Nuclear War, Terrorism:

Protection From EMP

There's no need to go back to the Stone Age if nuclear war occurs...

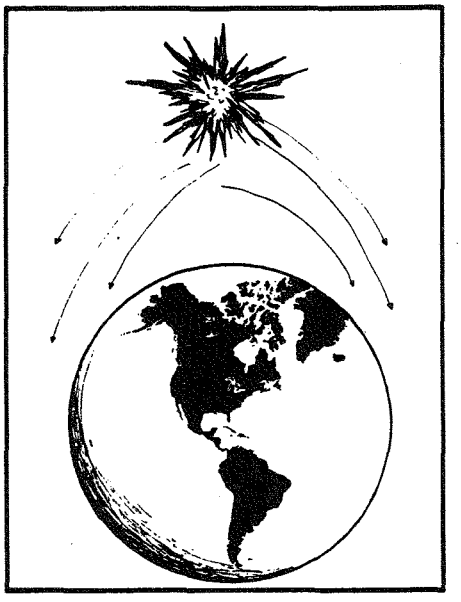
By Duncan Long

EMP. The letters spell burnt out electrical systems and a return to the Dark Ages to many survivalists. But it doesn't need to be that way. Once you understand EMP, you can take a few simple precautions to protect yourself and equipment from it. In fact, you can enjoy much of the "high tech" life style you've become accustomed to — even after a nuclear war.

EMP (Electromagnetic Pulse), also sometimes known as "NEMP" (Nuclear Electromagnetic Pulse), was kept secret from the public for a long time and was first discovered more or less by accident when U.S. military tests of nuclear weapons started knocking out phone banks and other equipment miles from ground zero.

While EMP is no longer "top secret," information about it is a little sketchy and often confusing. Adding to the problems is the fact that its effects are hard to predict; even electronics designers have to test their equipment in powerful EMP simulators before they can be sure it is really capable of withstanding the effect.

EMP occurs with all nuclear explosions. With smaller explosions the effects are less pronounced. Nuclear bursts close to the ground are dampened by the earth so that EMP effects are more or less confined to the region of the blast and heat wave. But EMP becomes more pronounced and wide spread as the size and altitude of a nuclear blast is increased. Of these two, altitude is the quickest way to produce greater EMP effects. As a nuclear device is exploded higher up, the earth soaks up fewer of the free electrons produced before they can travel some distance.



A nuclear explosion in space would release gamma radiation which would react with the upper layer of the earth's atmosphere to create EMP that would blanket the whole continental U.S. and much of Canada.

The most "enhanced" EMP effects would occur if a nuclear weapon were exploded in space, outside the Earth's atmosphere. In such a case, the gamma radiation released during the flash cycle of the weapon would react with the upper layer of the earth's atmosphere and strip electrons free from the air molecules, producing electromagnetic radiation similar to broad-band radio waves (10 kHz-100 MHz) in the process. These electrons would follow the earth's magnetic field and quickly circle toward the ground where they would be finally dampened. (To add to the confusion, we now have two more EMP terms: "Surface EMP" or "SEMP" which refers to ground bursts with limited-range effects and "High-altitude EMP" or "HEMP" which is the term used for a nuclear detonation creating large amounts of EMP).

Tactically, a space-based nuclear attack has a lot going for it; the magnetic field of the earth tends to spread out EMP so much that just one 20-megaton bomb exploded at an altitude of 200 miles could, in theory, blanket the continental U.S. with the effects of EMP

It's believed that the electrical surge of the EMP from such an explosion would be strong enough to knock out much of the civilian electrical equipment over the whole country. Certainly this is a lot of "bang for the buck" and it would be foolish to think that a nuclear attack would be launched without taking advantage of the confusion of high-altitude explosion could create. Ditto with its use by terrorists should the technology to get such payloads into space become readily available to smaller countries and groups.

But there's no need for you to go back to the Stone Age if a nuclear war occurs. It is possible to avoid much of the EMP damage that could be done to electrical equipment with just a few, simple precautions.

First of all, it's necessary to get rid of a few erroneous facts, however.

One mistaken idea is that EMP is like a powerful bolt of lightning. While the two are alike in their end results — burning out electrical equipment with intense electronic surges — EMP

is actually more akin to a super-powerful radio wave. Thus, strategies based on using lightning arrestors or lightning-rod grounding techniques are destined to fail in protecting equipment from EMP.

Another false concept is that EMP "out of the blue" will fry your brain and/or body the way lightning strikes do. In the levels created by a nuclear weapon, it would not pose a health hazard to plants, animals, or man PROVIDED it isn't concentrated.

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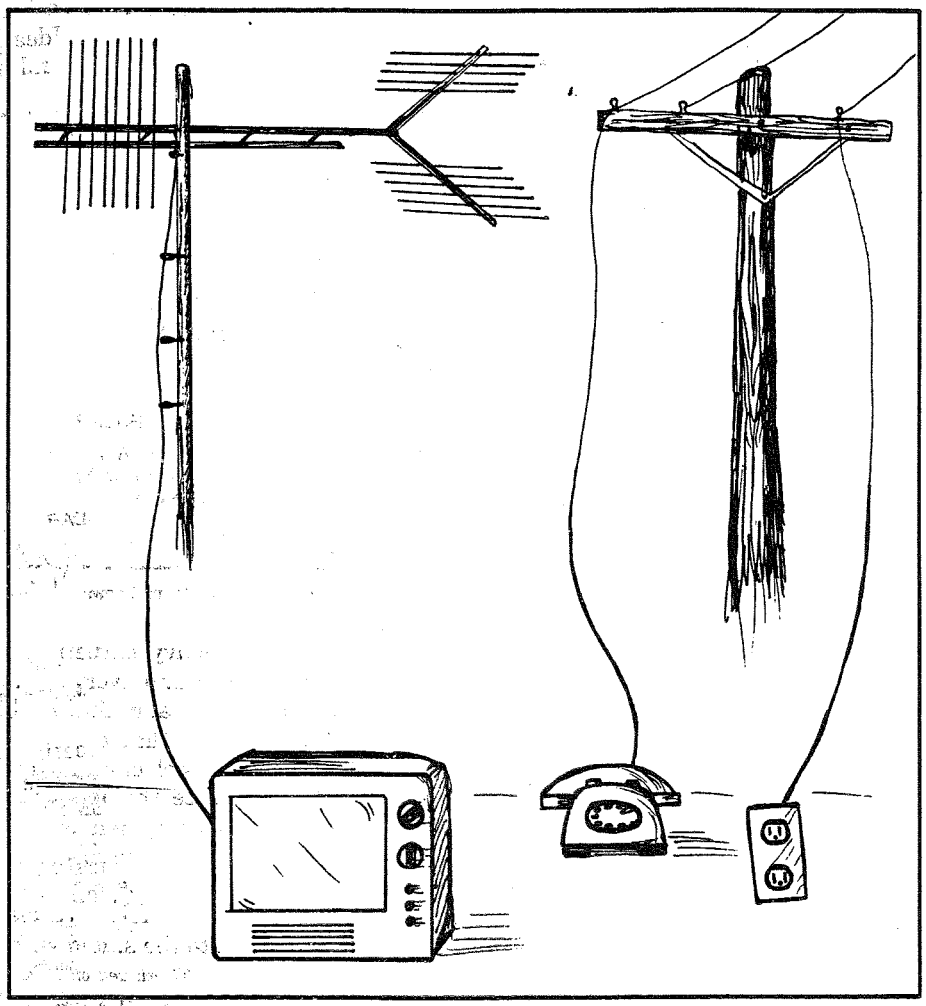

EMP can storm into your home at the speed of light through the telephone, via antennas, or over the AC power grid. Equipment connected to such wiring will probably be destroyed unless special precautions are taken.

That could happen if it were "pulled in" by a stretch of metal. If this happened, EMP would be dangerous to living things. It would become concentrated by metal girders, large stretches of wiring (including telephone lines), long antennas, or similar set ups. So — if a nuclear war were in the offing — you'd do well to avoid being very close to such concentrations. A safe distance for nuclear-generated EMP would be at least 8 feet from such stretches of metal.

This concentration of EMP by metal wiring is one reason that most electrical equipment and telephones would be destroyed by the electrical surge. It isn't that the equipment and telephones would be destroyed by the electrical surge. It isn't that the equipment itself is really all that sensitive, but that the surge would be so concentrated that nothing working on low levels of electricity would survive.

Saving Equipment — Protecting electrical equipment is simple if it can be unplugged from AC outlets, phone systems, or long antennas. But that assumes that you won't be using it when the EMP strikes. That isn't all that practical and if a nuclear war were drawn out or an attack occurred in waves spread over hours or days you'd have to either risk damage to equipment or do without it until things had settled down for sure.

One simple solution is to use battery-operated equipment which has cords or antennas of only 30 inches or less in length. This short stretch of metal puts the device within the troughs of the nuclear-generated EMP wave and will keep the equipment from getting a damaging concentration of electrons. Provided the equipment isn't operated close to some other metal object (i.e., within 8 feet of a metal girder, telephone line, etc.), it should survive without any other precautions being taken with it.

If you don't want to buy a wealth of batteries for every appliance you own or want to use a radio set up with longer than 30-inch antenna, then you'll need to use equipment that is "hardened" against EMP.

The trick is that it must REALLY be hardened from the real thing, not just EMP-proof on paper. This isn't all that easy; the National Academy of Sciences recently stated that tailored hardening is "not only deceptively difficult, but also very poorly understood by the defense-electronics community." Even the military has equipment which might not survive a nuclear attack, even though it is designed to do just that.

That said, there are some methods which will help to protect circuits from EMP and give you an edge if you must operate ham radios or the like when a nuclear attack occurs. Design considerations include the use of tree formation circuits (rather than standard loop formations); the use of induction shielding around components; the use of self-contained battery packs; the use of loop antennas; and (with solid-state components) the use of Zener diodes. These design elements can eliminate the chance an EMP surge from power lines or long antennas damaging your equipment. Another useful strategy is to use grounding wires for each separate instrument which is coupled into a system so that EMP has more paths to take in grounding itself.

A new device which may soon be on the market holds promise in allowing electronic equipment to be EMP hardened. Called the "Ovonic threshold device," it has been created by Energy Conversion Devices of Troy, Michigan. The Ovonic threshold device is a solid-state switch capable of quickly opening a path to ground when a circuit receives a massive surge of EMP. Use of this or a similar device would assure survival of equipment during a massive surge of electricity.

Some electrical equipment is innately EMP-resistant. This includes large electric motors, vacuum tube equipment, electrical generators, transformers, relays, and the like. These might even survive a massive surge

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of EMP and would be likely to survive if a few of the above precautions were taken in their design and deployment.

At the other end of the scale of EMP resistance are some really sensitive electrical parts. These include IC circuits, microwave transistors, and field Effect Transistors (FETs). If you have electrical equipment with such components, it must be very well protected if it is to survive EMP.

One "survival system" for such sensitive equipment is the Faraday box.

A Faraday box is simply a metal box designed to divert and soak up the EMP. If the object placed in the box is insulated from the inside surface of the box, it will not be affected by the EMP traveling around the outside metal surface of the box. The Faraday box is simple and cheap and often provides more protection to electrical components than "hardening" through circuit designs which can't be (or haven't been) adequately tested.

Many containers are suitable for make-shift Faraday boxes: cake boxes, ammunition containers, metal filing cabinets, etc., etc., can all be used. Despite what you may have read or heard, these boxes do NOT have to be air-tight due to the long wave length of EMP; boxes can be made of wire screen or other porous metal.

The only two requirments for protection with a Faraday box are: (1) the equipment inside the box does NOT touch the metal container (plastic, wadded paper, or cardboard can all be used to insulate it from the metal) and (2) the metal shield is continuous without any gaps between pieces or extra-large holes in it.

Grounding a Faraday box is NOT necessary and in some cases actually may be less than ideal. While EMP and lightning aren't the "same animal," a good example of how lack of grounding is a plus can be seen with some types of lightning strikes. Take, for example, a lightning strike on a flying airplane. The strike doesn't fry the plane's occupants because the metal shell of the plane is a Faraday box of sorts. Even though the plane, high over the earth, isn't grounded it will sustain little damage.

In this case, much the same is true of small Faraday cages and EMP. Consequently, storage of equipment in Faraday boxes on wooden shelves or the like does NOT require that everything be grounded. (One note: theoretically non-grounded boxes might hold a slight charge of electricity; take some time and care before handling ungrounded boxes following a nuclear attack).

The thickness of the metal shield around the Faraday box isn't of much concern, either. This makes it possible to build protection "on the cheap" by simply using the cardboard packing box that equipment comes in along with aluminum foil. Just wrap the box with the aluminum foil (other metal foil or metal screen will also work), tape the foil in place and you're done. Provided it is kept dry, the cardboard will insulate the gear inside it from the foil; placing the foil-wrapped box inside a larger cardboard box is also wise to be sure the foil isn't accidentally ripped anywhere. The result is an "instant" Faraday box with your equipment safely stored inside, ready for use following a nuclear war.

Copper or aluminum foil can help you insulate a whole room from EMP as well. Just paper the wall, ceiling and floor with metal foil. Ideally the floor is then covered with a false floor of wood or with heavy carpeting to insulate everything and everyone inside from the shield (and EMP). The only catch to this is that care must be taken NOT to allow electrical wiring connections to pierce the foil shield (i.e., no AC-powered equipment or radio antennas can come into the room from outside). Care must also be taken that the door is covered with foil AND electrically connected to the shield with a

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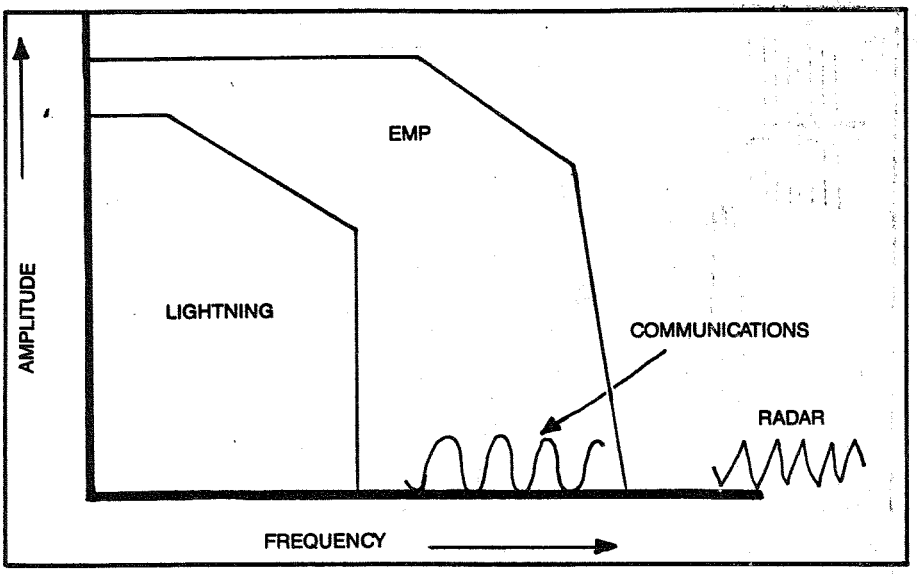
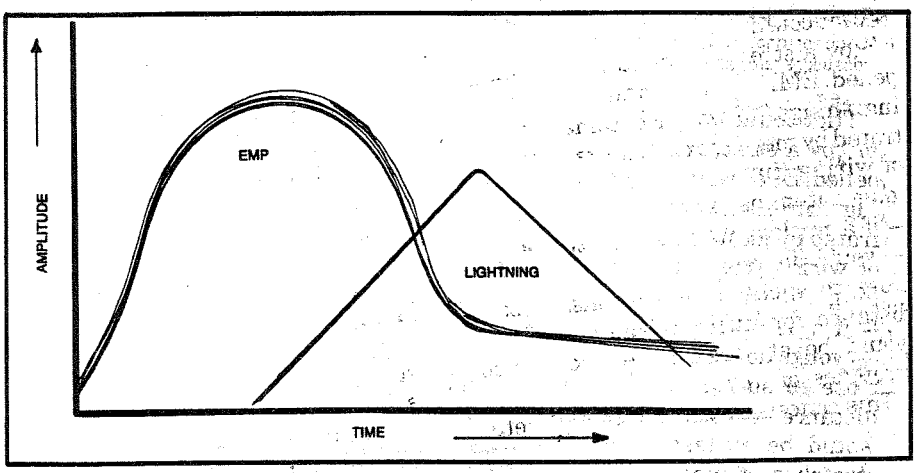


Spectrum comparison of EMP and other common environmental electronic wave forms shows how wide a band EMP covers.



EMP, while similar to lightning, builds up its peak power considerably faster than lightning making it impossible for many devices designed for protecting equipment from lightning to react fast enough to stop EMP's damage.

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wire and screws or some similar set up.

Many governemtn civil defense shelters are now said to have gotten the Faraday box, "foil" treatment. These shelters are covered inside with metal foil and have metal screens which cover all air vents and are connected to the metal foil. Some of these shelters probably make use of new optical fiber systems — protected by plastic pipe — to "connect" communications gear inside the room to the "outside world" without creating a conduit for EMP energy to enter the shelter.

EMP Myth — Another "myth" that seems to have grown up with information on EMP is that nearly all cars and trucks would be "knocked out" by EMP. In fact, according to researchers at Oak Ridge Laboritories, most cars and trucks are EMP resistant because they have parts that aren't overly sensitive to EMP and the metal car body acts like a Faraday cage to protect many of the parts that are (with the cage not grounded to the earth thanks to the vehicle's rubber tires).

While it certainly seems probable that some newer cars with a lot of IC circuits or other "computers" to control essential changes in the engine might be damaged by EMP, this is not as great a worry as one might suppose, according to these scientists. Buying spare electronic ignition parts and keeping them in a vehicle (perhaps inside a Faraday box) isn't a bad idea, but it seems probable that many vehicles will be working following the start of a nuclear war even if no precautions have been taken with them.

The only exception to this are with cars having fiberglass bodies — sorry sports car fans — or cars on metal bridges or close to other metal stretches which might attract a massive surge of EMP.

One area of concern are explosives connected to electrical discharge wiring or designed to be set off by other electric devices. These might be set off by an EMP surge. While most survivalists don't have access to such equipment, claymore mines and other explosives would be very dangerous to be around at the start of a nuclear war if they weren't carefully stored away in a Faraday box. Ammunition, mines, grenades and the like in large quantities might be prone to damage or explosion by EMP, but in general aren't all that sensitive to EMP.

A major area of concern when it comes to EMP is nuclear reactors located in the U.S. Unfortunately, a little-known federal dictum prohibits the Nuclear Regulatory Commission from requiring power plants to withstand the effects of a nuclear war. This means that, in the event of a nuclear war, many nuclear reactors' control systems might be damaged by an EMP surge. In such a case, the core-cooling controls might become inoperable and a core melt down and breaching of the containment vessel by radioactive materials into the surrounding area might well result. If you were needing a reason not to live down wind from a nuclear reactor, this is it.

Provided you're not next door to a nuclear power plant, most of the ill effects of EMP can be overcome. EMP, like nuclear blast fallout, can be survived if you have the know-how and take a few precautions before hand.

And that is what being a survivalist is all about. ●

EMP-INDUCED ENERGY ON ELECTRICAL LINES

TYPE OF CONDUCTOR	PEAK VOLTAGE (Volts)	PEAK CURRENT (Amperes)
Long unshielded power line	100,000-5,000,000	1,000-10,000
Unshielded telephone line	100-10,000	1-100
AC power line at wall plug	1,000-50,000	10-100
Antenna*	100-1,000,000	10-10,000

*Figures vary greatly according to the type of antenna and its size. UHF antennas have lower levels of EMP than do VHF with HF antennas having the highest levels of EMP.