

# Safety for Beginners



# Safety for Beginners with Jon Newstrom, KL7GT



Safety is everyone's responsibility!

# Course Introduction

- Safety is an attitude which is gained through knowledge and best practices.
- Safety is Everyone's responsibility!
- Who/What are we trying to make “safe”?
  - Our family, friends, the general public, ourselves AND our equipment.
- This course will be for beginners; we will get through the basics. Then we'll have an advanced discussion only if we have time.

# Starting Point: my hand held

- What are the hazards of using this radio?

# Hazards of this HT

- Poke someone's (yours?) eye out.
- RF exposure (use speaker mic/headset)
- Operating in a dangerous place (RF field)
- Distraction (focused on listening and talking and not situationally aware).
- Overcharge/drain the battery (fire/explosion)
- Heat
- Lightning rod?

# The five basic safety concerns/conditions

- Grounding
- Lightning
- Electrical
- RF Exposure
- Field work – field day, emergency, public service.
- Bonus (if we have time): Safety and ICS

# Other safety concerns if time allows

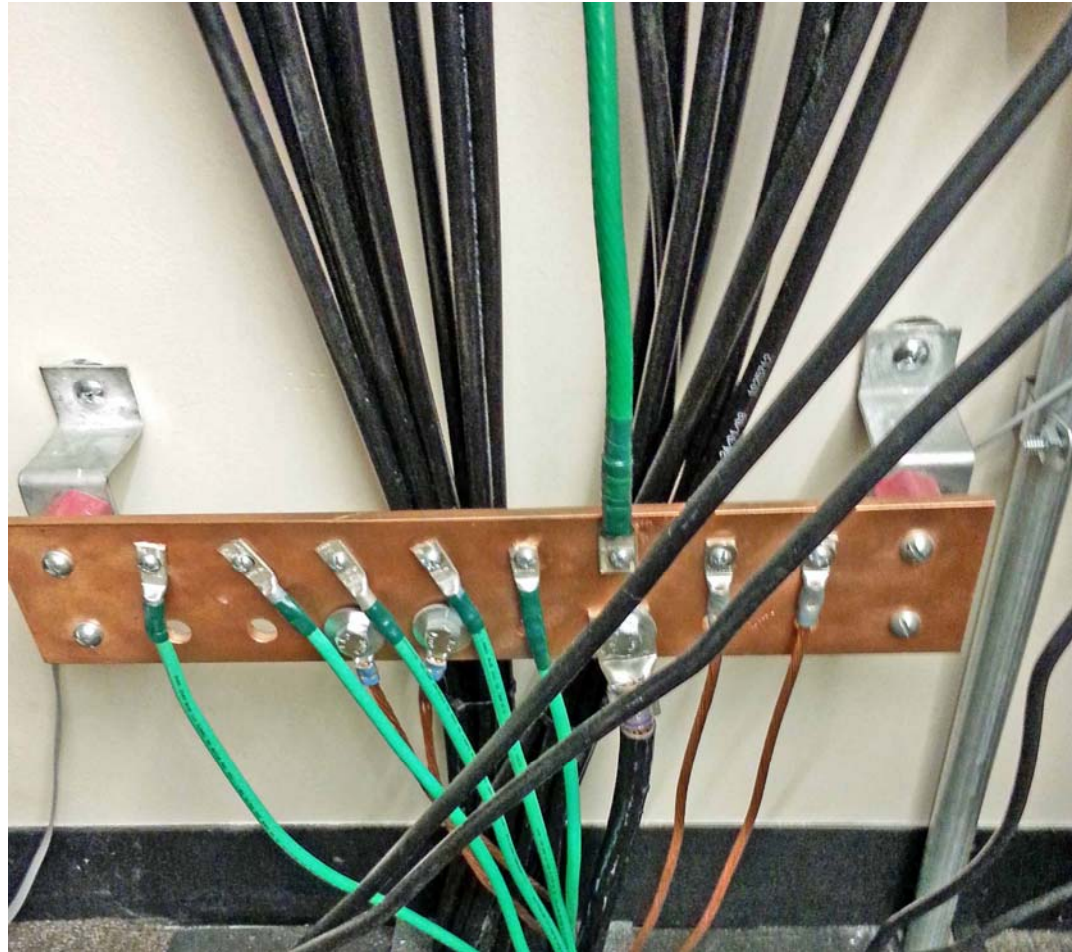
- Physical Layout (trip, fall, or injury hazards)
- Antennas
- Towers
  - Rigging (guy lines strong enough?)
  - Engineering (wind load, base, antenna mounting)
  - Set Up (climbing)
  - PPE (Personal Protection Equipment)
  - Ground
  - Lightning
  - Lighting? Marking?
- Food and Water
- Shelter
- First Aid

# Grounding - Electrical or “safety ground”

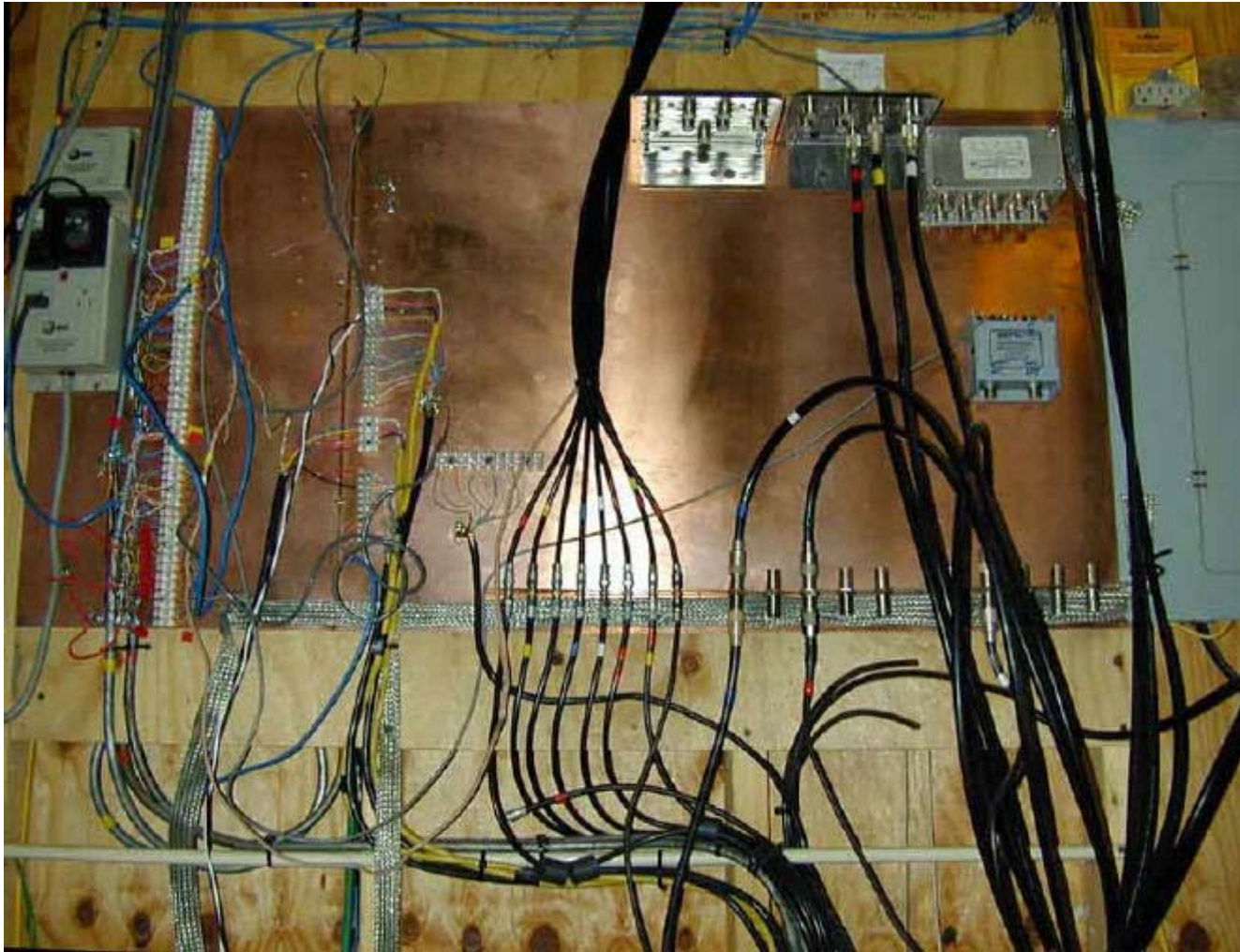
- Required by code – Ground ties to the neutral at one point.
- It’s good practice to have “one and only one ground” (Common Point Ground) - what does that mean? [Coax and Power Cord]
- Everything – all your equipment - should have a three-pronged plug. There are exceptions – battery chargers, some computers, land-line telephones.
- The safety ground is connected to the chassis of your equipment, and protects you if somehow a “hot” line connects to it.
- The concept of “balanced” – POTS (Plain Old Telephone Service)
- RF Ground – it’s tricky and advanced – touched on later
  - IF you have a tower, the tower’s ground and your shack’s ground should be connected together with buried copper strap.
  - If you are building or doing concrete work – consider an Ufer Ground.



# Common Point Ground



# Common Point Ground



# Lightning Ground

- Where is this? What is there?



# Lightning Ground – A very advanced topic.

- Good news – there is a LOT of information out there
- Bad news – there is a LOT of information out there
- Scary news – lightning will grab ANYTHING to find ground
- Really scary news – lightning is FAST AND POWERFUL
- With ground(s) – SHORT and WIDE is what you want
- If you are pouring concrete – look at an Ufer ground.

# Lightning Ground

- Complete this sentence:
- “Electricity follows the path of \_\_\_\_\_”

# Lightning Ground

- Complete this sentence:
- “Electricity follows the path of least resistance.”
- Parallel Resistance

# Lightning Ground

## – Practical discussion

- Handheld (sorry to say, but: YOU are the lightning ground!)
- Mobile (capacitive coupling to the ground)
- Base Station – single point ground panel
- Antennas/towers
  - Some antennas need a ground, some are “balanced”
  - Towers, mostly, are grounded
    - » Run ground wires/straps straight – no kinks – no sharp turns
    - » Good radials buried 6 to 18” below grade
      - 8 or more radials (4 if desperate)
      - Grounding rods along radials at intervals twice the length of the ground rod.
      - If you are pouring a concrete base – consider Ufer ground.
- Telephone lines – POTS (Plain Old Telephone Service) are balanced and NOT grounded, use special lightning arrestor.
- Speaking of lightning arrestors. . .



# Lightening Ground

- Wide copper straps – VERY straight (no kinks)





# RF Ground

Eye Radio

98.6 Mhz

Juba, Sudan



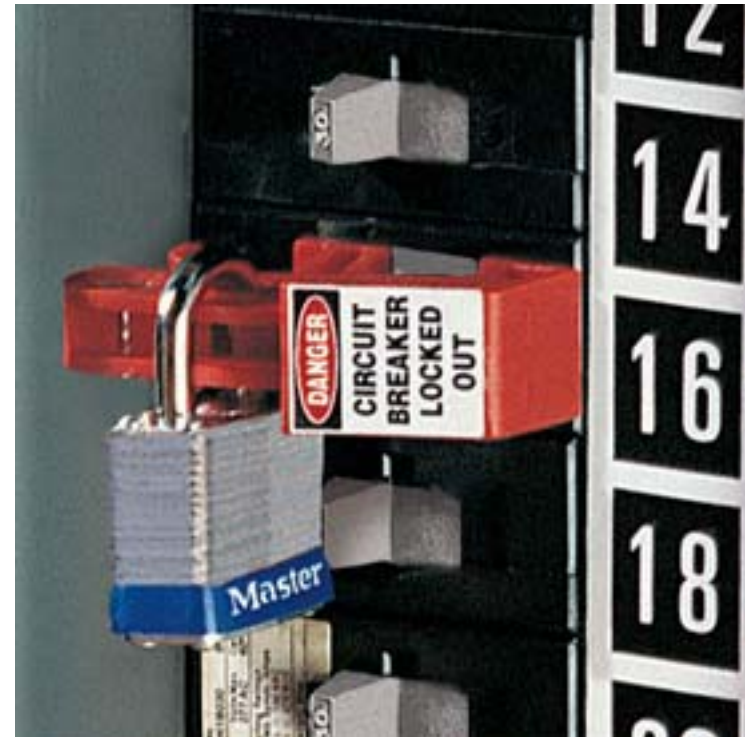
# Electrical

- Power lines and towers/antennas
- Extension cords/Power Strips
  - Daisy chains
  - Mixed circuits (mixed ground?)
- Wire gauge – the right wire for the right current
- How to know how much power things take?
  - Look in the manual
  - Add up the fuses
  - Use Ohm's law  $P=I * E$

# Electrical

- Surges and how to protect your station
  - Power strip with “surge protection” = junk (NOT recommended)
  - UPS (Uninterruptable Power Supply), typically, won't protect you from fast surges
  - Power Conditioners \$\$\$\$ (expensive) and ### (heavy) and worth it!
- Don't mix circuits
  - Example: Generator on the transceiver, “city” power on Power Amplifier
  - Example: Your shack has two separate circuit breakers for its outlets.
- Good Practices
  - Never work on anything “hot” – think before stripping wires
  - Plug in the power cord last
  - Unplug equipment (and put the plug in sight) before you work on it (sleeper circuits)
  - With High voltage (especially DC) – one hand behind your back
  - Remember what capacitors do – store energy
  - Electrical “lock-outs”

# Electrical lockouts



# RF Exposure

- Remember this is a beginner's class
- That means beware of over-simplification.
- It also means there are a lot of opinions out there, and this course will give a general opinion.
- Safety is your responsibility, and you have to decide what is safe!

# RF Exposure

- The Inverse Square Law is your friend. Power is attenuated (reduced) in an inverse square of the distance.
- Operate at the lowest possible power.
- Don't look into a wave guide or directive antenna used for UHF/SHF
- Don't operate transmitters or amplifiers with the cover off. Don't work around or on antennas when any of them are in use. Use lockouts if possible.

# RF Exposure

- IF you are close to these power levels (at the antenna)– THEN do the math (see link (one next slide) and the end of the slide deck)
  - 160 to 40 meters – 500 Watts PEP
  - 20 meters – 225 Watts PEP
  - 15 meters – 100 Watts PEP
  - 10 to 1.25 meters – 50 Watts PEP
  - 70 cm – 70 Watts PEP
- Beyond this point there be MATH!

# RF Exposure

- [http://www.arrl.org/files/file/Technology/tis/info/pdf/rfex1\\_2.pdf](http://www.arrl.org/files/file/Technology/tis/info/pdf/rfex1_2.pdf)



# Field Operations

- All of the safety concerns we have discussed apply to field operations as well. Some risks will increase.
  - Neatness becomes even more important
  - Increased likelihood of the General Public will also be at risk
    - Why does this matter? We chose to be hams, they didn't
  - Electrical could easily become tricky
    - More than one generator?
    - Alternative power such as solar/wind/batteries
  - Grounding
    - Generators, towers, operating positions all need to be properly grounded
  - RF Safety
    - Multiple stations operating means accumulation of RF exposure.
    - Antennas deployed much lower (less height) than at “home”, and potentially more dangerous. Public too close.

# Field Operations

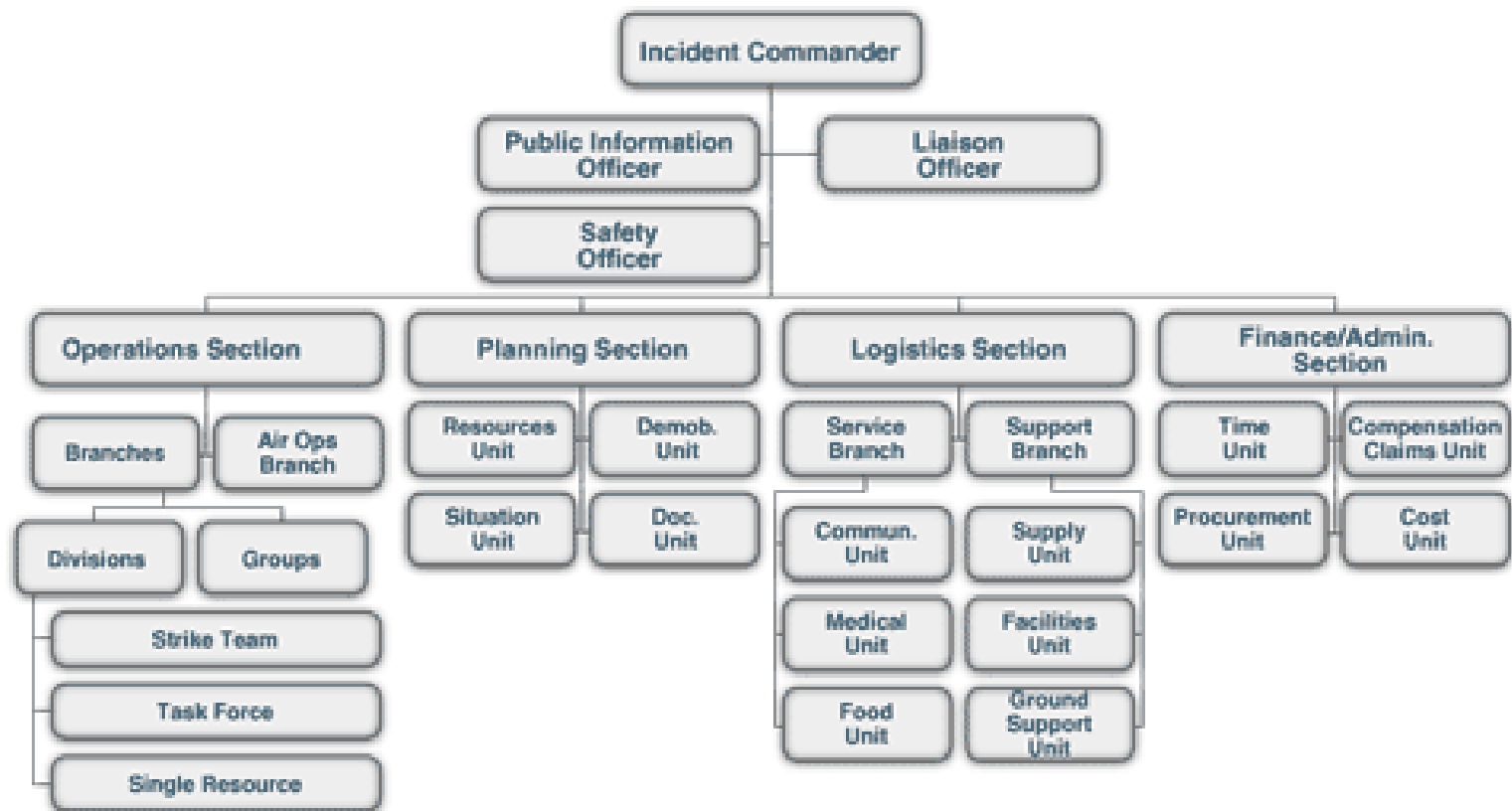
- Lightning
- Food Safety
- Trip and similar hazards
  - Power, coax, network cables
  - Guy lines
  - Antennas with eye-level elements (poking hazard)
- Untrained or distracted “helpers”
- Working with people you don’t know (names?)
- Generators
  - Fuel Storage and refueling procedures
  - Grounding
  - Access to (block it off)
- PPE (Personal Protection Equipment)
  - Gloves, Shoes, Hardhat?
  - Vests, goggles
  - Good ladders (OSHA Stickers)

# Safety under ICS

- Brief explanation of the Incident Command System/Structure.
  - Safety Briefing
  - “Put on your own mask before assisting others”
  - Role of the Safety Officer under ICS
    - SO is an advocate for Safety, and has the IC’s ear!
- **Safety is everyone’s responsibility**

# Safety under ICS

## Incident Command Organizational Chart



# Bucket List

- What do YOU want to discuss in more depth?
- Ground
- Lightning Ground
- Electrical
- RF
- Field Operations
- Incident Command – Safety
- First Aid

# Resources

- **General**

- ARRL's "home" page on safety

- <http://www.arrl.org/safety>

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- **Electrical**

- From the ARRL antenna book

- <http://www.arrl.org/files/file/Technology/tis/info/pdf/AntBk.pdf>

- General ARRL page on electrical safety

- <http://www.arrl.org/electrical-safety>

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- **Grounding**

- <http://www.arrl.org/grounding>

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- About Ufer grounds

- [http://en.wikipedia.org/wiki/Ufer\\_ground](http://en.wikipedia.org/wiki/Ufer_ground)

# Resources

- **Lightning**

- ARRL's lightning safety page

- <http://www.arrl.org/lightning-protection>

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- Three good articles on lightning safety

- <http://www.arrl.org/files/file/Technology/tis/info/pdf/0206056.pdf>

- <http://www.arrl.org/files/file/Technology/tis/info/pdf/0207048.pdf>

- <http://www.arrl.org/files/file/Technology/tis/info/pdf/0208053.pdf>

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- **RF Safety**

- RF safety evaluation and exemption worksheets:

- [http://www.arrl.org/files/file/Technology/tis/info/pdf/rfex1\\_2.pdf](http://www.arrl.org/files/file/Technology/tis/info/pdf/rfex1_2.pdf)

- How to evaluate a Ham Station:

- <http://www.arrl.org/files/file/Technology/tis/info/pdf/CH5references.pdf>

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- **Safety in the field:**

- Nice article walking through field day RF safety

- <http://www.arrl.org/files/file/Technology/tis/info/pdf/9906048.pdf>