THINKING OF A "GREEN" WAY TO RUN YOUR RADIO STATION?

How about a way to run your radio station if the commercial electrical power is out, and you cannot find fuel for your "back-up" generator?

Have you thought about NOT using a fossil fueled electrical power system?

Solar power, wind power, micro-hydro power, and some other similar ways to make electricity have been around for a while, and solar power has really come down in cost in recent years. Now you can have a very capable solar power elecdtrical system for your ham radio system for less than $1000, which is less than a lot of the engine driven electrical generators out there cost right now. The venerable and reliable Honda EU-2000 starts now at just under $1000, and I have seen it recently for just under $1200.

The use of alternative or renewable energy power sources for operating a small radio statiion in time of an emergency is well established. Rick Palm, K1CE, has written several articles in QST in recent months on this topic.

My main recommendation for such a power source is defined by the ability to set it up quickly, and to be independent of other energy sources, such as the commercial electrical power grid, and fossil fuels to run a generator or other power generator.

At this time, this will usually come down to either, or both, of two other power sources; photovoltaic solar panels, and small wind generators.

The solar panels really work well when you have full sunlight, and even in the rain, you will get about 10% of their power output from them. And often when it is cloudy, or at night, we might also have wind, so the use of both solar panels and a wind generator really does work quite well. They are compatible and they are complementary. The combination really is a very effective and ecologically friendly way to make some electricity. And they do not require any fossil fuel source that might be in very shourt supply in time of an emergency.

Let's look at how much electrical power you need to run your radio station.

For an FM radio for 2 Meters, 440 MHz, or other application, you can use the radio manufacturer's listed Direct Current power rating to see what is needed for the radio when transmitting. For most mobile and base station radios, it will be different depending on the transmitter power where a 50 Watt transmitter will draw around 12 to 15 Amperes. When just receiving, it will be about 1.0 to 1.5 Amperes of Direct Current. The FM radio when transmitting is operating at the full power that is set. Most of the radio manufacturers will ask you to drop your radio down to about 50% or "half power" If you are talking "for a long time."

For a radio operating in most of the digital modes, this is another case where the radio transmitter will be operating at the full power setting chosen while transmitting, but that is also beyond what the radio cooling system was designed to handle when using the radio in a normal conversational or "QSO" mode. For that reason, they will usually ask that we cut the power back to about 50% or half power when operating with the digital modes, and you are sending a long message.

For a radio transmitter being operated in the CW mode, commonly it is expected that the normal spaces between the dits and the dahs will be enough to bring the "duty cycle," or the ON time to OFF time ratio, down to about 50% when keying. Normally there will not be any power reduction needed for the CW mode of operation.

For SSB or Single Side-Band Suppressed Carrier voice mode, on the voice peaks when taklking is the time when the full rated DC Power current draw is required for good clean linear operation from the transmitter. That is the DC Current rating that you will see listed for the standard 100 Watt HF radio transceiver which usually will be 20 to 21 Amperes. However, that current is needed only for the voice peaks, and between syllables and other pauses in our normal speech, the current draw can drop down to the normal quiescent current draw rating of about 1.5 to 2.0 Amperes. In my measurements, I have found that the Average Current Draw for a SSB transmitter is just about 50% or one half of the rated current during transmit. For most 100 Watt HF transceivers, this will be about 10 Amperes DC.

For AM transmission or Amplitude Modulation, (Sorry, no. that is not really "Ancient Modulation." Besides, the AM broadcast stations that we listen to on our car radios are still using it, so it is not "ancient."), the way that the RF signal is transmitted does mean that there is the carrier plus the two side bands that make up the RF signal. The RF carrier takes one-half of the energy going into the RF signal, and the remaining half or 50% is split between the two side bands. When you are not talking, the RF carrier is still there being transmitted, so the transmitter is working all the time, but the output power will vary between 50% and 100% depending on the modulation level resulting from your speech. During transmission, the DC power current draw will vary from 50% to 100% also. This is a pretty high duty cycle, so the radio will normally provide a much lower power level for AM, and on many radios the AM mode will be about 25 Watts. There is a reason why they say that SSB has four (4) times the "talk power" that AM has.

So the FM, Digital, and AM modes are the ones that take the highest power level from the power supply, and CW and SSB are the most thrifty down at about the 50% level in normal transmitting operation.

We can use these actual working power levels during transmit, and the duty cycle for our radio use time, for determining how much power we will actually need for operating our radios.

The main power level that I will look at is the "Average Power Current Draw" when transmitting. For the 100 Watt HF radio transceivers that I use, that is just about 10 Amperes for SSB. That is the power level that I use when setting up my solar panlel system for my radios. Most of the time, the radios in my shack are used on SSB.

Normally I use a 180 Watt rated system made up with three (3) 60 Watt solar panels. From this 180 Watt solar panel array I will normally get about 10.3 Amperes of current in full sunlight. With this 180 Watt system I can operate the radio transmitter during the day and recharge the batteries that

I used during the night. Yes, it is cheaper to buy and wire up only One (1) large solar panel to do this, but I have found that I can physically carry two of the 60 Watt solar panels with one under each arm easily, and the 180 Watt or 200 Watt solar panels are much larger and bulky and require more careful planning for how I am going to get or carry that larger solar panel to where the radio will be operated. For that reason I use the three (3) smaller 60 Watt solar panels. They can be packaged for transport much easier, even in the back of the Subaru.

And the solar panel power goes to the rest of the system through 14 AWG copper wire cables that are about 25 feet long. There is an entirely different and separate type of connector on the solar panel power cables that will not plug into anything else besides the next item on the list, the solar panel charge controller.

A working photovoltaic solar panel system will require more than just the solar panels. The next item is the "solar panel charge controller," which is a solar industry name for their special purpose voltage regulator. Next is the battery (yes, they are still required) system, and then the DC power distribution system, and possibly a battery power monitoring system also. I do recommend the battery power monitoring system for most applications, and I will explain why along with why you should have a fairly large battery system.

While the solar panel charge controllers are available from many vendors, there are some considerations of special interest to ham radio people, and one of them is the question; "Will this thing talk to my radios?" For this reason, I do suggest getting a solar panel charge controller from people who are aware of EMI and RFI considerations. These will include the ones from Trace Engineering (now Xantrex), Outback, MorningStar, BuddiPole, and Mike Bryce, WB8VGE at The Heathkit Shop. I have and have used ones by those makers and I have found them to be quiet at RF where we are interested. All of them seem to do the jobs we expect. There may be other makers now also, but I have not tested them yet, noir have I found specific claims in their literature that their products are RF quiet. There are some available from a well known West Coast tool outlet, but my reaction to their advertising for their charge controllers is not confidence inspiring. I have two of their charge controllers here now, but there has not been sufficient sunlight in the time I have had them to set up a test system with their charge controllers with my normal 180 Watt system, and I will be listening with the Anritsu MS-2711B Spectrum Analyzer to see if they are RF quiet also. I really did have hope for having this done by this weekend, but that did not happen. My main recommendation is to select from the established solar panel charge controller makers who are aware of the EMI-RFI problem.

One recent development with charge controllers is the growing popularity of 3 or 4 stage charging programs in these newer charge controllers.   These really are of benefit to our batteries, and their use will prolong the life of the batteries when the batteries are just left on the solar panel system. They will drop to voltage going to the battery after it has been charged, and iut goes back down to a "float" level where the voltage is reduced to about 13.20 VDC. The main benefit of this lower voltage following full recharging is that it really reduces the possibility of overcharging our AGM batteries, and with a liquid electrolyte battery with the removable caps for checking the water level and refilling with distilled water, is that it virtually eliminates the tendency to cause bubbling and gassing in the electrolyte, and there is almost no water loss at all while in this state. The new 4 stage charging programs really are worth it.

Batteries. This can vary widely. My normal recommendation has been to look at the sealed, non-spillable, gelled electrolyte, AGM or Absorbed Glass Mat, VRLA or Valve Regulated Lead-Acid batteries. For our use, ones in the 25 AH to 35 AH capacity are nicely portable and are not too heavy nor expensive. I do not recommend the standard car type lead-acid battery because of the need to keep it in one upright attitude and the possible damage if the case is dropped or hit by something, or just turned over. With the 25 AH size batteries, I have and use a fiberglass case that will hold four of them, and this package is approved for flight as luggage on our normal commercial airlines. Yes, I had to pay excess baggage charges, but I did get the entire station there.

Another possible consideration today is the Lithium-Ion-Nano-Iron-Phosphate chemistry light weight battery which is much more safe than the news making type that have caused some concern about fires. I do not yet have any information on the FAA and their position on allowing that type battery as luggage on airlines. These batteries are smaller and lighter in weight for the same capacity than the AGM and other more common batteries, but they are also much more expensive.

For the battery power monitoring function, I use a Ham Source, Saratoga, Turnegy, or other similar plug-in power monitor with Anderson PowerPole connectors that allow the wiring from the battery to be unplugged and the 12 VDC Power Monitor to be installed in series into the circuit to watch the voltage of ' the battery and the current draw from the battery. This does take some bit of interpretation, because the power from the solar panels and the charge controller will have any needed power to match what the radio is calling for to have that additional 12 VDC electrical power be provided by the battery. In my case, I do know that the solar panels and the charge controller are providing about 10 Amperes of current and any current above that level is being provided by the AGM battery. And I can watch the voltage of the battery with the battery power monitor. If it starts to drop below about 12.30 VDC, then I know that I have reached the 50% capacity point in the battery. If it gets down to 12.00 VDC, then I have reached the 25% capacity or state-of-charge condition, and it is time to take that battery off circuit, put one of the charged batteries into the circuit (usually this will happen at night), and get the low battery onto the charging system. Sometimes this means waiting until the next morning when the sun comes up and the solar panels are putting out power again.

One other possible protective device is a Low Voltage Alarm or a Low Voltage Disconnect. The ones that I have are adjustable to the trip point that I do not want my batteries to drop below. Mine go between the Battery Power Monitor and the 12 VDC Power Distribution System. I have them from Buddipole, PowerWerx, and West Mountain, the Rig Runner people. There are others also, such as Quick Silver Radio.

I should also mention that I do like to get some sleep at night, so I do not normally carry enough batteries with me to run the station entirely through the night, except perhaps on a listening mode only.

For the power distribution system, this will consist of the wiring, the connectors, and any dedicated 12 VDC power "break-out boxes" where things can just be plugged into a selection of common connected Anderson PowerPole connectors. I do suggest the use of 10 AWG stranded copper wire for this wiring between the batteries and the boxes. With a peak current draw of 20 Amperes, this will ensure a low voltage drop at the power terminals going into your radio. For the normal radio and accessory power connectors, I suggest the common Anderson PowerPole connector. The Anderson PowerPole can also be used for the connection between the Charge Controller and the Battery, but I use an entirely different kind of a connector from the Solar Panels to the Charge Controller input. I do not want to plug a higher voltage solar panel into the 12 VDC power system. And I also use 14 AWG wiring from the solar panels to the Charge Controller input; the current in that part of the system will be just over 3 Amperes from each 60 Watt solar panels, but those cables on mine are 25 feet long. The rest of the 12 VDC power distribution is done with 10 AWG copper wire, except for such things as the LED lights that are done with 18 AWG copoper wire, after they are plugged into the 12 VDC power distribution box. For most of the accessories, I will usually use either 16 AWG or 18 AWG copper wire for those circuits.

The only other thing to mention is the possibility of using a Battery Voltage Booster such as the ones by N8XJK, MFJ, and others. These are intended to keep the voltage going to the radio at a constant 13.8 VDC to provide stable power to the radio to assure good linearity and consistent performance even when powered by a normal lead-acid battery where the battery voltage will start at 12.6 VDC and only go down with use. They will draw more power from the battery during this "boost" mode, and drop the battery voltage down faster as a result. While I do have some of these devices, I do not normally use them with my portable system. I do use one for the radios out in the motor home, but I have a much larger battery power capacity in the motor home, so I can run the battery booster without too much fear of causing any problems with the coach batteries.

Ok. That covers the main points of a solar panel system.

The next section is on Wind Generators.

Earlier it was mentioned that solar power and wind power are compatible and complementary. During trhe day when we have sunlight, the solar panels will provide most of the electrical power. One reason for this is that for the type of wind generator that I have, the charging control system inside the wind generator will monitor the voltage of the battery, and if it is over 13.6 VDC, it will recognize that the battery is charged, and it does not need to provide any assistance. At night, when the solar panels do not make any power, if the control system in the wind generator sees that the battery voltage has dropped, and the wind has come up, then it will allow the wind generator to make power to recharge the battery. This combination really does work pretty nicely. At night when I am in bed, and the wind comes up, I can hear the blades of the wind generator whistling, and I know that it is making electrical power.

One thing that I do need to say is that the wind generator is on its own separate tripod and mast, and it is not physically mounted to or connected to the motor home or to any building where people may be trying to sleep. It will transmit vibrations into the motor home or into a building if it is attached to that building. It is only connected electrically to the batteries in the motor home. This is a "portable" system like a ham radio "portable" radio system, so the tripod and mast are about 25 feet tall, so the wind generator is above most of the things on the ground, but, no, it is not up at 80 or 100 feet where the air really is clean and much more stable and also usually at a higher wind velocity. The wind generators that I have were made by South West Wind Power who were in Flagstaff, Arizona, and mine are the Air-X and the Air-Breeze. Both of these are still available from Primus Wind Power in Lakewood, Colorado. You can look at their web site at www.primuswindpower.com/

Now to the subject of a "possilbe" electrical power source, the fuel cell.

One question that has come up is about the possible use of fuel cells in this application. The main problem with them is the "fuel" part. A preferred fuel is propane or butane, and the common steel cylinders in the size needed to operate a fuel cell for a reasonable time will be very large or bulky and heavy. And there are some precautions that should be taken with any LPG system, and in the usual rush to get a station assembled, up, and operational, I am not sure that all of the precautions will be performed. At this time, I am not able to make a general recommendation for a fuel cell as a source of electricity to operate a small radio station in an emergency situation.

One way where a fuel cell could very well have an application is in connection with an RV or Recreational Vehicle. They will already have the tanks or cylinders for holding the propane or butane installed in the vehicle, and they may have installed on the RV propane system the supplemental "quick connect" fittings to allow use of a BBQ or other outside cook stove or something equal, plus people with them usually will have some familiarity and experience in working around and safely using an LPG system. So RV people already have a head start in this realm.

But then, most of the time, RVs will already have the gasoline or diesel or propane powered 120 VAC generator in the motor home or trailer anyway, so it might become a question of which has the better fuel efficiency, and how much weight do we give to the quieter operation of the fuel cell?

That covers the major points about using "alternative and renewable energy" electrical power sources that are practical for ham radio station operation. While this concept is not difficult, it is not used as often as it can be, and it does have some financial advantages with its "one time purchase" quality, and no continuing need for fuel from outside sources. Once you have it, the source of your electricity is free; the sun and the wind.

Try it;

Ralph, N7KGA
Latté Land, Washington