorded since**.
4. LIGHTNING PROTECTION SYSTEM (LPS)

Campanile at St. Marks Square in Venice
4. LIGHTNING PROTECTION SYSTEM (LPS)

• If anyone is still skeptical of the effectiveness of an effective lightning protection system, allow me to offer one more example of having an effective conductor (which is the primary purpose of an LPS) to protect property and human life.

Be prepared to look carefully at this next picture and understand that the vehicle and all passengers suffered absolutely no harm:
4. LIGHTNING PROTECTION SYSTEM (LPS)

- Cloud-to-Ground lightning striking a Nippon Airlines commercial flight taking off from Kamatsu Air Force Base, Japan during the winter. Note that the same level of energy striking the nose of the plane exited the tail of the plane. Talk about being in the wrong place at the wrong time.
4. LIGHTNING PROTECTION SYSTEM (LPS)

• In addition to the above cited examples, please consider that without lightning rods and proper lightning protection systems, there would be no electrical power (see photo below); no communication systems such as radio, television, telephone; no water and sewer services; no amusement parks operating after a thunder storm; no launch vehicles on launch pads or launched into space from Cape Kennedy; and many other services that we take for granted.
4. LIGHTNING PROTECTION SYSTEM (LPS)

• Example of an LPS installation, this being the home of John Wright.
4. LIGHTNING PROTECTION SYSTEM (LPS)

• Another view of a home with an LPS installation showing that the bird-cage has also been properly protected.
4. **LIGHTNING PROTECTION SYSTEM (LPS)**

- In addition to the air terminals (lightning rods) being installed on the top-most roof area, all metal appendages (including roof-mounted satellite TV antennas, fans, metal vents, etc.) must be grounded to the down-leads, and high vents must have their own lightning rods.
4. LIGHTNING PROTECTION SYSTEM (LPS)

• One final word of advice:

  – Purchase of a complete “LPS” in conformance with NFPA-780 will include all of the items previously discussed, including the “Primary Electrical Service Surge Arrestor” and “Bonding and Grounding” of all incoming utilities, if any of these services have not been previously installed.

A UPS for your computer is not supplied by the UPS installer. Additionally, surge suppressors for any sensitive and valuable electrical / electronic appliances and equipment within the home will not normally be installed by the LPS contractor.

Remember, a UPS for your computer is a highly recommended purchase for maximum security and safety of your computer.
4. LIGHTNING PROTECTION SYSTEM (LPS)

- One final word of advice (continued):
  - **BE AWARE:**
    
    *It is possible that installers nailing “Lightning Protection System” (LPS) components to the roof and/or otherwise invading the roofing material (such as passing down leads through a hole in the roof/soffit) may be voiding the roofing installation warranty.*

    The LPS contractor should assist in this matter by coordinating the effect on roof warranty with the roofing contractor, and/or otherwise provide written assurances that such warranties have not been voided (such as repairs at the LPS contractors expense if problems develop).
CONCLUSION:

- There is no *absolute “iron-clad”* guarantee that anything you do will positively prevent damage or loss due to a lighting strike. Lightning is a natural phenomenon and is totally unpredictable.

*The choice is yours and yours alone.*
CONCLUSION:

• Installation of a “Lightning Protection System per NFPA-780 has an extremely high probability of protecting your home from a direct lightning strike.

  – To the best of my personal limited knowledge, it has never been proven positively that a home protected by a “Lightning Protection System” that is in full compliance with NFPA-780 has been destroyed by a lightning strike. The Villages has had an unusual number of rogue contractors installing “lightning rods” (which are not legitimate LPS).

  – In addition, it has been scientifically and historically proven that a structure protected by an NFPA-780-conforming Lightning Protection System will positively protect a home from a direct lightning strike. (Data from the University of Florida Camp Blanding Test Facility)

The choice is yours and yours alone.
CONCLUSION:

• If you do not consider installing a “Lightning Protection System (lightning rods),” then it is very important to consider installation of “Bonding and Grounding” of all incoming services per NFPA-780. This action will have the highest probability of preventing, or at least minimizing, the amount of damage that could occur as a result of a “proximity” lightning strike (but understand individual surge suppressors are still required).

- This is extremely important for homes with gas service due to the use of CSST gas lines in the attic.

The choice is yours and yours alone.
CONCLUSION:

• It is absolutely imperative that you install surge suppressors on all small appliances and all electrical/electronic equipment that you value within your home. These will eliminate or at least minimize the potential for damage from a “proximity” lightning strike.

The choice is yours and yours alone.
APPENDIX

APPENDIX A: Myths

APPENDIX B: FAQ

APPENDIX C: Articles of Interest

APPENDIX D: Examples of homes within The Villages with typical conditions failing to meet NFPA-780 Requirements

APPENDIX E: STANDARDS:
» ANSI, NFPA & IEC Publications
» Military Standards
» LPI & UL Publications

APPENDIX F: Reference Publications

APPENDIX G: Web Sites
MYTHS:

• MYTH - Lightning never strikes the same place twice.
  – Truth: Lightning can often strike the same location several times a year.

As an example, the Empire State Building is hit about 25 times each year.

In addition, towers of similar height in Florida get struck about 100 times per year.
MYTHS:

• MYTH – Umbrellas, cleats, and golf clubs attract lightning.
  – Truth: **NOTHING “attracts” lightning.**
    The only determining factor that effects where lightning will strike is the location of the thunderstorm itself.
    It also will matter on how the lightning stroke tends to follow the vagaries of atmosphere in attempting to find “ground” (termination).
MYTHS:

• MYTH - Lightning strikes, or is more likely to strike, tall items.
  – Truth: Lightning has the ability to strike everywhere and everything. Lightning does not discriminate.

NOTE:
See the article in Appendix B regarding a fatality that occurred on a golf course – as a result of the lightning stroke coming horizontally.
MYTHS:

• **MYTH** - Once a Lightning Protection System is installed, nothing more needs to be done.

  – **Truth:**

  • Following any work done on the roof (by anyone including yourself) and preferably no less than once every five years, your installation contractor should be contacted to look for any deterioration, damage or changes to the installed System.

  • Any structural additions made to your home may require additions to the Lightning Protection System – the installing contractor should assess the addition and it’s impact on the installed System.
FREQUENTLY ASKED QUESTIONS ABOUT LIGHTNING

How often does lightning strike?
The International Meteorological Survey Association estimates that lightning strikes the earth approximately 100 times every second.

How frequently does lightning strike in the United States?
Every year, lightning strikes approximately ten times for each square mile. With approximately 9,000,000 strikes annually throughout the continental area of the United States.

What is the lightning flashes we see in the sky?
The path of burning air through which the invisible bolt passes.

What causes the thunder that follows lightning?
Thunder is the sound caused by the rapid expansion and closing of the heated air channel at the lightning stroke.

Are low or small buildings subject to lightning strokes?
As much so as any other size of buildings. Lightning generally strikes where the stored electrical charge is the greatest.

Do high trees near a building offer any protection from lightning?
Trees are non-conductors of electricity... There have been many instances where lightning has struck trees near a building, run out a limb of the trees into the house to find a better ground within the building... through the plumbing system or the grounding of the electric power system. Thereby, a tree contributed to damaging or destroying the building.
APPENDIX B

FREQUENTLY ASKED QUESTIONS ABOUT LIGHTNING (continued)

Is a building that is provided with metal roof and sidings safe from lightning?

Why should it be? When METAL ARC WELDING is done with only a few hundred volts of electricity... then why, or how, could an ordinary metal roof or metal sided building be immune from damage when struck by millions of volts and thousands of amperes? Underwriters Laboratories, inc. state that lightning protection to such structures can be obtained only through the use of modern lightning rod equipment.

Are Concrete, Brick, and other like structures safe from lightning?

Lightning has been known to strike and destroy concrete bridges over rivers. It has also been known to strike concrete and brick smokestacks. It has also struck concrete mausoleums, monuments, and other like structures with devastating effects.

Why are sharp points used with lightning rod installations?

The simplest explanation would be that they would be the highest point above your building to be struck by lightning. However, the sharp points have many functions... Sharp points act to receive and discharge electrical energy... They prevent the lightning from striking by dissipating the electrical charge from the earth... One of Benjamin Franklin's very earliest discoveries was the power of the point to dispel or attract the electrical charges.
FREQUENTLY ASKED QUESTIONS ABOUT LIGHTNING (continued)

Many people think that electrical wires leading into the building, is a safety measure from lightning... is this true or false?

*Why should they be? Electrical wires are metal of both induction and conduction. They can induce and conduct and electrical charge into your building. Underwriters Laboratories, Inc. recommends that secondary lightning arrestors be installed on electrical power lines where they enter the building.*

Do grounded television masts offer any protection to a home from lightning?

*99 9/10 percent of all television masts are grounded with a clothesline. With improper grounding clamps and improper ground rods. Furthermore, a television mast, in many cases extends from ten to forty feet above a building, with its huge antennas spreading out like a huge umbrella. This offers a considerable lightning hazard and even if it were properly grounded. In most cases, the protective area of the building it would cover would be inadequate, unreliable and insufficient. Furthermore, what protection would you have should the wind blow it over? Why depend on a television mast for lightning protection when modern lightning protection equipment would be more architecturally desirable?*

Do insurance agents recommend lightning rods?

*Those that are informed do. Lightning rods are recommended and endorsed by the "National Board of Fire Underwriters." The National Board of Fire Underwriters is sponsored and maintained by 224 old line stock fire insurance companies, and also many smaller, mutual companies.*
Are lighting rods recommended and endorsed by architects?
Yes, by those that are informed. Lightning rods are endorsed by the American Institute of Architects, and also the American Institute of Electrical Engineers.

In what ways has modern lightning protection been improved?
In every way. They have improved in the designing of materials, fixtures, accessories...according to rigid requirements of the National Fire Protection Association (NFPA-780), U.S. Bureau of Standards, Underwriters Laboratories (UL-96A), as well as manufacturers installation methods.

ALL installations are made to conform to the architecture of the building upon which they are being installed.

When is the best time of the year to buy lightning protection?
The best time to buy and install is now. There is no closed seasons on lightning and electrical storms. Just how would/could you be able to determine the exact time to have lightning rods installed to avert or prevent a disaster from a bolt of lightning?
This is a copy of an article describing the unnecessary death of a golfer simply because he chose to stay under a tree during a lightning storm instead of heading for safety, as his three companions did.
APPENDIX C

Second page of above Article showing damage to cart, bag and golf balls.

GO IN IMMEDIATELY, DON'T WAIT.
This is a copy of the article by The Villages District Public Safety Department Fire Chief, Mike Tucker, that appeared in The Villages Daily Sun on Tuesday, September 2, 2008. This article provides Mr. Tucker’s general advice and opinions to all Villagers regarding lightning protection and alarm systems.

This presentation hopefully provides the necessary information in more detail to assist residents in being better educated and more intelligent in pursuing proper lightning protection.
APPENDIX C

Florida Test House Lightning Protection Upgraded for Year Two

On May 23rd the lightning protection system on the lightning test house at the University of Florida was altered in preparation for the 2005 lightning season. The system used in 2004 was installed in compliance with NFPA780 and used two down leads connecting to two double rod grounds. For 2005 the system has been outfitted with two additional down leads with double ground rods—there is now a path to ground at each corner of the building. A counterpoise conductor was also added encircling the house and interconnecting the ground rods. The addition of the ground ring reduced the ohms of resistance of the individual grounds ten fold.

The house is now ready for the 2005 lightning season. Last year the scientists successfully triggered lightning strikes to the lightning protection system on the house three times. Each strike provided volumes of data. One strike in particular involved nine return strokes and has proven particularly interesting to the researchers. The data collected is providing never before seen information concerning how lightning travels over a lightning protection system as well as what happens to the lightning discharge as it moves out over the ground.

The Lightning Safety Alliance is the official sponsor of this two year research project. The ULPA, LPI and various individual lightning protection firms have provided the funding for the project, which carries a $40,000 price tag per year. A final publication of the findings from this project will likely be released in late 2006 and may lead to advancements in grounding practices.
APPENDIX C

Copy of an article from the September 2006 edition of Florida Living featuring Dr. Vladimir Rakov, University of Florida Professor and Director of the International Center for Lightning Research and Testing that is located on the Grounds of Camp Blanding (halfway between Gainesville and Jacksonville, Florida).

The near photo illustrates the results of a rocket-assisted lightning strike on a test tower that is adjacent to the test house mentioned in the previous slide.
APPENDIX D

LIGHTNING PROTECTION SYSTEM INSTALLATION DEFICIENCIES

The following slides provide a few visual examples of LPS installations within The Villages that do not adhere to specific requirements of NFPA-780, and thus have the potential for greater damage from a direct lightning strike than if no “lightning rods” had been installed.
APPENDIX D
LIGHTNING PROTECTION SYSTEM (LPS)

It is difficult to see, but the lightning rod is dead-ended, that is, it is not connected to its respective ground rod as required in Figure 3.8.1 from NFPA-780. (NOTE: This is at the end of the garage, and the lead wire is longer than 16 feet [NFPA-780 allowance for “dead ends.”].)

In addition, there is no air terminal/lightning rod installed on the tall vent, and there is no evidence of a grounding wire attached from the roof fan to the ground lead from the existing air terminal / lightning rod.
It is not very clear, but the left photo shows the down-lead from the roof air terminals/lightning rods attached to a short piece of rebar installed by an uncertified LPS installer.

The proper method would be to bury a copper rod as defined previously and shown in Figure 3.13.1.1 diagram from **NFPA-780**. The photo on the right shows a proper installation in progress.
This air terminal/lightning rod has approximately two (2) inches of the rod showing above the ornament/wind vane. Paragraph 3.6.1 of NFPA-780 clearly states that terminals shall not be less than 10.0 inches in height (and this shall be above any ornamentation).
This lower radius is extremely sharp and fails to meet the requirements defined in Paragraph 3.9.5 of **NFPA-780**. The upper radius also is considerably less than the Standard requirement. The Standard clearly states that no radius shall be less than 8.0 inches.
APPENDIX E

STANDARDS:

ANSI Publications:

- **ANSI LC-1**  Interior Fuel Gas Piping System Using Corrugated Stainless Steel Tubing
- **NFPA 54**  National Fuel Gas Code
- **NFPA 70**  National Electrical Code
- **NFPA 302**  Fire Protection Standard for Pleasure and Commercial Motor Craft
- **NFPA 407**  Standard of Aircraft Fuel Servicing
- **NFPA 410**  Standard on Aircraft Maintenance
- **NFPA 780**  Standard for the Installation of Lightning Protection Systems
APPENDIX E

STANDARDS:

NFPA Publications:

- NFPA 54  National Fuel Gas Code
- NFPA 70  National Electrical Code
- NFPA 302  Fire Protection Standard for Pleasure and Commercial Motor Craft
- NFPA 407  Standard of Aircraft Fuel Servicing
- NFPA 410  Standard on Aircraft Maintenance
- NFPA 780  Standard for the Installation of Lightning Protection Systems
APPENDIX E

STANDARDS:

IEC Publications:

• IEC 1024-1  Protection of Structures Against Lightning, Part 1
• IEC 1312-1  Protection Against Lightning Electromagnetic Impulse, Part 1
• IEC 1662   Assessment of the Risk of Damage Due to Lightning
• IEC DIS81  Protection of Structures Against Lightning, Part 1
APPENDIX E

STANDARDS:

IEEE Publications:

• **ANSI/IEEE C62.11**
  Standard for Metal-Oxide Surge Arresters for Alternating Current Systems

• **IEEE 0093-9994/1100-0465**
  Protection Zone for Buildings Against Lightning Strokes Using Transmission Protection Devices
APPENDIX E

STANDARDS:

Military Standards:

- AFR 127-100
  Explosives Safety Standards

- AMCR 385-100
  Safety Manual, Chapter 8

- DoD 6055.9-STD
  Ammunition and Explosives Safety Standard, Chapter 7

- MIL-HDBK-419A
  Grounding, Bonding, and Surge Suppression, Volume I and Volume II
APPENDIX E

STANDARDS:

Military Standards (continued):

• NAVSEA OP-5
  Ammunition and Explosives Ashore, Volume 1

Lightning Protection Institute Publications:

• LPI-175 Standard of Practice for the Design – Installation – Inspection of Lightning Protection Systems

UL Publications:

• UL 96A Standard for Installation Requirements for Lightning Protection Systems
• UL 1449 UL Standard for Safety Transient Voltage Surge Suppressors
APPENDIX F

REFERENCE PUBLICATIONS:

• The Art and Science of Lightning Protection
  By Martin A. Uman

• Lightning Rod Improvement Studies
  By C.B. Moore, W. Rison, J. Mathis, and G. Aulich

• Lightning Induced CSST Fires
  By Mark Goodson

• The Report of the Committee on Atmospheric and Space Electricity of the American Geophysical Union of the Scientific Basis for Traditional Lightning Protection Systems
  By the American Geophysical Union (AGU)

• Position Paper of Lightning Protection Systems, November 12, 2002
  By the American Metrological Society (AMS)
APPENDIX F

REFERENCE PUBLICATIONS:

• The Basis of Conventional Lightning Protection Technology
  2001 By the Federal Interagency Lightning Protection User Group

  By the Insurance Information Institute
WEB SITES:

CERTIFIED/LISTED LPS INSTALLERS WEBSITES

LIGHTNING PROTECTION INSTITUTE:
http://www.lightning.org/?page=directory&subnav=Installers#SWC1V_FL

UNDERWRITERS LABORATORY:
www.ul.com/lightning
APPENDIX G

WEB SITES:

- [http://www.lightning.org](http://www.lightning.org) Lightning Protection Institute home page
- [http://www.lightning.org/?page=directory&subnav=Installers#SWC1V_FL](http://www.lightning.org/?page=directory&subnav=Installers#SWC1V_FL) Site for LPI-Certified Contractors
APPENDIX G

WEB SITES:

- [http://www.lightning.org/documents/CSST_Article.pdf](http://www.lightning.org/documents/CSST_Article.pdf)  
  Lightning Protection & Bonding Of Metallic Gas Lines (CSST)

  Lightning Induced CSST Fires

  Lightning Fires to Problem Gas Tubing

- [http://www.lightning.org/documents/CSST_Article.pdf](http://www.lightning.org/documents/CSST_Article.pdf)  
  Lightning Protection & Bonding Of Metallic Gas Lines (CSST)

- [http://www.lightningsafety.noaa.gov/index.htm](http://www.lightningsafety.noaa.gov/index.htm)  
  National Oceanographic and Atmospheric Administration (NOAA) National Weather Service (NWS)
APPENDIX G

WEB SITES:

• www.ul.com  UL home page
• www.ul.com/lightning  Site for UL discussion of lightning and concerns
• http://database.ul.com/cgi-bin/XYV/cgifind.new/LISINSPECT/1FRAME/srchres.html  UL Listing of Contractors located in Florida
• http://www.nfpa.org  NFPA Home Page
• http://www.nahbrc.org  National Association of Home Buildings
APPENDIX G

WEB SITES:

• http://database.ul.com/cgi-bin/XYV/cgifind.new/LISINSPECT/1FRAME/srchres.html  
  UL Listing of Contractors located in Florida

• https://ifs.ul.com/lps/lightningprotectionhome.nsf/HomePage?OpenForm  
  UL – Lightning Protection Certification Services

• http://www.nfpa.org  
  NFPA Home Page

• http://www.nahbrc.org  
  National Association of Home Buildings

• http://www.neccodebooks.com  
  National Electric Code - Code Books

• http://www.lightning.ecc.ulf.edu  
  University of Florida
APPENDIX G

WEB SITES:


• [http://lightningsafetyalliance.com](http://lightningsafetyalliance.com) Lightning Safety Alliance

• [http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.htm](http://www.srh.noaa.gov/jetstream/tstorms/tstorms_intro.htm) NOAA Thunderstorm Days Map of the USA
APPENDIX G

WEB SITES:

Web Sites for CSST Manufacturers:

- [http://www.wardmfg.com](http://www.wardmfg.com)  
  Ward Manufacturing, Blossburg, PA
- [http://www.tracpipe.com](http://www.tracpipe.com)  
  Omegaflex, Westfield, MA
- [http://www.gastite.com](http://www.gastite.com)  
  Gastite, Springfield, MA
  Parker Hannifin Corporation, Ravenna, OH
- [http://www.tru-flex.com](http://www.tru-flex.com)  
  Tru-Flex Metal Hose, Howell, MI
- [http://www.mtlfab.com](http://www.mtlfab.com)  
  Tru-Flex Metal Hose, Howell, MI
WEB SITES:
Web Sites Relative to Lightning and CSST Gas Pipe:


  “Investigating the Causal Link Between Lightning Strikes, CSST and Fire”

  Warning tag to be attached in visible location to warn home owner of need for bonding and grounding and possibility of damage from lightning