Ham 42 – Antenna Path & 3 grounds – Why?

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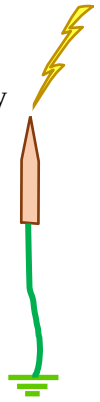

1. Why may an antenna require a lightning protection system? NFPA 780, *Standard for the Installation of Lightning Protection Systems*, provides assessment criteria considering a long array of conditions. Then it calculates the probability. If the probability is greater than 1, a lightning protection system should be installed.
2. Let us cut to the chase, if you stick an antenna outside that is higher than its surroundings, it has a high probability of a lightning strike and the coax provides a path to ground inside your shack.
3. An antenna system contains three sub-systems: (1) RF path, (2) mast, and (3) lightning protection.
4. The protection system is relatively simple. The technology is the same as Dr. Ben Franklin developed in 1750.
5. The design has three components. (1) Provide an alternative place for the lightning to attach called a strike termination device, STD. (2) Provide two alternative paths to ground, downcomers. (3) Provide an effective connection to the earth.
6. *Antenna*: The antenna and coax are one path to discharge lightning to ground. The objective is to split the current and provide a lower impedance (not resistance) path to ground for the transient electro-magnetic energy.
7. *Strike Termination Device:* Place a copper rod 24" above the point to be protected. Bond it to the metal support mast and to the antenna base. This becomes the preferred path rather than the antenna or building.
8. *Downcomers*: Two alternate downcomers split the transient current. The metal mast, if properly assembled with bonds, is the first downcomer.
9. *Basket-weave:* The second downcomer is #1/0 basket-weave copper conductor. Other stranded or solid conductor will not work since it has poor inductive reactance response, at lightning frequencies. Bond the conductor to the lightning rod.
    a. Route the basket-weave along the mast. Strap the downcomer to the mast to hold in place.
    b. If the top of the rod is 60' or higher above ground, bond the basket-weave to the mast half-way down. This keeps a large potential difference from developing, due to different impedances between the mast and downcomer.
10. At the bottom of the mast, a separate bond to a separate ground rod connects to each of the three sub-system paths: the coax, the mast, the downcomer.
    a. Run the #1/0 basket weave downcomer all the way to its ground rod.
    b. Bond another #1/0 basket-weave to the base of the mast. Run it to its ground rod.
    c. Bond a #10 AWG conductor from the entrance common point ground, described below, to a third ground rod.
11. *Equipotential*: Bond together the three ground-rods underground. Bond each rod to both other rods. Separate the ground rods by ~17 feet if feasible. In poor soil, bury the ground rods in concrete.
12. If the tower is tall, then run radials from each leg of the tower and additional ground rods are placed at about 17' intervals along the radials. Too close and they have less effect, too far and there is not adequate connection to earth.
13. Now let's talk about how to mitigate the residual transient energy on the path we are trying to protect, the coax.
14. Do not coil the coax. That actually acts as a transformer and can make the transient effects worse. I used to do that, following normal ham practices.
15. *Ferrite*: Put Type 31 ferrite beads near the antenna. The ferrite creates a huge inductive reactance, mitigating the flow of the transient on the coax. So, it goes elsewhere, like the two downcomers.
16. *Feed-point protection*: Because of inductive reactance build-up, if greater than 25 or so feet from the entrance, place a PolyPhaser™ in-line with the coax near the antenna. Bond to the mast, as an alternate downcomer for the energy diverted by the PolyPhaser from the coax.
17. *Single-point protection*: Near where entering the building, place another PolyPhaser™. Bond to a metal plate and provide a direct path to a ground rod. This is a much smaller wire, #10 AWG, since not much energy remains on the coax downcomer.
18. There is a very specific reason for everything on the antenna protection design. Be careful.
19. References for more information: NFPA 780, *Standard for the Installation of Lightning Protection Systems*; NFPA 70, *NEC, National Electrical Code, Chapter 8*; ARRL Handbook, *Grounding and Bonding;* Transtector.com, *White Papers*; IEEE Papers including "Lightning, Grounding, and Protection for Distributed Control and Communications Systems: A Retrofit," by Marcus O. Durham and Robert A. Durham (1993). Theway Labs.