Emergency Communications
Lessons Learned from Past Operations and Exercises

These are some of the lessons taught about emergency communications. These insights have been gained through analysis of normal operations as well as feedback from emergency communications operations and exercises over the past twenty years.

Some of these lessons were learned the hard way and have been tested, verified and commented upon time and time again, so it's nothing new -- except to the newcomers.

Learn from the previous learners so you won't waste your time repeating the same mistakes and discussions.

That'll free up your time to learn from and enjoy new opportunities. -- Ron Hashiro, AH6RH March 27, 1999

Enjoy, and feel free to drop me an e-mail if you have any questions at ah6rh@arrl.net.

Preparations - Perspective and Orientation

Remember that the number one objective by anyone on the team is to forward the message(s) to its final destination.

Remember the mantra: "Move the message forward."

Use this to focus and concentrate when you're totally exhausted and can't think clearly.

Your mission is to use any available communication technique to forward the message to its final destination. Whether it's via landline telephone, e-mail, fax, INMARSAT satellite phone, amateur radio, Marine VHF, GMRS, CB, bicycle runners, carrier pigeons, signaling mirrors, prayers or smoke signals, the method is immaterial.

The only thing that matters is getting the message delivered in usable form to the recipient in a timely and accurate fashion so that the recipient can take action.

At no time should anyone be put into a situation that endangers themselves or anyone nearby.

Once an emergency arises, you are shifting from normal, day-to-day operations to an emergency operation. It may take from thirty minutes to three hours to get

people and equipment into the right locations, to assemble and test their stations, and begin operating. In a matter of minutes, you must create a new environment where none previously existed -- and the chances are that it won't happen seamlessly on its own.

Recognize and accept this reality -- do not rely upon someone else.

It is your responsibility to your team to exercise initiative to perform your own preparations. Similarly, it is your responsibility to your team to be flexible and adaptable to whatever conditions may appear during an actual operation.

The first few minutes and hours are most valuable. It is also the most likely time that inexperienced or unknowledgeable people are likely to get on the air, or make a phone call. They want to ask for information. Or they talk about their experience if the disaster has already struck. Some may offer a field observation about what they experienced at their location.

You need to maintain positive control and get them to stop their conversation on the emergency channels. Briefly address their interest or concern. If needed, suggest that they stop their transmission and offer another simplex or repeater frequency for them to use for the rag chew session. If they do not cooperate, note the date, time, frequency and other pertinent information to follow-up action by law enforcement or other officials.

Now, before the disaster, is the time to prepare personally for emergency and disaster situations.

Now, without added distractions, there is time to think it through, purchase what you need without fighting lines at the store, to assemble supplies and equipment into kits and to write job aids (lists of instructions and directions) and checklists.

Now, before the disaster, is the time to read about and learn practical skills such as basic first aid, CPR and severe weather awareness instead of watching comedy or reality shows on TV. The reality you will find yourself in will be very real and no laughing matter.

Your single most important item in the field is fresh water, 3 gallons per person, daily.

You'll use

- one gallon for drinking water,
- one gallon for the preparation of food and cooking,
- and one gallon for cleaning/personal hygiene/sanitation.

Keep in mind that water weighs 8 pounds per gallon, so you want containers sizes for water that you can carry and handle.

You may reduce the amount of water transported if you know with certainty that a supply of water is available and not affected by the incident.

Do not rely on beverages such as coffee or soda because they will actually dehydrate you!

Much has been written about the topic of personal emergency preparedness, so we defer further detailed discussion of that topic for another time. Follow-up on it. Your life and life recovery depends on it.

You must adequately prepare your family to either shelter in place for three days or evacuate to a safe area, with friends or to a public shelter.

Then if you have safeguarded your personal records and key belongings in off-site locations such as a safety deposit box, your equipment is already substantially packaged, you have a checklist made to include the last minute items, and a checklist for setting up operations, you've substantially increased your chances of attaining success within the crucial first two to three hours of the alerting period.

Just remember that nothing is "supposed" to go right in a real emergency.

Do not depend upon anyone someone else to do your preparations.

YOU must make it happen.

YOU provide for your own education and control the result.

YOU make it go right.

Once you have learned the basics, get experience by practicing in exercises and other on-the-air group simulations.

Then teach others what YOU have learned!

One cannot anticipate all the possible problems that can come up in the field, or on-the-air during a spontaneous event. By engaging in regular on-the-air activities, you can test equipment, practice problem-solving skills and teamwork while simultaneously advancing the mission of emergency communications. Don't be overly concerned with problem solving during the exercise. What's more important is that you experience problems and learn to be flexible and adjust to conditions, fielding multiple, unexpected situations that will help you perform during future activities.

If you want to experiment with a new technique or method, test it before you have a major exercise or event. You don't need more frustration or embarrassment. Don't compound your risks when the stakes are higher. Don't be distracted about the condition of someone else's equipment or lack of and operational readiness.

Since you're already at your site (or heading to your assignment), focus on your situation first, and then deal with other situations as conditions permit. The better

your preparations and the faster you arrive at your destination, the faster you'll handle your situation.

Message Handling, NCS/NTS skills

Practice your radio operation skills, message handling and Net Control skills BEFORE the emergency. Do it NOW! You had better practice them now.

You do not want to deploy to the field with any form of uncertainty or hesitation.

Work out your "stage fright", "opening night jitters" or "butterflies in your stomach" ahead of time in a comfortable and safe environment, such as an afternoon or evening net or practicing directed net procedures on simplex with a group of your buddies.

Practice being efficient with your time and the use of other people's time.

Remember your "ABC's" of Accuracy, Brevity, and Clarity. Eliminate excessive chatter; make your transmissions precise, concise and clear by getting immediately to the point. During an emergency, you don't want to be creating "dead air" with the mike keyed down while trying to collect your thoughts when net time is limited and traffic is waiting.

Make your transmissions sound crisp and professional. Listen to the air traffic controllers, public safety dispatchers, Coast Guard and maritime services, as good examples.

Do not take any more transmission time on the radio than is necessary.

Because, guess what?

Someone IS waiting to use the frequency! (That's why all frequencies are congested during an emergency.) You don't like it when someone hogs a repeater with rag chew when YOU need it, so be considerate, reciprocate similarly, and keep your airtime short.

Message handling also means knowing how to find the most expedient, efficient route to send formal or tactical messages between different agencies, bands and nets.

Practice passing messages in ICS-213 and ARRL Radiogram formats. Formal messages have a higher likelihood of being acted upon by emergency responders, because it has all the important information up front that they need accompanying the message, so they'll spent less energy in hesitation as they try to sort out the message. If you prepare and send the information as a formal message, it'll be handled and routed quicker. And during an emergency, time is of the essence.

Spend time to practice and acquire NTS skills. Establish a receive frequency that you will "guard" or monitor, then announce the monitored frequency(ies) used by your unit on other local and regional nets.

Various agencies and nets need to encourage sending stations to use alternate frequencies off the main nets. Use your monitored frequencies to call receiving stations. Use of "side frequencies" (off-net traffic) is vital during periods of heavy traffic loads.

This enables the NCS to match pending needs quickly with available assets to keep the operations net moving. As soon as you have outlets for traffic send the stations off frequency to call their traffic, get things moving and then go back to main net and continue listening.

Directed nets should be routine if more than four stations share the working frequency. If the use of a frequency is controlled or the net is "directed," contact the NCS by stating your callsign only then wait for acknowledgment and permission by the Net Control Station before calling the receiving station.

As an operator, your training is complete when you can train another person to be a trainer. The reason? During an emergency, you can expect "spontaneous volunteers" to walk onto the project who have good intentions, but were not previously trained.

You must develop the ability to feel comfortable training others on-the-spot. Use this article as a handout and starting point. That will cut down the time needed to train.

Ultimately, you want your trained students eventually are able to train others. Not every one is capable or inclined to do this, but for those who can, it's a worthy art.

Preparation - Procedures, Training and Practice

Knowing and identifying the sender and intended recipient is vital for the proper handling and routing of each message. Otherwise, there is a good chance that the message will be advanced and relayed to a person other than the intended recipient and action and response will be delayed.

It should be stressed the text of the message should be relayed as-is, and not altered in any fashion. The sender is expecting that the recipient is receiving an exact copy of the message as it was originally written.

Do not substitute words.

Do not abbreviate words if the words were spelled out in the original message.

Practice relaying both formal messages (NTS formatted messages) and tactical messages.

Formal messages, which are originated locally, are "record communications" which are public records and part of the formal incident log maintained by the served agency.

The most important features of a formal message are:

(a) the date and time of the message,

(b) the originator or sender of the message, and

(c) the intended recipient or addresee of the message.

(d) the message body or content.

Formal messages can be sent outside the affected area, such as to State or Federal Emergency Management without having to be reformatted.

NTS message format is appropriate for emergency use, but you should be prepared to handle messages longer than the standard 25-word ARRL form. Most EOC, military and Federal agency message forms are 50 words. Ensure that your operators know how to handle non-standard formats such as ICS (Incident Command System) resource requests, local situation reports, etc. on the served agency form.

http://www.qsl.net/ah6rh/am-radio/emcomm/ics-213.doc-- Softcopy template in MS Word of the ICS-213 message form. The letter "a" is the body to preserve the formatting, and you replace it with information for the form.

http://www.qsl.net/ah6rh/am-radio/emcomm/msgform.doc-- Softcopy template in MS Word of the ARRL Radiogram format.

http://aditl.com/dradio/msgform.doc-- Mirror site

http://aditl.com/dradio/msgform.pdf

http://www.arrl.org/ead/teacher/kemp/appendixa.html

http://www.arrl.org/ead/teacher/kemp/radiograms.html

The NTS-style message form above is very handy and appropriate for emergency use.

Tactical messages are informal, real-time verbal messages sent for command and control purposes when time is of the essence. Tactical messages must still be documented. They are recorded as line items in your operator log, listing:

1) local time
2) who sent the message
3) who received it
4) who should receive it
5) subject, situation or resource request
6) who is responsible for the assignment or action, and
7) who gets the reply, if any

For information on practicing writing test messages., see:
http://www.qsl.net/ah6rh/am-radio/emcomm/message-writing.html

For information on practicing sending messages, see
http://www.qsl.net/ah6rh/am-radio/emcomm/ics-213-radio-protocol.html

Structure your communications plan to minimize the need for relay stations. To the maximum extent possible, formal traffic and tactical communications should be made "direct" without the use of relay stations. Each use of relay station doubles the time needed to "move the message forward.

Factors such as terrain, attenuation from buildings and foliage, receiver desense and congested frequencies greatly influence what can be done, but if at all possible find a clear frequency and communicate directly.

Do not rely solely on repeaters. Practice the use of multiple simplex frequencies, HF NVIS (High Frequency Near Vertical Incidence Skywave), as well as packet radio and PSK-31 techniques.

Do not expect to rely solely on handheld walkies and repeaters. Repeaters commonly go down during wind and ice storms and other severe weather situations, earthquakes, etc. Hurricane Iniki, September 11, 1992 is a good example.

- http://www.qsl.net/ah6rh/am-radio/articles/iniki.html QST Article: Hurricane Iniki Rallies Amateurs
- http://www.bvkhawaii2.com/billyg/iniki.htm Star-Bulletin article:Ham radio vital link for Kauai during Iniki
- http://homepage.mac.com/gpool/portfolio/writing/iniki.html WorldRadio article: Iniki and the American Red Cross

You should also use 25 or 50 watt mobile radios, in case you have to go direct on simplex operations. You may need to use additional power, but recognize that it will put a strain on battery operations.

There is substantial interference and desense from radios that are operated near to each other. For example, a ten watt VHF 2 meter FM radio will effectively wipe-out the receivers of all other 2 meter radios in the immediate vicinity -- effectively limiting you to only one 2 meter conversation at a time, perhaps preventing you from hearing important traffic directed to you. Most amateur 2 meter radios with

out-of-band receive are susceptible to intermod interference from strong nearby, in-band radio transmissions, such as paging transmitters.

So expect to use multiple frequency bands for your local and regional operations.

Your ACS/ARES/RACES radio network plan should exploit different bands and modes to diversify your use of radio spectrum.

Use 2 meters FM for local, tactical use, supplemented by 222 and 440 MHz for inter-urban repeaters, building-to-building simplex and incident area local communications. Agree on a limited set of VHF/UHF frequencies for all team members to monitor during the initial stages of activation. A designated repeater is the most efficient way of keeping people informed and coordinated during the early stages of an alert.

If the designated repeater is down, have people "guard" and monitor the repeater output frequency on simplex to inform and direct responders to the "alternate" repeater or local working frequency. Also, have someone guard 146.52, the National Simplex Calling frequency. Be prepared to use a separate repeater for logistics such as check-in, and talk-in if responding to a localized incident.

If an incident is localized, repeaters outside of the immediate area will probably be unaffected, so use them to coordinate resources and pass tactical messages. If the incident area is localized, establish one or more simplex frequencies on one radio band (VHF or UHF) for local operations and a repeater frequency on another band (UHF or VHF) for calling and resource coordination.

Those with dual-band mobiles and HTs with magnetic mount antennas can exploit this tactic effectively.

If possible, designate or install a UHF repeater with the greatest coverage for use as a calling channel within a given metropolitan area.

Use 2 meters SSB and HF for wide area regional and statewide communications beyond local repeater coverage. Horizontally polarized 2 meter SSB using a simple half wave loop and 25 watts is effective to 100 miles from typical mobile / portable stations most of the time. Technicians who have not yet upgraded can be put to work on this mode exploiting using common 2 meters + HF radios such as the Icom IC-706, while encouraging them to upgrade.

Extensive cloud cover can enhance VHF and UHF propagation over mountain ridges. This is a valuable observation by the old-timers that when combined with knife edging can further inter-valley communications during times of heavy rainfall.

HF-SSB and CW operations are essential for reliable "long haul" beyond 100 miles.

Near Vertical Incidence Skywave technique is required for reliable "short path" regional coverage within 300 miles, which is not dependent on existing communication infrastructure.

This permits both direct communications and informational bulletins with a minimum use of relays, especially in mountainous terrain with no line-of-sight.

The 60 meter band (5 MHz) is very effective in extending the hours of continuous NVIS operation, as 40 and 60 meters have a tendency to work during certain hours of the day.

Net operation within a metropolitan area is significantly improved when all stations can hear a common calling channel and move immediately to another working frequency to handle traffic. Stations should call and confirm a usable frequency, then change frequencies to exchange the traffic.

Do not "rag chew," converse or pass bulletins on the designated calling channel. You want to complete as many requests for contacts as possible. If you have need to pass a long bulletin, announce the frequency (another repeater or HF channel) and time (e.g.: top of the hour or in X minutes) where you will pass the bulletin.

The bulk of your traffic will probably be passed using two-meter VHF, so you'll need a frequency band that's not on VHF for calling. Therefore, a two-meter VHF repeater would not work out as well as UHF. UHF repeaters, antennas and diplexers are smaller than their VHF counterparts. Compact UHF repeaters, controllers and filter cans can be wall mounted in a wall cabinet, which permits installations in more locations, including space restricted areas such as elevator machine rooms. This increases the utility of dual-band HTs and mobiles with simultaneous dual receivers.

Monitor the UHF side for calls and VHF side for traffic.

The user interface for packet radio is most important. The software and interface for packet radio interface should resemble e-mail so that clerical people can operate the equipment. Winlink, with it's Internet-style e-mail and TCP/IP functionality is recommended. JNOS can be used on older, MS-DOS computers.

An emerging area is the higher speed IP communications made possible by the Icom ID-1 1.2 GHz digital radio systems. These radios can pass IP traffic and messages at 128 Kbps. Combined with compact, high gain 1.2 Ghz antennas such as loop yagies, corner reflectors and panel antennas, and large structures used as passive repeaters, metropolitan and wide area data networks can be built that pass volumes of automated messages and e-mails between the amateur radio operators and the Internet. Non-line of sight networks spanning radio paths of over 120 miles using 1.2 GHz radios and high gain antennas have been tested.

Be prepared to physically deploy into the field as opposed to insisting on operating within a comfortable building such as furnished and equipped office building.

You may have to operate from an evacuation shelter which is typically a school cafeteria -- which is nothing more than four walls, a concrete floor, a roof over your head and rows of hard tables and bench seats. If you do get assigned to an office building, the chances are it is not designed to readily contain and operate an

amateur radio station, so you'll need long coax cable runs and deal with less than ideal antenna mounting location.

You should also anticipate operating outdoors in a field, so get some sturdy and comfortable boots or work shoes to protect your feet -- you won't know ahead of time that the situation may or may not require quality protection for your feet. Athletic shoes should used only in non-hazardous situations. Safety shoes with a rugged, high traction sole, which provide ankle support on rough terrain, are recommended. Bring a hat, sunglasses and sunscreen, as well as insect repellent and/or insect spray to deal with annoying insects.

Preparation – Radio Equipment

Don't use more RF output power, but use a better antenna and mount it as high as you reasonably can. Your signal will radiate better with a better antenna, allowing you to conserve battery power. Therefore, you get more operating time for the battery you are carrying. Transmitting with lower power also allows more receivers to operate in the same area by minimizing receiver desense to other stations operating nearby.

Mounting a two-meter base antenna ten to fifteen feet above the ground will substantially improve your capabilities. It will also improve your reception. Be prepared to use longer coax runs to position your antenna if you're in an office building.

Even a "ribbon J-pole" antenna made from 300 ohm TV ladder feedline is better than a flexible "rubber duck" which comes with most portables. A ladder-line J-pole is compact, cheap and light, so there's no excuse for not using something better than a rubber duck antenna.

I find that a good antenna for two meters is an end-fed half wavelength antenna. An end-fed half wave antenna does not require a ground plane or counterpoise to operate correctly. If you use an antenna that does require a ground plane or counterpoise such as the quarter wave antenna, omitting the ground plane or counterpoise, and the antenna does not radiate the transmitted signal completely. As a result, you will get a high SWR reading and the radio will reduce its power output if it has an SWR protection feature -- or it may burn out the final output transistors when you needed them the most.

My favorite antenna is the Diamond NR73BNMO dual band mobile antenna on a NMO magnetic mount antenna base.

It is versatile enough to use with a five watt VHF or dual-band walkie, VHF or dual-band mobile in the car, or a VHF or dual-band mobile in an office building setting.

Or, you can mount it atop a mast with an NMO antenna mount and an L-shaped mounting bracket. It does not need a ground plane or counterpoise.

For point-to-point long haul regional communications, directional antennas such as yagis, quads and corner reflectors are recommended to increase your range and reduce the amount of local in-band interference. Position your beam antenna so that other antennas are vertically separated by at least a half wavelength and placed to the side and rear -- away of the main power lobes of the Yagi antenna.

Bring your own headphones or an earphone for your HT and expect to use them. There is substantial audio interference from operating in a confined space. Headphones cut down the noise and allow you to hear your QSO without interfering with the operator next to you.

If possible, use a foot switch to operate the push-to-talk function. For most mobile and base radios, it's very easy to fashion a connector that enables you to control the radio with a foot switch. This will free your hands when you need them the most to do more things.

Carry extra fuses. Tape them to the radio(s). This is so that they are readily visible to others and that each radio has its matching fuse already selected and ready to use. You can use a 35mm film canister to house the spare fuses and tape them to the power cord, or you can tape the fuses directly to the power cord with vinyl electrical tape.

Use a scanner rather than using your two-meter radio to monitor activity. A scanner has several advantages over a second radio for monitoring activity in the amateur band. It scans faster and has more available frequency bands and memory channels. It requires less power to operate and frees up your radio so you can talk, while enabling you to delegate monitoring to a non-amateur with confidence that they will not transmit when you're not supervising the area.

Try to assemble your station into a carrying box or rack that can easily be moved and still be ready-to-operate. Time is of the essence during the initial moments of operations. Keeping things in a "rack" or frame where the radios can be pre-wired together and can be grabbed and moved keeps the set up time to a minimum.

I have found that a two rack unit (2U) industrial case from SKB Cases and aluminum 19-inch shelves to be a good solution, although it is rather pricey. The cases have removable front and back covers, giving quick and easy access to the control panel and the antenna connection. I would not recommend the three rack unit (3U), as it is bulkier and can weigh a lot more when filled with the additional radio equipment.

A more cost effective method is to arrange the equipment in plastic “milk crate” carriers available at office supply stores, recognizing that there are limitations In terms of protection against the weather and other hazards.

Standardize the types of batteries you use, such as AAA, AA and D cells to minimize the number of different of types of batteries you need. If you are successful in standardization of batteries, you'll find that you need only AAA, AA and D-cells for the majority of your radio and lighting equipment.

The use of AA alkaline cells instead of rechargeable batteries is encouraged for short-term operation. Alkalines typically provide about five times the operating time equivalent NiCd or NiMH batteries, thereby the eliminating the weight and bulk of a charger.

Bring one set of lithium AA batteries for your walkie as a reserve. Lithium batteries have more capacity than alkalines, are lighter, operate better in colder weather and have a shelf life of up to ten years. You may find yourself in a situation where you need the extended operation and can't pause to exchange the batteries. Replace the alkalines with the lithiums before you engage the situation.

You may not have reliable AC power to recharge your batteries. If you are responding to a long-term situation with AC power, bring multiple NiCd, chargers and a power strip to simultaneously recharge and conserve your stock of alkaline batteries.

You need a handful of AAA and 9 volt batteries for miscellaneous equipment such as VOM meter and digital pagers.

Make photocopies of your equipment manuals and store them with your radios. Don't leave the details of how to operate your equipment to memory. Having manuals in your Go Kit enables others to study, and if necessary, use your radio.

Execution

Remember that ACS/ARES/RACES are emergency communicators and not first responders or emergency rescue personnel. Keep your Civil Defense RACES ID on you at all times. Do not impede the work of professional responders such as fire fighters, police, public works and emergency medical personnel.

Stay out of the "hot zone" unless specifically instructed, given the required safety equipment and have been briefed on personal protective measures. You don't want to endanger yourself and add yourself to the casualty list. Follow the directions of your field team leader or the served agency ICS chain of command.

You may be asked to perform duties beyond emergency communications. Remain flexible to respond to the needs of the situation, but do not jeopardize your primary communication mission and remember that your primary objective is to "move the message forward," accurately to its destination in a timely fashion.

Use tactical callsigns to speed up the net. If you have less than 26 stations, give each one a letter unit designation and call them by their ITU phonetics.

For example, the first shelter could be designated "Unit Alpha". You can then say "Alpha, call Bravo" instead wasting time giving out the full callsigns. Every amateur is familiar with ITU phonetics, so this is nothing new.

Fixed station tactical calls should generally indicate location and function, such as "Maui EOC." Mobile station tactical calls should indicate function and a unique designator, such as "Supply 2." You don't have to ID every transmission, but only at the end of the last transmission in a series, or every ten minutes -- whichever comes first.

After the net has been running for a while in a tactical mode, NCS should take roll call IDs.

Safety and accountability under the Incident Command System require "Personal Accountability Reports" or "PAR-Checks." This is done by having NCS call out the tactical call of each station deployed and having each station acknowledge in turn with their callsign only. This simple acknowledgment verifies that the stations are present and available on the net. That's all you need to do.

Refrain from using phonetics on repeaters with good signals because it wastes time and holds up the net.

If you have a weak station on the net, split the net into two nets so the weak station won't hold back operation of the main net. Otherwise, you'll have too many stations on hold waiting while you try to communicate with the weak station. Assign another station as a relay and alternate NCS to move to a second frequency to work with the weak station(s) and relay information back to the net.

Look over this list every couple of months as a refresher and a reminder.

Practice these procedures and equip yourself now, while there's still time.

This handout is dedicated to:

- Stan Harter, KH6GBX, for his years of tireless effort in preparing Hawaii and California for emergency communications operations.
- Katashi Nose, KH6IJ, for his ingenuity as well as his many years of leadership in experimentation, field verification and practical education on radio and electronics. He showed us how things work and how things can be accomplished.

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