Today's "Modern" Lightning Protection: Mr. Hocus Pocus, Meet Mr. Smoke & Mr. Mirrors

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1.0 Introduction

Since early times, merchants have sought to appear distinct and special by promoting ordinary-functioning products with unique properties:

- *"Apply this face powder and look twenty years younger !"*
- "*Put these magnets next to your fuel injection system and get sixty miles per gallon!"*
- *"Drink our healthy beverage and lose 15 pounds per week !"*
- *"We discharge lightning strikes with our multi-pointed product !"*
- *"Our lightning Terminator creates ionic flow to re-direct lightning strikes !"*
- *"Pulsbar captures lightning and directs it harmlessly to earth."*

2.0 Discussion

Many lightning air terminal (AT) designs suffer such exaggerations. Some new shapes of AT devices have made appearances in recent times. Descriptive phrases for these unconventional designs include such pseudo-scientific terms as "20,000,000 pairs of fast-acting electrons," "directed charge presentation to the fourth power," "plasma generators," etc.

Early Streamer Emitter (ESE) air terminals are in this category. So are "dissipation arrays (DAS)" employing "charge transfer systems (CTS)." Extensive independent research by scientists such as Hartono & Robiah, V. Rakov, M. Uman, A. Pedersen, Dehn & Sohns, and others have concluded that these unconventional devices work no better than ordinary lightning rods. They just cost more.

Installers of conventional lightning protection devices should follow the recommendations in the USA NFPA-780 *Installation of Lightning Protection Systems*, the IEC 62305 *Protection Against Lightning*, the Australian/New Zealand AS/NZS 1768 *Lightning Protection*, and other recognized international authorities.

The first page of NFPA-780, Section 1.1.3, explains that ESE and CTS/DAS are not recognized and thus are to be excluded. No AT and no lightning protection system can provide 100% safety from lightning's effects. Directly installed ATs, including CTS/DAS/ESE are intended to protect structures from fires and physical damage.

The idea is to "collect" the lightning to a "preferred" source and from there to "divert it" along a conductive routing "harmlessly" to ground. There is no guarantee this will work since lightning often has its own agenda.

Examples:

1. Structure is metal. Will the entire building become energized?
2. Structure is wet from rain. Where is the "path of least impedance"?

3. Structure contains metal window frames and electrical wiring inside exterior walls. Does the lightning engage them also?
4. Roof of structure has metal ductwork, water drains, HVAC, ladders, vent pipes, TV antennas, etc. in addition to lightning rods. Do they conduct too?

Protection of people is a separate subject from building or structural protection. To be protected, people must avoid being a part of the current circuit-path. Thus, avoiding contact with electrical equipment, copper water pipes, telephone wiring, etc. is important. Outdoors, no place is safe nor can it be made safe. Evacuation to metal vehicles or to permanent buildings is suggested at the first signs of thunder or lightning.

Electrical and electronic equipment only can be defended by surge protection devices (SPDs – also known as TVSS, or Transient Voltage Surge Suppressors) properly installed and referenced to low impedance grounding. SPDs work by absorbing heat and by diverting harmful voltages to a conductive earth. SPDs installed at main entry panels and for signal circuits are required by NFPA-780.

Beware of false advertising claims here too. See the National Electrical Code (NEC) Sections 280 and 285 for guidance on SPDs and arrestors. Read the NLSI website at www.lightningsafety.com.

Further information and details about surge protection and grounding can be reviewed in IEEE-STD 142, in IEEE-STD 1100, in IEC 62305, etc. Another important topic is bonding of all metallic conductors. Without effective bonding, the lightning protection system will not work. Poor bonding may result in voltage rise mismatches, which in turn may lead to “arcs and sparks” on sensitive low voltage equipment.

Finally, remember that no type of air terminal design will contribute to lightning safety if the threat enters a structure indirectly via electrical wiring, buried metal water pipes, telephone wiring or other secondary avenues. Only SPDs, good grounding and good bonding will mitigate the hazard. The table below of Lightning Protection Defenses describes how all the components of lightning protection systems fit together.

Lightning Protection Defenses

	Direct strike	Indirect strike	Exterior location	Interior location	People safety	Structure safety
Air terminals	yes	n/a	yes	n/a	n/a	yes
Down-conductors	yes	n/a	yes	yes	n/a	yes
Bonding	yes	yes	yes	yes	yes	yes
Grounding	yes	yes	yes	yes	yes	yes
Shielding	yes	yes	yes	yes	yes	yes
Surge protection	yes	yes	yes	yes	yes	yes
Detection	yes	yes	yes	yes	yes	yes
Policies & procedures	yes	yes	n/a	n/a	yes	yes

Apply these sub-systems as appropriate (yes or n/a) to specific facilities or structures.

3.0 Conclusion

A prudent approach to risk management of the lightning hazard is indicated by being proactive and to apply legitimate defenses. Avoid "junk science" products. Perform detailed due diligence via "Google investigations" and via proceedings from legitimate academic journals. ***Safety is the prevailing directive.***

4.0 References

Dehn & Sohn, *Lightning Protection Guide*, Dehn & Sohn: Neumarkt, Germany, 2007.

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