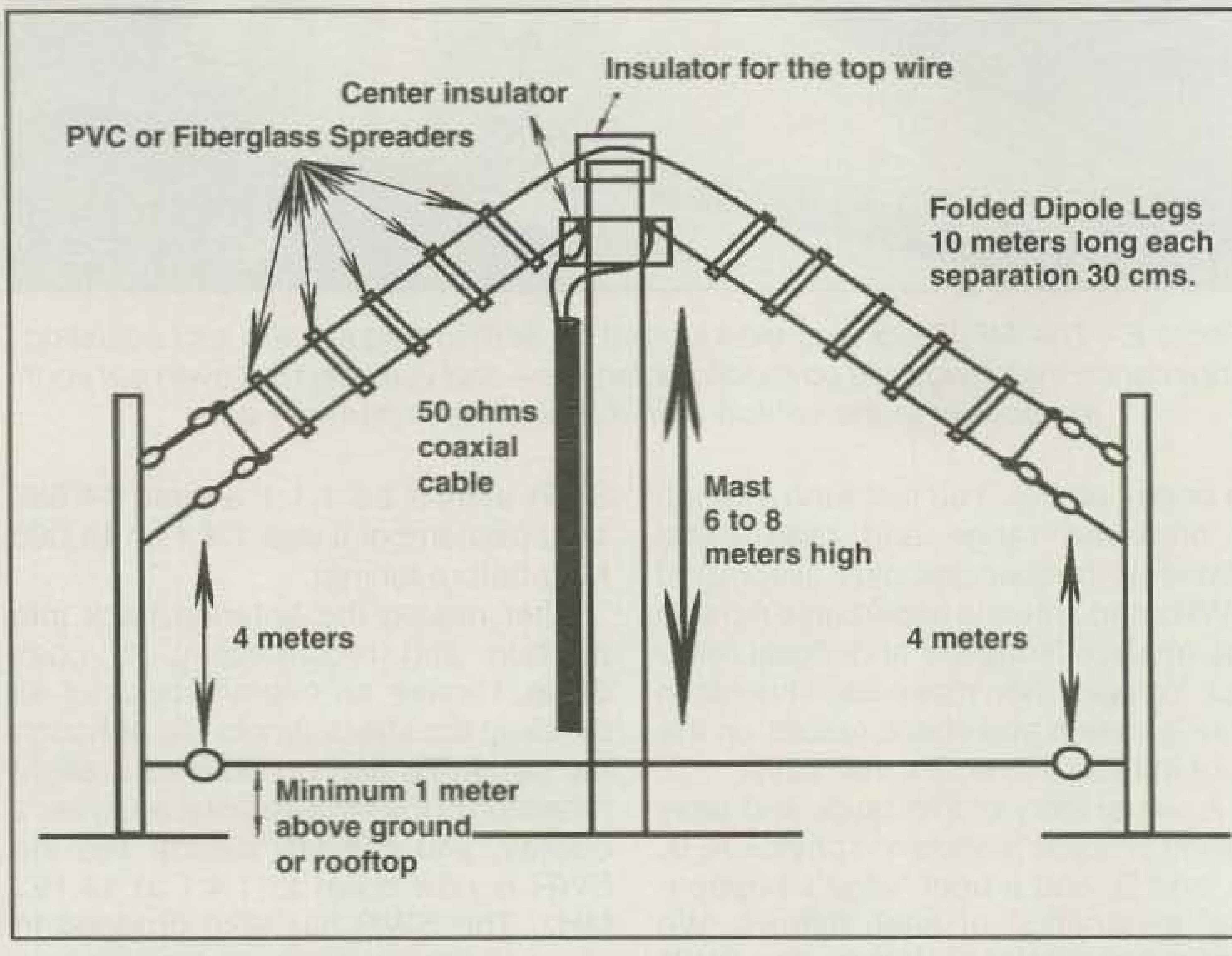
BY ARNIE CORO, CO2KK

Connecting Your Station To The World

Build A "Cloud Warmer" NVIS Antenna System



CO2KK's folded-dipole Near Vertical Incidence Skywave (NVIS), or "Cloud Warmer," antenna for 40 meters. The horizontal line near the bottom (1 meter off the ground) is the reflector. If fed with open-wire line, the same antenna is usable on 30 meters, and a similar antenna can be built for 80 meters. It is excellent for short-range communications, as in emergency or traffic nets. (Illustration by Olga Dalmau)

Gale-force winds had already started and our hurricane emergency communications net was in full swing. Radar data was coming in, pinpointing the eye of the storm and the track it was following.

Signals from the portable station at the radar site were difficult to copy for almost every station participating in the net, except two who had installed permanent Near Vertical Incidence Skywave (NVIS) antenna systems just a few days before the official June 1st beginning of the hurricane season.

The portable station was also using an NVIS system of sorts, because Crescencio, CO4BM, had decided to place the half-wave 40 meter dipole really close to the ground, as the weather station personnel had told him that it was very likely that the Punta del Este site would receive the full blast of the hurricane that was rapidly approaching.

After the storm was over, many amateurs started to ask me questions about why the NVIS systems had performed so well, delivering really strong signals, plus another very desirable characteristic for emergency communications: much less QSB (fading) at around sunrise and sunset, as one would get with standard half-wave dipoles installed at the typical 10 to 15 meters (30 to 45 feet) above ground.

First used by broadcasters in the tropics, the NVIS antenna has now become a standard for close-range communications via the ionosphere. Because it points your signal nearly straight up (note the "near vertical" in the name), this type of antenna has become affectionately known as a "cloud warmer." It is an ideal system for emergency communications on the 80 and 40 meter bands, and will provide regular net control stations with an outstanding signal.

Interest generated by the effectiveness of the NVIS system during hurricane emergencies led to the design of the antenna shown in fig. 1, which may be installed using a single mast or tower, as the two legs of the folded dipole slope gently at a not-too-critical angle, so the long Dacron™ rope insulators can be tied to short masts or the side of a building or maybe a conveniently located fence.

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CO2KK's NVIS Folded-Dipole *Plus* Reflector System

At first glance, looking at fig. 1, you may ask, "Why use a folded dipole?"

The answer is very easy to explain. The CO2KK NVIS system uses a closely spaced tuned-reflector element, which considerably reduces the feedpoint impedance of the radiating element.

If you use a standard single-wire half-wave dipole, the typical feedpoint impedance will go as low as 10 ohms, and usually around 12 to 15 ohms, depending on the local objects within the antenna's near field. By using a *folded dipole* element , the 10 to 15 ohms impedance is quadrupled to between 40 and 60 ohms, a very convenient value for using the antenna with a 1:1 balun and a 50-ohm coaxial line. The use of the 1:1 balun is very important, as you don't want feedline radiation to spoil your radiation pattern!

The CO2KK NVIS antenna can be built for permanent use by using fiberglass spreaders conveniently placed to keep the two wires that form the folded dipole at a constant spacing, and the 1:1 balun must be rated according to the power used by your station. I strongly recommend using an *air-core* balun, which can be homebrewed easily and will not saturate when running high power, as ferrite core ones tend to do.

Keep in mind that base stations operating during emergencies normally run near maximum legal power, even when using generators, as communications officials tend to agree that running the net control station at high power levels keeps the operating channel clear, something that is quite logical, to say the least.

Reports received over the past three years during which the antenna has been in operation show that the NVIS

Tuning the Reflector Element

In a typical CO2KK type Folded Dipole + Reflector NVIS system, the reflector wire is placed at not less than 1 meter (39 inches) above the ground, with 2 meters (78 inches) preferred.

The close proximity of the ground to the reflector element, together with the close asymmetrical proximity of the inverted-V shaped folded dipole, make it necessary to *tune the reflector to resonance,* using a lightly coupled grid-dip meter. *(See Feb. 2000 CQ for "The Grid Dip Oscillator," p. 22, and "How to Build an LED Indicating Dipmeter," p. 26.—ed.)*

If you plan to operate the NVIS antenna on the 40 meter band, select the segment that is most likely to be used during either your regular net operations or during emergencies. In my case the antenna's reflector was tuned for maximum gain at 7.1 MHz, which was almost perfectly achieved by tuning it to a frequency 5 percent lower than 7.1 MHz (6.745 MHz).

The length of the very close to the ground reflector element will depend on so many variables that my advice is for you to deal with each antenna as a special case, and tune the reflector to a frequency 5 percent lower than the resonant frequency of the folded-dipole element.

system antenna delivers a very strong signal during local daylight hours in the range from about 30 to 500 kilometers (20 to 300 miles), while its behavior during the ionospheric transitions that occur around sunrise and sunset make it particularly useful to keep communications running during emergencies.

No attempt was ever made to measure actual antenna gain, although the fact that it is a 2-element Yagi array with a closely spaced reflector could lead us to think that the NVIS Folded Dipole + Reflector should provide no less than 4 dB gain over a standard half-wave dipole installed at between 10 and 15 meters above ground level.

Additional Advantages

The NVIS system has other advantages, too. Among them, there is one which is also particularly convenient for emergency communications systems, and it is the fact that signals coming in at low-incidence angles above the horizon are attenuated to an extent that makes reception of the desired high-angle signals much better—in other words, there is a definite advantage to installing the NVIS system, as the signals from nearby stations coming in at high-incidence angles are much stronger than those coming from DX stations.

In addition, the 7 MHz band system, using a folded-dipole radiator, can provide service on the 10.1 MHz band (30 meters), if the antenna is fed using open-wire line, something that might be useful for running a digital communications net on that band during the hours when NVIS signals are available on 30 meters.

You can also build a similar system for 80 meters, but this would require a much higher mast, which could be difficult to keep up in the middle of a hurricane, although the NVIS 3.5 to 4.0 MHz folded-dipole antenna would be ideal for Net Control Stations that operate systems handling regular (non-emergency) traffic.

What About Higher Frequencies?

NVIS systems are limited to operation at 10 MHz or below due to the fact that even a very highly ionized ionosphere will not support Near Vertical Incidence Skywave on higher frequencies. Very intense type-L sporadic-*E* layers sometimes send back to Earth signals on frequencies as high as 20 MHz, when the oblique incidence signals may propagate for brief periods on frequencies up to or even above 100 MHz. However, these do not occur often enough for the antennas to be reliable above 10 MHz.

Overall, the NVIS antenna should be strongly considered for any operator—such as an active traffic-handler or emergency communicator—who needs strong signals and reliable communications on 80, 40, or 30 meters with nearby stations within a range of 200 miles.

73, Arnie, CO2KK

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What About a 3-Element NVIS Beam?

Why not use the parasitic element as a *director* instead of a reflector? And...why not make the NVIS system a 3-element beam shooting straight up?

The first question is not too difficult to answer: A reflector mounted close to the ground is easier to deal with, will provide the required gain and bandwidth, and can be more easily accessible for tuning than a director mounted above the driven element!

Making the NVIS system a 3-element parasitic array will reduce the area of the ionosphere illuminated by the radiation pattern, something that is not desirable, as it will also reduce the effective service area of the antenna.