How To Protect Your Homestead in case of an EMP

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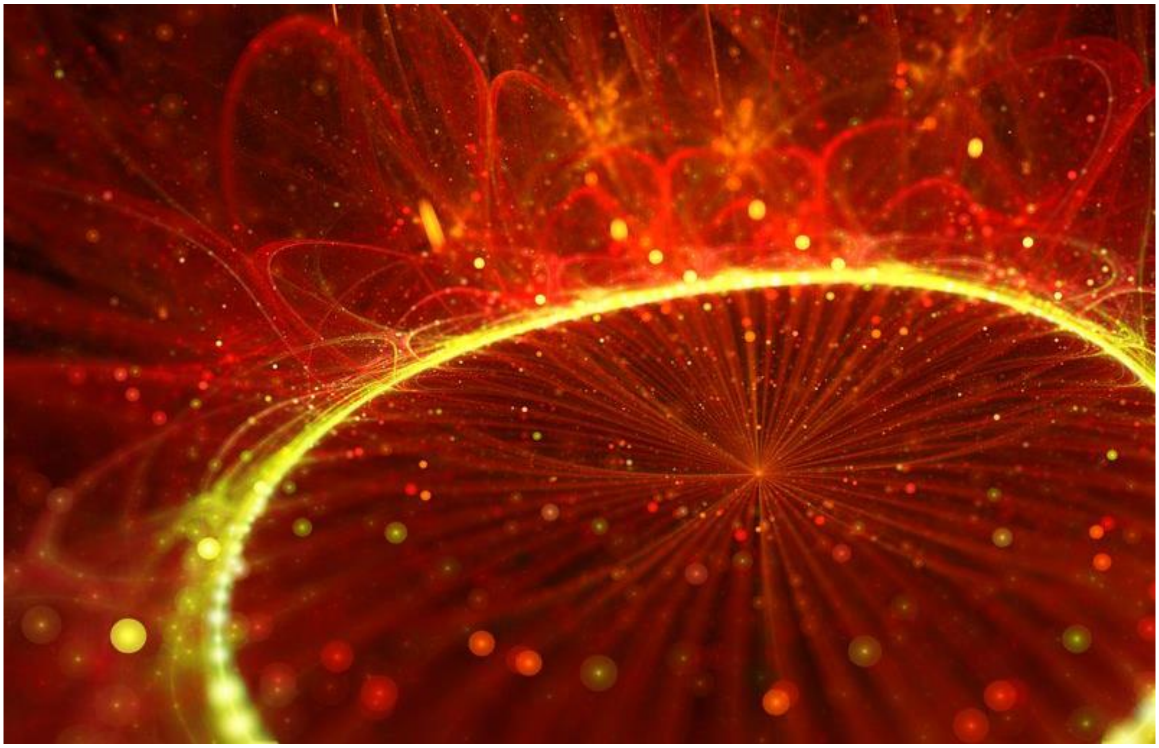

How to Protect Your Gear from EMP

Imagine not having any electricity for days, weeks, months or even years… no lights, no communication channels, no water, no refrigeration, no navigation systems, no gas pumping, no food transportation, no waste pumping or garbage collecting.

This is the potentially cataclysmic threat that EMP poses, and the reason to plan your survival.

Understanding the probability of an EMP of sufficient field strength, during your lifetime, is sufficient to warrant action on your part to protect your devices and solar panels from it.

Which One Is Worse?

There are differences in effect and magnitude between nuclear high-altitude EMP (NHEMP, or EMP caused by a nuclear weapon detonated high above the earth), geomagnetically induced EMP (GIEMP or EMP caused by solar weather), and nuclear low-altitude EMP (NLEMP or EMP from a nuclear weapon detonated near the ground). You have to know them in order to protect properly against their different effects.

NHEMP occurs when a nuclear weapon is detonated in the upper stratosphere or higher. Gamma rays interact with the earth's magnetic field causing it to re-radiate a powerful EMP and scatter high energy electrons, creating a thousand times the EMP that the same weapon would cause in a lower-altitude burst.

NHEMP is not a single EMP pulse, but rather, it a pulse consisting of three separate components: E1, E2 and E3.

- **E1** is an extremely fast and brief pulse that induces very high voltages in electronics within roughly line of sight of the detonation. It affects all electronics that have sufficient conductive area, whether they are connected to the grid or not. It happens so fast (1-2 nanoseconds) that surge protection used in the power grid can't clamp fast enough to stop it and will be disabled by it. Although surge protection with fast enough clamping times exists, it is not typically used since it's more expensive and more commonly occurring surges are much slower than E1.
- **E2** behaves very much like lighting. Much of its effect on the grid would be protected against by lightening protection, if the lightening protection circuits were not already burnt out by E1 when E2 arrives. Like E1, E2 can also effect electronics whether they are plugged into the grid or not.
- Unlike the previous two components, **E3** induces extremely high voltages in long conductors that run parallel to the earth's magnetic field such as power lines, phone lines, railroad tracks and metal pipelines. E3 travels through the grid, blowing fuses, destroying transformers, knocking out substations, power plants

and burning out any sensitive electronics connected to the grid. Unlike the other two components, E3 only affects grid-connected electronics.

GIEMP is caused by the sun. Solar activity spews solar radiation which sometimes hits the earth and causes the earth's magnetic field to re-radiate powerful E3 EMP toward the earth's surface. The affected area can be as small as a few hundred mile radius, or can be so large that it can affect the entire planet. Although the GIEMP can affect a greater area, it can't perturb any electronics that are not connected to the grid.

NLEMP is similar to NHEMP, but it lacks the thousand-fold amplification caused by its higher-altitude sister. That's because the nuclear weapon detonates too low to cause the earth's magnetic field to re-radiate EMP.

How can we shield solar panels against all three components and all against all three threats? Just protect them against NHEMP, since it packs all three components and is the most powerful type of EMP.

Use Faraday Cages for Your Gear…

One of the key factors in protecting our solar gear is whether it is installed and in use or is in storage and will used after an EMP. Since stored panels aren't plugged into the grid, we don't have to worry about E3, and we can simply use a Faraday cage to shield against E1 & E2.

Keep in mind these important principles about Faraday cages, if you start building one by yourself:

- Current should be able to travel unimpeded through the conductive outer skin of the Faraday cage. If you use an ammo can, for example, remove the paint where the lid touches the body of the box and remove the rubber gasket since they would impede the free flow of current through the can. If you want a tight seal, replace rubber gaskets with conductive gaskets.

- Use sufficient shielding. The cage must provide at least 74dB of shielding. We should round up to 80dB to allow for wear and tear that will occur to Faraday cage over time. 1 mil of aluminum foil provides 96dB of shielding. If you use aluminum foil for the conductive skin, be sure that there is plenty of foil on foil overlap and that the pieces seal tightly to each other.
- The cage needs a tight seal without any gaps or holes. Because of the large frequency range we must protect against a hole as small as a ¼ inch could compromise the integrity of the Faraday cage for our purpose.
- A ground wire is not necessary to protect the contents of the cage. A Faraday cage can protect solar panels even if the cage is suspended in a vacuum. But because large currents could be induced into conductors, it is a good idea to ground large cages to prevent electrical shock when you touch the cage to open it. The larger the cage, the more important the ground is to prevent anyone from being shocked. For a cage protecting an entire building, for instance, a proper ground is strongly recommended.
- Make sure that the inside of the Faraday cage is lined with non-conductive material. Prevent contact between the conductive skin of the Faraday cage and its contents. Create some distance between the solar panels and the cage's conductive outer skin so that electricity can't arc from the skin to your panels. Current will take the path of least resistance, so arcing large gaps will not be an issue unless the flow of the current through the cage's conductive skin is impeded like in the example of the ammo can where paint along the lid to can contact surfaces and the rubber gasket should be removed.

Since most DIY Faraday cages are either too bulky, too heavy or too delicate to travel with you in your rucksack or backpack, another solution is needed to protect portable solar arrays, portable solar chargers and other portable solar gear in your pack.

For example, I carry a USB solar recharging device in my bug-out bag. It has 2 small solar panels that charge a battery so that the device can recharge cellphones, MP3 players, GPS's and other electronics. When I configure my pack as an "I'm Never Coming Home" or INCH bag (or whenever I want additional solar power), I add my packable, folding solar array. To protect portable solar equipment carried in my backpack, I use lightweight bags marketed as Faraday bags to shield them.

… or a Faraday Bag

While the bags are generally a little more expensive than a DIY Faraday cage, they have a few advantages over a cage:

- Lighter weight
- Less bulk

- Waterproof
- More durable

When choosing Faraday bags, be sure to select thick, puncture-resistant bags. Make sure to find out the strength of the shielding in the bags before you make a purchase.

I haven't been able to find a single bag that provides 80dB of shielding! Most bags are designed to protect sensitive semiconductor products from electrostatic discharge or to hide your passport and credit information from would be identity thieves so the most shielding currently offered in a bag is a little over 40dB.

Since an NHEMP could produce almost double the field strength that 40dB of shielding will protect, take the added precaution of sealing your solar panels inside two layers of bags which each provide at least 40dB of shielding.

Some shielding is definitely better than no shielding, but there is no reason to run the risk. You may not be far enough away from "sky zero" for the field strength of the EMP to weaken enough that your panels will be safe. Lastly, make sure that the bags that you choose have a non-conductive inner layer just like needs to be installed in a Faraday cage to prevent electricity from arcing from the conductive layer(s) of the bag into the solar gear that you are trying to protect.

In Conclusion

- EMP caused by nuclear weapons has three different types of effects that need to protected against.
- EMP caused by the sun will not affect devices that aren't connected to the grid.
- Solar panel & electronics stored in inexpensive shielding solutions such as Faraday cages and Faraday bags are only protected from E1 & E2 while they are inside their shielded storage containers!

And you know the principals involved in building an effective Faraday cage, what to look for in Faraday bags and that one layer of most of the bags on the market today is insufficient to protect against EMP.

How to Protect Your Solar Panels in case of an EMP

Our country's way of life and most people aren't prepared to survive when an EMP will cripple the entire U.S. power grid and kill electric equipment in the entire country. Protecting your solar gear makes the big step ahead to your survival.

You might choose to start with an easy, inexpensive project right now such as constructing a DIY Faraday cage for your solar panels, or tuck a few mission-critical solar gadgets inside a couple of layers of Faraday bags to go in your rucksack.

Next in increasing order of cost, complexity and difficulty, are solar panel installations on homes or retreats which are not connected to the grid. For this type of application we will shield the solar panels themselves, all associated wiring, inverter hardware, the battery bank and as little space as a couple of rooms or as much as the entire building.

How It Works

Shielding large spaces is most easily and least expensively accomplished in the design and building phases of the home and its solar power system as opposed to retrofitting an existing home and installing solar panels on it.

By creating a larger envelope of shielding, with the same shielding properties as a Faraday cage, all of the electronic devices in the shielded portion of the building will be protected. Shielding large spaces eliminates redundant purchases and the hassle of storing spare electronics in a Faraday cage for possible future use.

Also, you don't need to shield dozens of devices individually nor install surge protection and shielded wiring between them.

To shield against the maximum theoretical EMP field strength (50 thousand volts per meter) of known NHEMP detonations, we must shield our solar panels to 74dB over a frequency range below 64Mhz.

But shielding them to 80dB will give us a margin of error since our shielding will likely become somewhat compromised over time and by the wear and tear of life and the elements.

Shielding Solar Panels for an Off-Grid Retreat

To shield our grid-independent retreat, the entire outer skin of the structure must be shielded to our target 80dB. The entire roof, the exterior of all of the walls and the floor must all be shielded.

This will obviously be much easier to accomplish during the design and construction phases.

It can be accomplished by choosing conductive construction materials and methods which provide the needed shielding and lack of impedance, such as:

- Conductive metal roofing materials
- Conductive paint
- Conductive metal doors, door frames and conductive gaskets
- Conductive matting laid over the foundation or skin applied to the bottom of the sub-floor
- Conductive bonds, joints, brackets, gaskets and seals must be used to joint different materials
- Conductive window frames must be used
- Conductive window film or 2 layers of 20 opening per inch wire screening covering windows but still allowing light to pass through them and an unobstructed view will still providing the requisite level of shielding,
- 2 layers of conductive 20 opening per inch wire screening covering the solar panels will allow light transmission to the panels while still providing the requisite shielding. 2 layers will protect against construction mistakes and wear.

The outside skin of all walls must be shielded or the wiring within the walls will conduct the EMP into the electrical system. If less than the entire structure is shielded, the shielded rooms must be wired independently of the rest of the house or the use of costly fast-clamping surge protection equipment will be necessary to isolate the shielded rooms

The building should be properly grounded because of its large area.

Install micro-inverters underneath the shielded skin that envelops each solar panel instead of a single, and large inverter cabinet that rests on a cement pad next to the structure. You will increase redundancy and avoid shielding the inverter cabinets, and installing surge suppression and shielded wiring.

Shielding Solar Panels for a Grid-Connected Location

The most difficult and expensive solar installation is the protection of is a grid-connected home or building.

The same principles apply to this project as applied to the simpler projects but since the home and its solar energy system is connected to the power grid, this one requires additional protective measures.

This installation will be more vulnerable to the power charges induced by E3 because it is grid connected. For that reason, in addition to the measures taken in the previous projects, keep take good care of the following:

- The home's connection to the power grid should have a mechanical, manual bypass circuit allowing the home to be physically disconnected from the grid.
- The home's connection to the power grid must be fitted with the fast-clamping surge suppression previously mentioned.
- In order to deal with the power company, the home will need an electric meter. If a smart meter with a data connection is installed, the data connection would also need to be surge protected.
- Being more along the lines of a remote cabin, the last model was assumed to be pretty self-contained. Grid-connected homes typically have more connections penetrating the shielded envelope in addition to power such as copper phone lines, cable TV, satellite TV, radio antennas, etc.. An external cellular antenna will be necessary. A cell signal repeater located inside the shielded home will also be needed since virtually no signals of any kind will penetrate the home's shielding.

- Non-conductive water and sewer pipes should be used where they penetrate the shielding envelope. EMP trapping baffles could be constructed where non-conductive pipe penetrations occur to reduce the amount of EMP entering through these points.
- Fiber optic cabling can be substituted for copper data and voice cable runs since fiber optic cable is non-conductive and will not conduct surges caused by E3 EMP inside the shielding envelope.
- Shielded foyers, mud rooms or rotating doors should be installed at entrances and exits. Passing through 2 shielded doors to enter the building, but allowing only 1 door to open at any given time will maintain the envelope. It would be a shame to go to all the cost and trouble of this level of protection just to have an EMP occur when the door is open and compromise the contents of the structure.

This last type of installation will raise the cost of a new home by about 30% including the cost of adding a solar installation with a battery bank and backup generator.

But the added cost would be recouped over time through savings on future electrical bills and it is hard to put a price tag on piece of mind and the ability to maintain your standard of living after an EMP.

Of course, costs would increase for a retrofit in proportion to the complexity of the build and the amount of material needed.

How to Protect Your House in case of an EMP

First let's see what it takes to shield something from EMP, the let's take for example one type of house - a Quonset Hut - to determine if the building could provide a cost effective solution to EMP under the right circumstances.

The (Very) Basics on Shielding Against EMP

As you may recall from an elementary physics class (or a diligent 2-seconds of research on your "Inter-web Thingy,") Faraday cages can be used to shield vulnerable microelectronics from EMP. The shielding provided by the conductive skin of the Faraday cage is the difference in EM flow outside and inside the cage.

So the cage does not completely stop or shut out the EMP, it just “turns down the volume” to point that it doesn’t “blow the speakers” (so to speak) of electronics protected by the cage. The volume of sound, EMP wave flow or sound wave flow is lower or quieter inside the cage than outside it.

This protective skin needs to have the following properties:

1. It must completely encapsulate whatever you are trying to protect. Depending of the frequency range of energy you are protecting against, the skin can be a cage or a mesh. But for our application, openings as small as a quarter inch could allow EMP inside, compromising the protected space. So mesh would have to be roughly 20 openings per inch or finer. If you are trying to shield a multisided space such as a cube, all six side would have to be shielded. I often see people forget about the floor! EMP is not like rain, you cannot just drape a space blanket over the object and call it good.

2. The flow of electrons through the skin must be unimpeded. If you join two or more sheets of conductive material to form the conductive skin, the seams where they mate must be free of non-conductive paint or any other insulation. I see people make this mistake a lot with metal ammo cans. They fail to remove the paint where the lid fits onto the box and remove the rubber gasket. Gaskets are still helpful, but they need to be conductive gaskets as opposed to the non-conductive rubber gaskets that come in the cans.

3. Any insufficiently shielded wires or other conductors penetrating the skin compromise its integrity.

4. The conductive skin must have a non-conductive layer gap of air between the skin and whatever you are protecting. If the object touches the skin or is too close to it, the electromagnetic energy can be conducted from the skin into what you are trying to protect.

5. The conductive material must provide sufficient electromagnetic shielding (measured in decibels) to protect against EMP. The thicker the conductive material, the more shielding it will provide. To shield against the field strength of an EMP generated by a nuclear weapon detonated high in the earth's atmosphere, directly above your location, would require approximately 73dB of shielding. If the weapon was detonated hundreds of miles away, this number will be lower.

Just keep in mind that the relationship of shielding thickness to the number of dB of shielding it provides is logarithmic, so doubling the shielding layer thickness does not double the dB of shielding. This means that if you buy a Faraday bag that provides 40dB of shielding, and you put your bag inside another 40dB you don't end up with 80dB of shielding. You would end up with less than 50dB of shielding at that level.

And to protect against a super-EMP weapon (a nuclear weapon optimized to yield the maximum amount of energy released in the form of EMP as opposed to light or heat) this number would have to be much higher. You would not be talking Mylar bags, aluminized bags or tinfoil anymore, you would need a shielding material more along the lines of an aluminum pressure cooker for that.

Does the Quonset Hut Stack Up As a Faraday Cage?

Can a Quonset Hut be turned into an EMP-shielded home? With this reader question, the devil is in the details. If you are ready to face them, grab a napkin, sharpen a pencil and then go rent a crane: you have work to do!

I imagine that the reason that leads to this question is something along the lines of: "Quonset Huts have a steel skin, and steel is a conductor, so they must provide some shielding against EMP.

Almost 200,000 of the buildings were manufactured for WWII, some are still in use by the military to this day and many others are still knocking around as surplus, so maybe this could be an inexpensive way to build a shielded home or retreat or some sort. But the subject of EMP is complex, and a building is a major investment. For most people, it would be a considerable waste of resources to erect a building that did not serve its intended purpose."

Once assembled, a Quonset Hut is essentially a semicircular cross-section of corrugated, of galvanized steel that can be moved by crane and set on a concrete slab or wooden floor. Steel is a conductor, so won't that offer some electromagnetic protection?

If you have been paying attention, you may already know the answer. **IF** the steel sections have been properly joined **THEN** you have a start.

Notice that the answer is conditional and that even then, a Quonset Hut can only be viewed as possible place to start or source of raw material in the form of steel. Even if the integrity of the building's steel skin is maintained, you would still have some major issues to deal with in order to turn it into an EMP-shielded structure.

Here is what it would take to turn a "Q-Hut" into an EMP-shielded stronghold:

- Any sealant, lacquer, paint or other non-conductive material between the seams of steel sections, any holes or gaps a quarter of an inch or larger will compromise the free flow of electrons through the shielded "skin" of the structure so they would have to be stripped and replaced with conductive product.
- Any holes or gaps a quarter of an inch or larger will compromise the shielded envelope, including any windows, doors and the entire floor would not be shielded by "upside down steel half pipe" formed by the steel portion of the Quonset Hut. All these areas would need to be covered with material that meets our shielding requirement of greater than 73dB (for a normal nuclear weapon used to initiate Compton Scattering, generating a nuclear high-altitude EMP, not a super-EMP weapon.) As mentioned, 20OPI or smaller mesh could be used for the windows and to encapsulate any solar panels you add.
- No unshielded long conductors such as electrical wiring should be attached to the building without first being shielded, shunted through EM-shielded gaskets,

fitted with fast switching (less than a millisecond) surge protection with power handling in the same range as lighting protection circuits. They should also be properly grounded.

- The conductive skin should be separated from the building interior by a gap or suitable non-conductor. A non-conductive spray-on bed lining material or any other non-conductive material could be used for this purpose, just do not forget the floor!

How to Protect your Car from EMP

Thirty years ago, most of the cars used carburetors, and only a few people believed that electromagnetic pulse (EMP) is a real threat.

Nowadays, even NASA admits that EMP is one of those events we could not recover from: it would stop all infrastructures that sustain modern society which rely so much on electronics. No communication, to transportation, and no escape with your fancy new car out of the crowded urban jungle.

So if you are one of those readers who wish to consider EMP-resistance as a factor in selecting a bug-out vehicle, then you should not miss this article.

I have been doing the survival thing for some time and I see precious few absolutes when it comes to survival and a whole lot of gray area. And I am not a mechanic or car salesman by trade, but I do have a solid background in technology and understanding of EMP as well what most people would term as vast experience as a self-reliant consumer.

9 EMP-Related Factors to Think Of When Buying a Car

First, there are factors to consider in choosing a post-EMP bug-out or survival vehicle:

1. Benefits of Diesel

A large and strong enough EMP could stop the extraction, refinement, distribution and sale of fossil fuels. Whatever gas you have on hand could be all the gas you get for years. The more highly a fuel is refined, the shorter its storage life. Diesel is less refined than unleaded so diesel stores longer.

You make biodiesel from crops that you grow. Diesel motors are somewhat simpler than gasoline motors in that they do not have an ignition system. This cuts down on some vulnerable parts.

Most tractors also run on diesel too, so for many homesteaders, it is worth considering.

2. Fuel Capacity

You can add oversized and/or additional fuel tanks to many vehicles, increasing the vehicle's range. A post EMP world will likely have far fewer gas stations, if any. To get at any of remaining fuel, you will need a pump and hose like the Jackrabbit by Black & Decker.

3. Cargo or Towing Capability

By the time you pile in what will surely be everything you own in this world, your spouse, your 2.4 kids, grandma and the golden retriever, you may be looking for ways to increase your vehicle's carrying capacity.

So cargo space, a trailer hitch, roof rack, swing outs and so forth will come in handy. For many, the vehicle will likely double as their home.

4. Off-Road Capability

Features such as 4-wheel drive, a full size spare, plenty of ground clearance, all-terrain tires, lockers, extraction or trail gear, towing points, winch and off road lighting will come in handy post-EMP because roads will no longer be maintained, disabled vehicles and vehicles that have run out of fuel will litter the roadway.

Imagine the highway or even your own street after a snowstorm without any snowplows or drivers to remove the snow and 4-wheel drive and over-size tires starts to look like a pretty good idea.

5. Ease of Maintenance & Repair

Simplicity is a good thing when it comes to survival. Without computers, there is only so much to “do it yourself” on newer vehicles so older vehicles have greater appeal. A good repair manual and well-equipped toolbox are mission-critical equipment.

6. Commonality of Parts

An expensive custom vehicle might look cool online or be fun to daydream about, but after a HEMP, the first time it needs a part, you might wish you bought something a little more pedestrian (no pun intended). Better still would be 2 or 3 less-expensive vehicles as opposed to a single vehicle that strains your financial resources.

My grandfather did this and I learned it from him. He would take multiple beat-up vehicles and turn them into fewer good ones … and have a bunch of spare parts left over. A bunch of spare parts would be a good thing post-EMP.

7. Fewest Possible Microelectronics, Computers or Chips

Some newer vehicles have in excess of 100 processors that run on miniscule amounts of power. They sense and control virtually every function of the vehicle and are very sensitive to EMP.

How far are you going to get without an engine, fuel injection, transmission or 4-wheel drive system? Sure, car manufacturers take reasonable precautions to shield them, but not against such great field strengths or over the entire frequency range EMP covers. Any transistor-based technology is vulnerable.

Avoid vehicles with the following systems, rewire them or replace them with their non-electronic counterparts and/or stock replacements in a Faraday cage:

- PCM (Powertrain Control Module)
- Anti-lock Braking System
- Electronic Fuel Injection
- Electronic Ignition
- Computers Controlling Critical Systems
- Consumer Electronics
- Long Antennas
- Negative Battery Terminal Grounded to Vehicle Frame

8. Overt vs Covert

It is often best to blend in as opposed to standing out. In the city, that might mean driving a white sedan or van. In the bush, it might mean a camouflage or matte earth tone paint job.

Other times, looking like you are not worth tangling with might be the better option.

9. Conductive Metal Body

For the best EMP-resistance, choose a vehicle with conductive metal body enclosing the engine and passenger compartment or cab over a vehicle with body panels made of fiberglass, plastic or any other non-conductive material.

How to EMP-Harden Your Auto

If your vehicle already has these features or you are already doing these things, then you are already part of the way there.

There are many features to look for and modifications to make to both your vehicle and your SOP (Standard Operating Procedure) regarding that vehicle.

No matter which automobile you choose, there is always more that can be done to minimize the effect of HEMP on the vehicle.

- Ground all conductive components of the vehicle to a single point on the chassis. Do not ground them to the earth.
- Park in an EMP-protected garage: you already know how to turn your Q-Hut into an EMP-proof house, so this could be a solution.
- Do not connect your vehicle to an unprotected engine oil warmer.
- Rewire with shielded wiring: Verify that your wiring is shielded or replace all you can with shielded wiring.
- Re-bond metal body panels: Remove body panels and make sure that you have good conductive bonds between body panels by removing paint and installing

conductive gasket material or make sure you have metal on metal contact with as much overlap as possible. This will help the body conduct energy through the vehicle skin like the skin of a Faraday cage. Just do not allow yourself to be fooled into thinking that the vehicle skin is without holes that compromise its integrity. EM shielding is not all or nothing. Every little bit helps.

- Route wiring close to the vehicle frame
- Install ferrite clamps or snap on cores on cable ends
- Protect cable entry and exit points with surge suppression: This will need to be fast-clamping surge protection faster than one millisecond that will handle high voltages. (Think lightening protection.)
- Mechanical ignition (points and condenser)
- Install EMP-rated surge protection on antennas
- Mechanical fuel & water pumps
- Carburetor or mechanical fuel injection
- Keep spares of vulnerable parts you cannot replace in a Faraday cage: You may have a vehicle that is mostly good to go, but it still parts like a starter, alternator and voltage regulator that do not contain microelectronics, but could still conceivably be affected. Get some extras and store them in a Faraday cage. They do not even have to be new. Pull them off a junk vehicle and test them if you cannot afford new parts.
- Manual transmission: Some will surely disagree with me on this one, but they are easier to repair and make it possible to push start vehicles even if the battery is shot or missing. Even some diesels can be push or roll started if you wire open the fuel valve.

This is by no means a comprehensive list of vehicle modifications. Every vehicle is different. As previously stated, there is no one standard followed by manufacturers even for EMP shielding.

Keep in mind that everything you do improves your chances. Start with the easiest and least expensive and work your way through the harder ones.