

## 024-01-16 Hamlet Net - Hazards

### Announcements:

- Test Session Info
  - Next VE session is Saturday, January 27th in the Clover Building at the Boulder County Fairgrounds, and starts at 9 am. It is a Patriot VE team session, so pre-registration is recommended. For more info, and to pre-register, see the Licensing/Testing page on the club web site, <https://w0eno.org/>, under the Education menu.
- LARC January General meeting is tomorrow, January 17th at the Clover Building at the Boulder County Fairgrounds. If you are unable to attend in person, the meeting will also be on Zoom. It starts at 6:30pm for socializing, and the meeting commences at 7pm. Chuck is presenting on what you can do before you become a silent key.
- We have some volunteer opportunities available where you can help out LARC:
  - Photographer / videographer - record team activities and upload to web site / YouTube
  - Newsletter Editor - put together the monthly Splatter newsletter
- There are several Board positions that will be available in October. Currently, the President, Treasurer and Secretary are planning to make this their last year of service. If you are interested in serving on the board of a 501(c)3 non-profit, please consider running for one of these positions. The current members would be more than happy to "show you the ropes" during the year, so you wouldn't start with zero experience.
- The Northern Colorado Amateur Radio Club's Winter HamFest is this Saturday, January 20th. Doors open at 8am and it runs to 1pm. Tables are still available if you have stuff to sell. Admission is \$7. They've got some great raffle prizes this year - A Yaesu FT-891 mobile, a Yaesu FTM-300R mobile, a Yaesu FTM-200R mobile, and two Yaesu handhelds. For more info, see their web site at: [www.ncarc.net](http://www.ncarc.net)
- January 27th, 2024 Winter Field Day - Clover Building at the Boulder County Fair Grounds. Runs from Noon to 5pm currently (checking with Setup will start after the VE testing at around 10:30 - 11am.
- Our sister club up in Nederland is looking for some help with events they are running. They have a weekly Monday night net with no predetermined agenda, so you can lead it however you want. They are also planning a Field Day site at Golden Gate State Park and are welcoming anyone who wants to participate. Finally, they are looking for

operators for the Ned Gravel run on July 8th. They have signup links for all these events, so head over to their web site <https://w0ned.org/> for more information!

- You can start earning your 2024 membership or future renewal by acting as NCS for at least 5 nets this year. You can run either this Tuesday night net or the Thursday night net (or both). We have scripts available for both, so all you need is a good connection into the repeater, and somewhere to keep track of names and call signs as people check in. If you're going to be on the net anyway, why not save some dough at the same time! There are four free memberships available for 2023, so don't wait to get started!
- Chuck has set a goal for the Club of running at least one activity a month. This can be a hands-on construction activity, an operating activity like Field Day, a fox hunt, or a special event station. The goal is to get people together to have fun with amateur radio! We have multiple locations at our disposal, as well as lots of Club equipment, so if you have an idea for something you think others hams would like to do, please let us know, and if you're willing to run it, even better!
- The Club is also looking for presentation topics for 2024. If you have any ideas, or better yet, would like to present, please let Chuck know and we'll get you on the schedule!
- All club activities are open to anyone - members and non-members. If you have questions, ask them on a net or **send email to [elmer@w0eno.org](mailto:elmer@w0eno.org)**

**Presenter: Bryan, AF0W**

### **Topic: Hazards**

- While amateur radio is certainly not in the same class as extreme sports like skydiving or BMX bike jumping, there are still some electrical and RF safety issues you need to keep in mind.
- The type and severity of the hazards are dependent on the equipment you use, and the type of operating you do.

### **Electrical Hazards**

- The first category is general electrical issues
- Radios, even crystal sets with no apparent power source, are electrical devices
- One of the most potentially dangerous electrical hazards is electric shock, which is caused by current flowing through your body
- It can disrupt heart and lung functions, cause or prevent muscle movement, and at high levels, can even damage skin and internal organs.

- The obvious solution is to avoid touching live circuits
- This applies heavily when working on tube-based equipment, such as older radios and amplifiers, due to the high voltages used in these circuits.
- You may say "Well, I've only got an HT, so I don't need to worry about this."
- While in general that is true - HTs are low-powered devices, there is still a very real potential issue and that is the battery being short-circuited.
  - a. Most HTs come with batteries that can be charged simply by dropping them into a charging base. The battery is charged via metal contacts that touch those on the charging base.
  - b. Since these contacts are not covered in any way, an issue can arise if the battery makes contact with a conductor such as metal keys or an antenna in a backpack which shorts the positive and negative charging contacts together, which can release a lot of energy!
  - c. For example, the ubiquitous Baofeng UV-5R has three terminals, labeled +, - and T. The function of the first two is obvious - the middle T contact is apparently for temperature monitoring, but it appears not to be connected to anything in the base on at least some models.
  - d. This issue can also arise with any spare batteries you take along, so consider protecting these by putting them into something non-conductive like a plastic sandwich bag.
- One protection device you will likely come across, especially if you build a battery box or GoBox are fuses.
- These are placed into a circuit to prevent fire and other damage from occurring when too much current flows through it.
- If you've purchased a mobile or desktop radio that runs off 12 volts, it likely came with a power cable with a fuse in either the positive or both leads. You may think the fuse is there to protect the radio, but it's really there to protect the power cabling.
- For example, the ICOM IC-7000 has a 5 amp fuse mounted inside the radio, but has 30 amps fuses in both power leads. If you were to short out the 12v power pin in the antenna tuner connector, it is very likely that a circuit trace or other internal component would fail before the 5 amp fuse opens, and that the 30 amp fuse would likely never open.

- Also, if you neglected to put a grommet or other protection on the power cables between the battery and radio, and the metal of the vehicle wore through the positive cable causing a short, the 30 amp fuse on the positive cable would hopefully prevent a fire.
- One thing to be aware of with fuses is that there is a time delay between a current overload and the time the fuse opens, and this delay changes depending on the magnitude of the overcurrent.
  - a. For example, a 20 amp fuse will likely handle a 30 amp current for up to 90 seconds before opening, and a 100 amp current for about a second.
- If you've ever touched the two ends of a jumper cable connected to an automotive battery together and seen the sparks, you know you wouldn't want this occurring under your dash for any amount of time!
- One thing you must never do with fuses is to replace them with a fuse rated for a higher amperage. In a pinch, you can try a lower-rated fuse, but never go with a large one!
- The delay between a current overload and the fuse breaking the circuit is also why amateur setups typically use fuses instead of circuit breakers. Circuit breakers have even longer times before acting, which allow a higher potential for damage in an overload situation.
- At some point, a shack-based system is very likely powered from household AC. This should always be done using a three-conductor cord and plug connected to a grounded, three-prong outlet.
- The third prong provides a safety connection to ground and is connected to the metal equipment chassis so an internal short between the current-carrying conductors and the equipment case will not result in the case becoming an electrified hazard.
- Also, did you know that even if it is not connected to the AC power line, a linear power supply or tube-based amplifier can still be deadly? They each likely contain large capacitors which will retain their energy even when disconnected from a power source.
  - a. You must always be careful to safely discharge this energy before working on these devices.

### **Contact RF Hazards**

- Another category of hazards can be referred to as RF contact hazards
- This is where direct contact occurs with an RF signal - an example would be someone touching an antenna during transmission, possibly resulting in a painful RF burn

- Another example would be touching an RF antenna connector on the back of a radio which is powered on, and then accidentally engaging the push-to-talk feature
- While you may not get injured if you accidentally touch the antenna of your HT while transmitting, encountering higher-powered RF can be very painful
- This is because the RF energy heats and damages tissue beneath the outer layer of skin, resulting in second and third-degree burns which heal very slowly.
- Things that impact the severity of the burns include the RF power level, contact surface area (larger is less severe), grounding or return contact, and the frequency of the RF signal, as the body absorbs more RF at certain frequencies.
- People have reported small fingertip burns from 5 watt HTs when accidentally transmitting and touching the antenna connector.
- If you do receive an RF burn, the treatment is like with any other type of burn. Run cold water over it, and seek medical attention if necessary.
- As with the previously-described electrical hazards, avoidance is the best defense.

### **Indirect RF Hazards**

- The last category of hazards are indirect RF exposure
- This occurs when encountering RF energy from an antenna, feedline, or other RF component, such as an attic-mounted antenna
- RF energy is non-ionizing, meaning it does not cause genetic cell damage as would be caused by radioactive material.
- This does not mean it is safe, however - it can still cause localized heating
- Rules and regulations are in place to protect people from this hazard
- The FCC has instituted RF exposure limits, called the Maximum Permissible Exposure limits, or MPE (mike-papa-echo).
- They factor in frequency, as some human tissue and structures heat more at certain frequencies than others.
- The frequency range with the lowest MPE is 30 to 300 MHz, so the VHF band is of greatest concern for radiation, including the 6 and 2 meter bands.
- The MPE limits differentiate between controlled and uncontrolled exposure.

- Controlled refers to situations where people are aware of an antenna and RF energy and can do something about it. In this case, higher power levels are allowed, and limits are based on a 6 minute average exposure.
- Uncontrolled refers to situations where you have no control of people near your antenna, such as neighbors or pets, and allows a lower exposure level and a 30 minute average exposure.
- In either case, proximity to the radio antenna is the single most influential factor when it comes to exposure levels
- There are a number of online calculators that will help you determine whether your installation meets the standards
- As an example, I calculated the results for both our repeater frequencies from a 25 watt radio feeding a quarter-wave antenna using FM modulation and transmitting for 5 minutes, then listening for 10 minutes.
- For 147.270 MHz, the minimum safe controlled distance was two-and-a-half feet, while the uncontrolled distance was three-and-a-half feet.
- For 448.800 MHz, the minimum safe controlled distance was 2 feet, and the minimum uncontrolled distance was 3 feet.
- To show the impact of power levels, increasing the 2 meter power from 25 to 50 watts raised the controlled distance from 2.5 to 3 feet, and the uncontrolled distance from 3.5 to 4.2 feet.
- My attic-mounted quarter-wave vertical is safe as there is no habitable space within that range.
- On the other hand, if I had an attic-mounted dipole on 20 meters connected to a 100 watt radio running FT8, the minimum controlled distance would be about 2 feet, while the minimum uncontrolled distance would be 4.5 feet. While the power and antenna gain are higher, the frequency is much lower than 2 meters.
- You can try out values for your own station by searching for "rf exposure calculator" on the Internet.
- If you find that your station exceeds these maximum permissible limits for exposure, you can mitigate the problems by relocating or reorienting your antenna, raising your antenna, reducing antenna gain, reducing RF power output, or changing to a lower duty cycle mode.

- Note that you should rerun your evaluation if any of the above characteristics of your station change over time, such as if you were to add an amplifier, or switch to an antenna capable of handling additional HF bands.

### Summary

- As you can see, amateur radio is not completely without hazards, but there are means of handling them all, as long as you are aware of their existence and design your system and operating habits to be safe.

### Questions:

- **The question for the week is:** Have you performed RF exposure calculations for your station, and if so, were you within the permissible limits?
- **In my case,** I've performed the exposure calculations for my station, including my VHF/UHF dual and single-band radios, as well as my 100 watt HF radio and 500 watt amplifier. My primary UHF/VHF antennas are all in the attic and safe. I have some magnetic mount dual band antennas in my shack, and while I use those primarily for receiving, they would be OK for 50 watt FM transmissions as well.

My HF antennas are all outdoors and are mounted high enough to be safe for humans and pets, but might cause issues for some tree squirrels!

### More Info:

- ARRL RF Exposure Calculator: <https://www.arrl.org/rf-exposure-calculator>
- Safety (ARRL): <https://www.arrl.org/safety>
- Safety: <https://newhams.info/category/safety/>
- If you have ideas for net topics or general meeting topics / presenters, please let us know! Tell us on a net, or send email to [k0itp@w0eno.org](mailto:k0itp@w0eno.org)

### Email to [elmer@w0eno.org](mailto:elmer@w0eno.org)

1. K0ITP - Chuck - Firestone
2. AI7JW - Ian - Longmont
3. NA0A - John - Boulder
4. WB4FAW - Charlie - Longmont
5. KF0MXH - Art - Longmont
6. W0PPC - Steve - Lyons
7. KV0N - Raman - California via Echolink
8. KF0FEC - Will - Boulder

9. AF0W - Bryan - Echolink El Paso

Field Day - need to make sure people avoid antennas and antenna / mast support lines

Tower climbing is another potential hazard

WB4FAW - Feedlines could come into play. Come in at 4-5 ft height, so could be accessed. Have open wire also. **RESEARCH TO SEE IF AN ISSUE WITH RF EXPOSURE!! (direct or indirect)**

**Does putting a "High Voltage" sign up open you to liability (i.e. you know it's dangerous)**

KF0FEC - The reason we put fuses into circuits is not to protect the load, but rather to prevent an overload from causing that wire to become overheated and causing a fire. You size the fuse according to the wire size. Want to always use a wire sized to handle current your device will handle at max. A lot of equipment comes with fuses in positive and negative leads. Most DC power is fused only on the positive side. When designing protection system, choose one strategy or another. Fuse everything on the positive side, or fuse on both. Want to avoid having system where some are fused on both, and some others are only on positive side. Radio is often hooked up to another piece of equipment, or the antenna shield makes contact with car. If negative side fuse opens up, now all the other ground paths become potential paths back to battery for radio.

**End:** 8:00pm