# SCARS Tech License Course – Week 7

## Operating Regulations

## Safety

Gayland Kitch WX5MOR

ARRL The national association for AMATEUR RADIO®

# Technician License Course

## Chapter 8

Lesson Plan Module – 8a

# Control Operators, Station Identification and Third-Party Communications

# Control Operator

- Control operator – the amateur licensee responsible for making sure transmissions comply with FCC rules.
- The FCC requires that transmissions are made only under the control of a licensed operator.

# Control Operator

- Designated by the station licensee.
- Must have a valid FCC-issued Amateur Radio license or have reciprocal operating permission.
- Station must operate within the authorization of the control operator's license.
- Control operator must be present at the control point of the station

# Control Operator

- Designated by the station licensee.
  - Assumed to be the station licensee unless otherwise documented.

# Control Operator

- Wherever the station controls are operated – not necessarily the physical transmitter
- The control operator must be able to assert control of the transmitter
- Control point can be at the transmitter, or linked to the transmitter
- Control by a circuit or computer is also allowed

# Guest Operations

- Non-licensed people can make transmissions but only when a control operator is present.

- The control operator is solely responsible for station operation.

- For licensed guest operators, both the control operator and the guest ham are responsible for station operation.

# Station Identification (ID)

- All transmissions must be identified

- State the call sign every 10 minutes during and at the end of the communication

- Use phonetics on voice modes

- Use of “Tactical Calls”
- Licensed Guests

# Miscellaneous ID Rules

- Repeaters must also ID using the same 10 minute rule.
- Can be voice or CW (at 20 WPM or less).
- Satellites and ISS have special rules.
- Special event calls.
- Club call or control operator call given once per hour.

# Third-Party Communications

- Third-party communication – transmissions on behalf of an unlicensed entity

- Could mean actually speaking on the air
- Could mean passing a message on behalf of a third party

- Two situations – different rules

- Within the US
- Communication that crosses international borders

# Third-Party within US

- No special rules.
- Just make sure the message is non-commercial in nature.

# Third-Party Across Borders

- Third-party agreement with US must exist
- Check for current third-party agreements from ARRL website or FCC sources if in doubt
- Most agreements are within ITU Region II
- This includes contest operation
- Identify with both stations' call signs

# Technician License Course

## Chapter 8

Lesson Plan Module – 8b

# Interference, Remote & Automatic Operation, Prohibited Transmissions

# Interference

- QRN or “Static”

- Natural interference (thunderstorms)
- Man-made (appliances and power lines)

- QRM

- Interference caused by other signals
- Can be from transmitted signals
- Can be created internally by a receiver

# Interference

- Harmful

- Interference that is disruptive, not necessarily willful.

- Deal with it as best you can, try to avoid causing harmful interference.

# Interference

- Willful

- Intentionally causing interference.
- This becomes a legal and law enforcement issue.
- This is rare and there are procedures to deal with this (ARRL Official Observers can help).

# Preventing Interference

- Use common sense and courtesy
- Know how to operate your equipment to reduce generated and received interference
- No one owns a frequency; be a good neighbor and share – have a “Plan B”
- Recognize special operations and special circumstances

# Control Point

- Where the control operator function is performed – not necessarily at the physical transmitter
- Local control: operator is at the transmitter
- Remote control: control point is linked to the transmitter by a control link which could be telephone, radio, or Internet
- Automatic control: control functions are operated by circuitry that ensures proper operation

# Automatic Control

- Control operator is *always* required
- Responsible for proper operation
- Repeaters, auxiliary stations, space stations, and beacons may operate under automatic control
- Repeater users are responsible for their transmissions through a repeater

# Prohibited Transmissions

- Unidentified transmissions
- Not giving your call sign
- False or deceptive signals
- Using someone else's call sign
- False distress or emergency signals
- Fake calls for help

# Prohibited Transmissions

- Obscene or indecent speech
- Up to interpretation, avoid controversial subjects
- Music

# No Commercial Communications

- Advertising ham radio gear is okay as long as it's not your regular business. (Don't advertise non-ham gear.)
- You may not use ham radio on behalf of your employer.
- Exception: teachers may use ham radio in their classrooms, clubs may employ an operator but only with restrictions on hours.

# No Encrypted Transmissions

- Encryption means deliberately encoding information for transmission in order to hide or obscure the message.
- Encryption is only allowed for:

- Radio control
- Space station control

# No Broadcasting

- Broadcasting is sending one-way transmissions to the general public:

- News
- Music

- Exceptions:

- Code practice
- Ham radio-related bulletins
- Retransmission of space station control communications

# Special Circumstances

- Emergencies and critical situations create special circumstances.
- Special events may qualify as special circumstances.
- Normal rules return when the situation returns to normal.

# Technician License Course

## Chapter 9

Lesson Plan Module – 9a

# Safety & Amateur Radio

# Electrical Injuries

- Shocks and burns.
- Low voltages can cause enough current to create problems.
- Equipment today uses lower voltage than tube equipment but it can still cause burns.

**Effects of Electric Current in the Human Body**

| *Current* | *Reaction* |
|---|---|
| Below 1 milliampere | Generally not perceptible |
| 1 milliampere | Faint tingle |
| 5 milliamperes | Slight shock felt; not painful but disturbing. Average individual can let go. Strong involuntary reactions can lead to other injuries. |
| 6-25 milliamperes (women)<br>9-30 milliamperes (men) | Painful shock, loss of muscular control*; the freezing current or "can't let-go" range. |
| 50-150 milliamperes | Extreme pain, respiratory arrest, severe muscular contractions. Death is possible. |
| 1000-4300 milliamperes | Rhythmic pumping action of the heart ceases. Muscular contraction and nerve damage occur; death likely. |
| 10,000 milliamperes | Cardiac arrest, severe burns; death probable |

* If the extensor muscles are excited by the shock, the person may be thrown away from the power source.

Source: W.B. Kouwenhoven, "Human Safety and Electric Shock," Electrical Safety Practices, Monograph, 112, Instrument Society of America, p 93. November 1968.

# Electrical Safety

- Avoiding contact is the most effective way of practicing electrical safety
- Unplug equipment before working on it
- Keep one hand in your pocket
- Make sure equipment is grounded
- Use power from GFCI-protected circuits

# Mitigating Electrical Hazards

- If working on live equipment is required:

- Remove jewelry
- Avoid unintentional touching of circuitry
- Never bypass safety interlocks
- Discharge high-voltage points and components to ground
- Capacitors can store charge after power is off
- Storage batteries are dangerous when shorted

# Responding to Electrical Injury

- REMOVE POWER!

- Have ON/OFF switches and circuit breakers clearly marked.

- Install an emergency master power switch and make sure your family knows how to use it.

- Call for help.
- Learn CPR and first aid.

# Electrical Grounding and Circuit Protection

- Make sure your station wiring meets code
- Most ham equipment does not require special wiring or circuits

- Use 3-wire power cords
- Use circuit breakers, circuit breaker outlets, or Ground Fault Circuit Interrupter (GFCI) circuit breakers or outlets
- Use proper fuse or circuit breaker size
- Don’t overload single outlets or circuits

# Grounding & Bonding at RF

- RF burns from "hot spots" at high RF voltage
- Do not cause serious injury at ham power level
- Prevent by bonding (connecting) equipment together with heavy wire or strap – braided strap not recommended at RF
- Prevent by keeping people away from antennas and radial or counterpoise wires
- Ground equipment for AC safety

# Lightning Protection

- Ground antennas and towers to local code
- Use 8-ft ground rod for each tower leg
- Bond rods to tower leg and the other rods
- Ground connections should be as short as possible
- Use lightning arrestors on a single ground plate where cables enter the house
- Unplug and disconnect equipment (including telephones and computers) and feed lines if lightning is expected

# RF Exposure

- Electromagnetic radiation (EMR) is not the same as radioactivity – much lower energy
- RF energy heats body tissues

- Heating depends on the RF intensity and frequency.

- If precautions are taken, RF exposure is minimal and not dangerous.

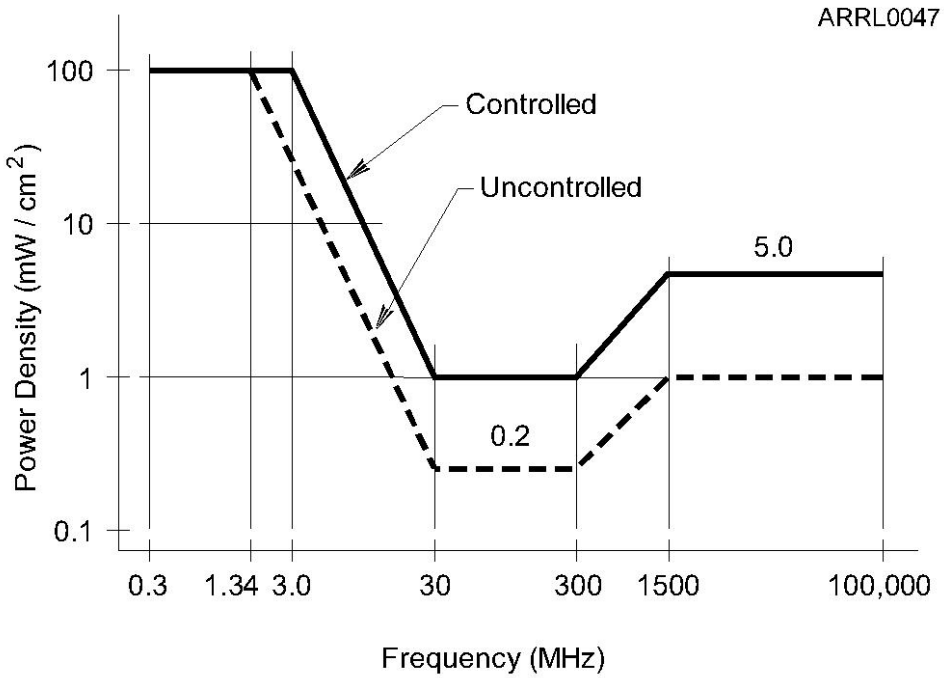
# RF Intensity

- Power Density

- Watts per square centimeter (w/cm2)

- Higher power density means higher RF exposure
- RF absorption varies with frequency because of body part size
- Safe exposure levels have been established by the FCC

# Maximum Permissible Exposure (MPE)



# RF Environment

- Controlled Environment.

- You know where people are standing in relation to your antenna and you can do something about it.

- Higher power density is allowed because you can make adjustments if needed.

# RF Environment

- Uncontrolled Environment.

- You have no control of people near your antenna.

- Lower power density is allowed because you cannot control or adjust the exposure of people.

# Duty Cycle and Duty Factor

- Duty cycle is the percentage of time that a transmitter is on during the evaluation period, from 0 to 100%

- Duty cycle = 100 x (time on / total time)

- Duty factor is the same as duty cycle, but given as a number from 0 to 1.0
- Higher duty cycle or factor means higher average power density and exposure

# Mode Duty Cycle

- Accounts for the different characteristics of the transmitted signal's waveform

**Operating Duty Factor of Modes Common**

| *Mode* | *Duty Cycle* |
|---|---|
| Conversational SSB | 20% |
| Conversational SSB | 40% |
| SSB AFSK | 100% |
| SSB SSTV | 100% |
| Voice AM, 50% modulation | 50% |
| Voice AM, 100% modulation | 25% |
| Voice AM, no modulation | 100% |
| Voice FM | 100% |
| Digital FM | 100% |
| ATV, video portion, image | 60% |
| ATV, video portion, black screen | 80% |
| Conversational CW | 40% |
| Carrier | 100% |

# RF Exposure Evaluation

- All fixed stations must perform an exposure evaluation.

- Use online calculator (easiest)
- Model exposure with software (difficult)
- Measure RF power density (most difficult)

# RF Exposure Evaluation

- At lower power levels, no evaluation is required. Varies with frequency – example: below 50 W at VHF.
- Re-evaluate exposure when station equipment or operating frequencies change.

# Reducing RF Exposure

- Relocate or reorient antennas
- Raise the antenna
- Reduce antenna gain
- Reduce RF power output
- Change to a lower duty cycle mode

# Mobile Safety

- Mobile Installations

- Secure all equipment
- Place equipment where you can operate it safely while driving
- Know local rules for use of communications equipment while driving
- May need hands-free microphone

# Power Line Safety

- Keep antennas well away from power lines
- Check for power lines before installing antennas in trees
- Provide a minimum of 10 feet of clearance if antenna falls
- Never attach antennas or guy lines to utility poles or structures

# Tower Work

- Basic tower safety

- Proper clothing, hard hat and eye protection
- Use a proper climbing harness, not a lineman's belt or rock-climbing gear
- Don't climb a crank-up tower supported only by its lift cable – block and secure it first
- Use a gin pole to lift heavy items
- Don't work alone – use a ground crew

# Technician License Course

## Chapter 9

Lesson Plan Module – 9b

# RF Interference (RFI)

# Radio Frequency Interference (RFI)

- Signals that interfere with radio reception.
- Interference can be FROM your station or TO your station.
- Solving the problem might take a little detective work!

# Types of RFI

- Direct detection – offending signals get into the electronic circuits to cause interference.
- Overload – strong signal that overwhelms the ability of the receiver to reject it.
- RF Current – can be picked up by cables of consumer equipment.
- Transmitted harmonics – must be filtered out at the transmitter.

# Filters

- Filters attenuate (reduce) signals
- High-pass – reduce low-frequency signals
- Low-pass – reduce high-frequency signals
- Band-pass – only pass a range of signals
- Notch – reduces a narrow range of signals
- Selecting correct filter requires understanding the source of the interference

# Ferrite Chokes

- Creates impedance (opposition to ac) on cables and wires.
- Can be used to block RF current that causes interference to entertainment equipment, microphones, monitors, amplifiers, etc.
- Wind cable through ferrite core to create blocking impedance.

# Cable TV Interference

- Usually the result of broken shielding somewhere in the cable.
  - Loose connections
  - Broken connections
  - Corroded connections
- Usually solved by proper cable maintenance by cable supplier.

# Noise Sources

- Electrical arcs (motors, thermostats, electric fences, neon signs)
- Power lines
- Motor vehicle ignitions or alternators
- Switching power supplies
- Computers, networks and TV sets

# RFI Guidelines

- Operate your equipment properly.
- Eliminate interference in your own home.
- Use good station building practices to eliminate unwanted signals.
  - Shielded wire and cables
  - Shielded equipment
  - Good connections and filters

# Dealing with RFI

- Take interference complaints seriously.
- Make sure that you're really not the cause (demonstrate that you don't interfere within your own home).
- Offer to help eliminate the RFI, even if you are not at fault.
- Consult ARRL RFI Resources for help and assistance.

# Part 15 Rules

- Applies only to unlicensed devices
- Unlicensed devices may not interfere with licensed services, such as amateur radio
- Unlicensed devices must accept any interference they receive from licensed services
- RFI from and to unlicensed devices is the responsibility of the users of such devices

# What the Rules Say

- Bottom line – If your station is operating properly, you are protected against interference complaints
- BUT – Be a good neighbor because they are probably not familiar with Part 15 rules and regulations

# Electrical Safety Grounding and Circuit Protection (in the Home)

- Make sure your home is “up to code.”
- Most ham equipment does not require special wiring or circuits.
  - Use 3-wire power cords.
  - Use circuit breakers, circuit breaker outlets, or Ground Fault Interrupter (GFI) circuit breakers.

# Electrical Safety Grounding and Circuit Protection (in the Home)

- Ground Fault Interrupter (GFI) circuit breakers.
- Use proper fuse or circuit breaker size.
- Don’t overload single outlets.

# RF "Grounding"

- Not the same as ac safety grounding
- "Bonding" is more accurate
- Keep all equipment at the same RF voltage
  - Current will not flow between pieces of equipment which can cause RF feedback
  - Minimizes RF "hot spots" (RF burns)
  - Use solid strap or wire for best RF connection

# End of Week 7

https://w5nor.org/tech