13. COMMUNICATION

13.01 Introduction:

Reliable information during a disaster or escalating crisis is paramount to survival. People need to know the scope of the disaster. They need information on evacuation routes and where to find food, water and medical help; and they need to know when and if help is arriving. Two-way communication (receiving and transmitting) is necessary in order to facilitate and mitigate the needs of the disaster victims.

Depending on the scope of the crisis, the communication systems we normally rely upon may become unusable. Home phones become overloaded or unusable in many disaster scenarios. Hurricanes and tornados could cause power failures, and without alternative power sources, cell phones and other battery dependent systems could not be recharged. Earthquakes could destroy repeater stations. An electro-magnetic pulse has the potential to destroy all unprotected circuitry.

Many past and recent experiences confirm that we cannot rely on traditional communication systems during emergency situations. We must, therefore, familiarize ourselves with alternative communication equipment and technology.

If we are serious about survival we should consider obtaining an Amateur Radio License (otherwise known as a Ham license), which will provide us with a legal means to "train on the job", for communications skills needed in the future. These skills will help us set up, maintain, protect and operate ham radio equipment. Means other than amateur radio do exist for communications, such as citizen's band radio (CB), GMRS radios and Family Radio Service (FRS). We will visit these options later in this lesson.

13.02 Basic Communications Considerations:

The basic requirements for setting up an amateur radio station are the radio, the power supply and the antenna. Almost all current technology ham radio equipment operates on 12 volts direct current (DC), which is the DC standard voltage.

Ham radio gear is available in many designs and frequencies. The very high frequency/ultra high frequency (VHF/UHF) radios are generally the most inexpensive of the ham radio equipment. They are available in handheld or mobile-portable units.

The benefits are:

1. They are small and compact, and offer the availability of hand held units.
2. They tend to be low in output power and low in power consumption
3. The antennas tend to be smaller in physical size.

They do have limitations:

1. Their range is limited to line of sight, unless a repeater is accessed. Line of sight can give ranges of a few miles to tens of miles.

2. Repeaters are used to extend coverage of VHF/UHF radios. Repeaters may fail due to lack of power or destruction from an EMP, as most of these facilities are generally not hardened to an EMP event.

The alternative to the VHF/UHF radios is High Frequency (HF) radios. They are generally larger and need larger antennas than their VHF/UHF brothers, but have the following advantages:

1. They can have ranges from tens of miles to thousands of miles.
2. They can operate on many frequencies. This enables the signal to reach a variety of distances, depending on the propagation of the signal. (Propagation is the ability for the signal to bounce off of the upper atmosphere).
3. They do not rely on a repeater.

In an EMP event, equipment operating above 100 MHz is theoretically more resistant to the pulse, as most of the electrical energy in an EMP resides below this frequency.

13.03 Power Supplies:

Purchase deep-cycle or gel-cell batteries to power radio equipment. These batteries are designed for multiple charge-discharge cycles, and can be recharged successfully many times from a very low charge state.

Batteries from automobiles, boat's and RV equipment could be used in an emergency for powering radio equipment; however, these starting style batteries do not like to be constantly drained and recharged and were not designed for that purpose.

You will need a power source and a battery charger to maintain your deep cycle batteries. Gel-cell batteries require a special charger and should not be charged from a regular deep-cycle battery charger.

Solar Panels:

Solar panels are often used to charge batteries. They will require a regulator to keep the batteries from being over charged. Solar panels with a charge value of at least 15 watts are needed to maintain a battery reasonably well. The higher the charge rate, the better the charging.

Deep Cycle batteries could also be used to power inverters to enable the operation of equipment on 120 volts AC.

Generators:

Generators are often used to run equipment and charge batteries. Generators require a good stock of fuel. Fuel, however, is usually scarce and not readily available during a disaster. If a generator is used, it must be used sparingly. Operate it for only a few hours a day and limit its use to critical equipment. In major emergencies, generator power should only be used to charge batteries, and batteries should only be used to run communication equipment and emergency lights. Review the lessons on winter survival and cooking with alcohol.

Other power supplies will be discussed in the "Alternative Fuel & Power" lesson.

13.04 Radios:
There are many radios on the market, both new and used. It would be advisable to consult a ham that is familiar with Civil Defense requirements to assist in purchasing your radio. Manufacturers such as Icom, Kenwood and Yaesu provide new and used equipment that is reliable and maintains value. Used equipment should be fully tested to confirm reliability for emergency situations. Be advised that used handheld VHF/UHF equipment may have batteries that are no longer functional, and new rechargeable batteries can be very expensive. Most of the latest HF equipment will operate on multiple frequencies through 30 MHz. This will include all Ham frequencies, the AM broadcast band and shortwave frequencies, enabling you to tune into international shortwave broadcasts for news and information. Also, many HF radios have an antenna tuner, which is very useful when using expedient or problematic antennas. Some of these HF radios can be modified to operate on non-ham frequencies and split frequencies for transmitting and receiving, such as is required by the Military Affiliate Radio System (MARS) and other emergency related services.

Older ham radios utilized vacuum tubes, which are more resilient to the effects of an EMP (Electromagnetic Pulse). They do, however, consume more power than the newer solid-state equipment.

13.05 Faraday Cages:
Faraday cages should be used to protect all emergency radios from the effects of an EMP. Any metal container will act as a Faraday cage. However, good metal-to-metal contact is imperative. Remove all gasket material from the lid. If the container has been painted, make sure to remove the painted area around the lid with sand paper.

Build a simple faraday cage from a small metal garbage can and lid. The lid must fit snugly over the can. If the lid does not make good metal-to-metal contact, the open area could act as a 'slot antennae' and allow EMP to damage your equipment. To further protect your equipment, purchase a metal screen about 6 inches wide and as long as the circumference of the can. Fold the metal screen in half, length wise, and place it around and over the lip of the garbage can. The lid should then fit snugly against the screen and garbage can, protecting all equipment contained inside.

13.06 Antennas:
A radio antenna is a device designed to do two things: It captures radio frequency signals from other radios and sends them to the receiver which converts them into electrical signals that you can hear; and second, it takes electrical signals from the transmitter as you speak and converts these signals into radio-frequency signals to be radiated to other listeners. The antenna works best when the length of the antenna is precisely the same as the wavelength of the radio frequency you are using. This is called the "resonance frequency". Antennas can also be cut to the size of a half-wave or even to a quarter of the wavelength you wish to use.

During an emergency, antennas that have been used for normal operations may become damaged or unusable. Simple emergency antennas such as "Dipoles" and "Inverted V" antennas can quickly be assembled if parts are readily available and the construction concepts are understood.

Dipole Antennas:
The dipole antenna looks like a "T", with the two legs of the antenna forming the top and the feed line forming the base. Two legs are cut to the desired resonant frequency and separated by insulators. The coaxial signal feed line connects to the antenna legs through the insulators. The two legs are placed horizontally and the feed line is placed vertically.

Inverted V Antennas:
An "Inverted V" is similar to a dipole, except that the legs of the antenna form an inverted V with the feed line and extend downwards toward the ground. The mathematical formula to calculate the resonant frequency for these two antennas is 466 divided by the desired frequency in megahertz (MHz). This length, in feet gives the total length of wire required to assemble the antenna. The length is cut into equal halves, which then becomes the 2 legs of the antenna. For example, an antenna for 3.9 MHz would be calculated as follows: 466/3.9 = 119 feet. Cut that length into two equal parts, or 59.5 feet each.

Vertical Antennas:
A vertical antenna can be constructed using the same formula, except use only one "leg" or quarter wavelength. The antenna must extend vertically from the ground. The antenna itself is isolated from the ground, with the center conductor of the coax attached to the metal tube or wire, and the shield attached to a ground rod. See Antenna Diagrams 7.36.

Antennas seem to always work better the higher they are erected. In an emergency situation, the ideal height may not be obtained. Put the antenna feed line as high as possible.

If you choose to get your Ham license, you will learn basic antenna theory.

13.07 Obtaining an Amateur License:
In order to receive your Amateur Radio license, you must have a basic working knowledge of the FCC regulations of communications, equipment and operating procedures. If you are totally unfamiliar with ham radio, it can be a little overwhelming, as you will be required to take a test to verify that you understand the concepts.

The best way to learn this information is to attend ham radio classes sponsored by local ham radio clubs. Another way is to have a friendly ham radio operator (an "Elmer") help you. My "Elmer" sent me to a class sponsored by a ham radio club.

If you are capable of self-study, there are several publications that can assist you. Radio Shack sells a book called "Now you are talking", and the ARRL (Amateur Radio Relay League) publishes various manuals to assist you in your radio quest. The Internet is also a very good resource for ham radio information.

13.08 CB Radios:
Citizens Band radios operate in the 11-meter band range. There is no FCC licensing required for CB radio use. There are 40 channels available for use. Channel 9 is limited for emergency communications or road assistance.

CB Radio operators normally transmit double sideband AM on the first 23 channels. On channels above Channel 23, upper sideband or lower sideband equipment may be used. The FCC limits the carrier power to 4 watts on the AM channels and 12 watts on the SSB channels. You may only use a type-accepted CB Radio transmitter. Any internal modification to a type-accepted CB Radio transmitter cancels the type acceptance, and use of such a transmitter voids your authority to operate the station. Power amplifiers are specifically disallowed for use with a CB Radio.

The 23 AM stations are often used by truckers and are shunned by many people because of the over crowded airways and the static interference. The range of CB radios is about 10 miles, which is significantly longer than the range for FRS and GMRS radios.

The FCC allows CB antennas of a maximum of 23 feet above the highest point of the building or tree on which it is mounted. The highest point of the antenna must not be more than 60 feet above the ground and there are additional restrictions for areas around airports.

An excellent source on FCC regulations for CB users can be found on the internet at http://home.att.net/~wizardoz/cbmw/fccrules.html.

13.09 CB sideband (SSB) radios:
CB sideband radios (SSB) are excellent radios for emergency use. They are very inexpensive and within the budget of most families. Fewer people use the sideband radios and it is easy to find unused airspace. The long range of CB band radios allows for links covering massive areas.

CB Nets:
FCC rules allow for Civil Defense use on CB radios. SSB radios can be used to link stations for organized cb nets. The people in the net cannot all talk to each other, but information can be linked and repeated throughout the area. The net leader should have an amateur radio license with a higher-powered radio that will access the CB bands. The Ham will then transmit on the CB wavelength to the people in the CB net. Many CB nets have chosen upper sideband radio equipment for use in their nets.

CB Net maps:
The individuals on the CB net should all be provided with a special map with grid lines using the alphabet for one direction and numbers for the other (such as m3 or some other set of numbers). The grid numbers for the participants' base location on the map will become their call sign (otherwise known as their "handle") and they will participate in the net using that number. This provides privacy and protection to the participants, as the map will be unique to participants in that chapter and other people listening on those frequencies will not have the same map.

Valuable information (such as blocked evacuation routes, road damage, radiation levels, emergency needs) can then be gathered from many sources that would otherwise be unavailable to the Ham operator. The Ham radio operator can then relay this information to CB nets in other locations. Local CB nets could be linked to other nets throughout the nation using this method.

13.10 FRS Radios:

Family Radio Service (FRS) radios are little handheld radios similar to walkie-talkies. They operate in the ultra high frequency (UHF) band and are not prone to the interference experienced on CB radios. No license is required to use the FRS radios and airtime is free. FRS radios operate on any of 14 dedicated channels (1-14) designated by the FCC expressly for FRS radio usage. FRS radios have a maximum allowable power of 0.5 mill watts (or 1/2 watt). They are very low power, but can be a good source of short distance (one or two miles) communications.

13.11 GMRS Radios:

There are 8 dedicated channels (15-22) designated by the FCC for the GMRS radios. Typical power ratings are between 1 and 5 watts with a maximum allowable power of 50 watts. An FCC operator's license is required for GMRS use. Their range is similar to the FRS radio; however, these radios can be outfitted with optional antennas to extend their range up to 5 miles.

13.12 Broadcasting Stations:

In a major disaster, knowledgeable amateur radio operators may wish to set up a small AM or FM Broadcast Transmitter. This service could provide "broadcast" communications to a group in a small regional area in the event normal communications was off the air. These transmitters are available from electronic hobbyist suppliers. Licensing may be required.

13.13 Review:

1. Significant emergency events will cause communications failures. We must consider means to communicate during an emergency.
    - Amateur Radio is ideal, it requires training, testing and licensing.
    - Citizens Band (CB) and Family Radio Service (FRS) are simple, short-range alternatives to Amateur Radio.
2. Amateur Radio allows the radio operator to select HF-VHF-UHF frequencies.
    - HF frequencies can provide reliable long distance communications frequencies.
    - VHF-UHF can provide reliable short distance communications.
    - Repeaters can extend VHF-UHF range, but are likely to fail during an emergency crisis.
3. Alternative sources of power must be provided to operate emergency communications equipment.
    - Equipment must operate on batteries that can be stocked and replaced, or rechargeable batteries.
    - If equipment runs on 120 volt AC power, a generator must be obtained and maintained.
    - Most modern communications equipment will run on 12 volts DC, storage batteries can be used and charged. Solar panels can be used for charging.

4. There are many options and types of radios.
    - Emergency radios should be procured and protected.
    - A radio should be stored in a metal-shielded container to protect it from possible Electromagnetic Pulse.
    - Tube radios are more likely EMP proof, but consume more power.
    - In order to be prepared, you must purchase a radio, and learn how to use it.
5. Learn how to set up and build an antenna.
    - Keep the components on hand for building an emergency antenna.
    - The dipole-vertical length formula is 466/frequency in MHz.
6. Studying for and testing for an Amateur License will enable you to become proficient in communications.
    - Contact a local "ham" club to find out about classes or help.
    - The Internet is a great resource for amateur radio information.
    - The book, "Now you are talking", sold at Radio Shack is a great resource.
7. Citizens Band Radios and Family Radio Service Radios are an alternative to Amateur Radio.
    - CB, FRS and GMRS radios can provide short-range communications as an option or alternative to Amateur Radio.
    - CB Upper-Sideband radios have better availability to airspace.
    - Upper sidebands can extend the use of Ham nets.
    - TACDA chapters can organize CB nets using upper sideband CB radios.
8. A small AM or FM Broadcast Transmitter can provide "broadcast" communications to a group in a small regional area.
    - Licensing may be required.
    - Mostly only an option after a disaster where conventional broadcast stations may be off of the air.
    - Available usually in kit form from electronic hobbyist suppliers.