

## **INTERFERENCE-RADIO SYSTEMS 8022**

(No.36 May 2016)

Situations involving interference to CAL FIRE or local government radio channels or systems have become increasingly common. Interference can be either intentional or accidental, but it is always disruptive to the conduct of our emergency radio communications.

Accidental interference is the most common situation, normally resulting from intermodulation "mixes" of other signals or from adjacent channel radio signals that are generating energy so as to interfere. Interference will increase in the future as the radio spectrum becomes increasingly loaded with various high power transmitters utilized for paging, data transmission, or other commercial "wireless" services.

The solution of interference cases is dependent on careful documentation of each situation. In some cases, the local Public Safety Communications (PSC) technician can determine the cause and use available equipment to eliminate the problem. Often, however, it may be necessary to consult with the PSC engineers and / or the Federal Communications Commission (FCC) to eliminate the source of interference. The initial action should be notification of the local PSC technician.

ECC Chiefs or other designated staff shall refer complicated interference situations through the Region Communications Officer to the Sacramento Headquarters Senior Communications Officer for coordination.

As soon as it is apparent that a serious and persistent interference problem exists, start documentation of all pertinent details:

- channels / frequencies involved
- CTCSS tones, if known
- occurrence patterns; time, days, period
- Voice Logger recording of audio
- specific mobile relays or base stations affected

Some interference problems may require extensive investigation to determine and resolve the problem source. The FCC has advised that, due to their budget and staffing limitations, radio system users will need to provide complete problem documentation prior to involvement of federal enforcement staff. In the future, FCC resources will become increasingly limited. In most cases, however, CAL FIRE and OES PSC staff should be able to resolve recurring interference situations.

## **REPORTING INTERFERENCE (Intra-System) 8022.1**

(No.36 May 2016)

Intra-system (CAL FIRE versus CAL FIRE) radio interference will occur occasionally. This is inevitable because CAL FIRE's limited frequencies must be shared and co-utilized by field units. There simply are not sufficient frequencies available to entirely eliminate interference. The extremes of radio traffic generated during major emergencies also increase the likelihood of interference.

Immediate notification and good documentation for follow-up analysis are keys to minimizing and solving serious radio interference. When trouble does occur, it is the responsibility of the "interfering unit," once alerted, to stop transmitting and seek an alternate channel of communications. The ECC in the unit being interfered with is responsible for documenting the problem and notifying the region CC.

The region CC is responsible for gathering and forwarding the following information to the Sacramento Command Center:

- location of interference: what portion of unit or incident?
- frequency or frequencies involved
- elevations in the area affected: maximum and minimum
- incident resources affected: command, operations, logistics, etc.
- corrective measures taken, if any

All radio frequency interference documentation is to be forwarded by region CC to Sacramento Command Center as soon as possible, but at least within 24 hours of first report. Preferred transmittal mode is fax or e-mail. Sacramento Command Center will immediately forward information to the senior TCO for follow-up analysis and action.

## **CTCSS TONE PROTECTION 8022.2**

(No.36 May 2016)

### **Radio System Interference**

Interference to CAL FIRE Local Net communications has become increasingly common, as a result of planned re-use of CAL FIRE assigned radio frequencies, FCC authorized frequency assignment, and as a result of antenna improvements made at various CAL FIRE remote radio sites as follows:

- Local Net radio frequencies have been re-utilized to create additional Command Nets. This was accomplished to increase radio system efficiency and relieve Command Net congestion. Re-use of radio frequencies, however, can cause interference to existing Local Net assignments.

- CAL FIRE radio frequencies are not assigned exclusively to our department. Federal Communications Commission (FCC) rules also authorize use of these radio channels to other local government “forestry-conservation” agencies. These users can also create interference to CAL FIRE radio nets.
- Improved antenna towers and associated radio and antenna systems at CAL FIRE remote radio sites have improved local area radio coverage. However, coverage may be extended unintentionally to other co-channel units (different units that share the same frequency) with resultant interference to other CAL FIRE radio nets.

### **Continuous Tone Coded Squelch System (CTCSS)**

An accepted, standard method for elimination of co-channel, public safety radio system interference is the activation of Continuous Tone Coded Squelch System (CTCSS) protection. CTCSS protection is built into modern radio equipment. Several years ago, CAL FIRE converted the mountain-top mobile relay selection from “burst-tone” to CTCSS.

**Note:** References are occasionally made to “PL” as a tone protection system. “PL” refers to “Private Line”, which is the trade name reference to the CTCSS feature provided in radio equipment manufactured by Motorola Corporation.

CAL FIRE radio equipment has provided us the opportunity to enable CTCSS protection throughout our radio system. Basic elements of CTCSS implementation include protection of all radio equipment:

- Each Local Net has been assigned a discrete CTCSS “tone”. Mobile relays within the Local Net will continuously transmit the assigned CTCSS tone.
- Radio receivers within each Local Net are CTCSS “protected” so that the receiver will not “open” unless it detects the assigned CTCSS tone. All receivers are protected: ECC control stations, FFS, AAB, Conservation camp base stations, all mobile radios, all HTs, and all aircraft and helicopter radios.
- An example of CTCSS protection is illustrated by examination of the Butte Local Net and the co-channel (151.400 / 159.375 MHz) CDF Command-4 Net, which is operating in central California;
  - (a) Butte radio receivers are protected by CTCSS “Tone-1”.
  - (b) Butte mobile relays will always transmit CTCSS “Tone-1”.
  - (c) Butte Local Net users will only hear radio traffic from their mobile relays.
  - (d) Butte Local Net users will not hear the interfering radio traffic from CDF Command-4, because that radio system transmits CTCSS “Tone-8”.

- All CAL FIRE tactical ground nets are tone protected with transmit and receive tone 16, (192.8).

## **CTCSS Tone Plans**

CAL FIRE CTCSS tone protection is published in the Radio Call Plan, as issued to all CAL FIRE radio users. CAL FIRE Telecommunications staff also provides a radio channel summary to the Aviation Management Unit, Northern Region and Southern Region Command Centers, and Unit Emergency Command Centers for distribution to agency, cooperator, and vendor aircraft operators.

With the exception of HUU and RRU, the assigned CTCSS tone is the same number as the second digit of the unit designator. Example;

- TGU unit designation is “2500”, which equates to CTCSS “Tone-5” (146.2Hz)
- CZU unit designation is “1700”, which equates to CTCSS “Tone- 7” (167.9Hz)

Exception to standard CTCSS assignments;

- HUU unit designation is “1200”, assigned CTCSS is “Tone-1” (110.9Hz)
- AEU unit designation is “2700”, assigned CTCSS is “Tone-5” (146.2Hz)
- LMU unit designation is “2200”, no tone assigned.

**Note:** These exceptions are needed to ensure protection from other radio nets. “Tone-8” (103.5Hz) has been assigned to CAL FIRE Command Nets 1 through 10, statewide. This assignment will provide protection from co-channel CAL FIRE Local Nets.

## **CTCSS Planning and Implementation**

CTCSS encoders / decoders were installed during replacement of Emergency Command Center control stations, FFS, Camps, AAB, HABs, Mobile Relay, and radio systems between 2005 – 2011 for the Narrowband replacement project. Mobile and Portable radios statewide are all capable of tone transmit and receive.

## **CTCSS Limitations**

Car-to-car (direct) communications: CTCSS protection for a specific Local Net includes activation of CTCSS tone decoding for all mobile radios. Car-to-car (direct) communications will require that the assigned Unit CTCSS tone be transmitted to “open” the mobile receiver. The mobile radios must be programmed to automatically select the proper CTCSS tone in the “TA” (talk around) transmit mode.

## CTCSS Standard Tones

CAL FIRE, US Forest Service, US Bureau of Land Management, and FIRESCOPE have designated the following standard CTCSS tone assignments:

Tone-1	110.9 Hz
Tone-2	123.0 Hz
Tone-3	131.8 Hz
Tone-4	136.5 Hz
Tone-5	146.2 Hz
Tone-6	156.7 Hz
Tone-7	167.9 Hz
Tone-8	103.5 Hz
Tone-9	100.0 Hz
Tone-10	107.2 Hz
Tone-11	114.8 Hz
Tone-12	127.3 Hz
Tone-13	141.3 Hz
Tone-14	151.4 Hz
Tone-15	162.2 Hz
Tone-16	192.8 Hz
Tone-17	67.0 Hz
Tone-18	71.9 Hz
Tone-19	74.4 Hz
Tone-20	77.0 Hz
Tone-21	79.7 Hz
Tone-22	82.5 Hz
Tone-23	85.4 Hz
Tone-24	88.5 Hz
Tone-25	91.5 Hz
Tone-26	94.8 Hz
Tone-27	97.4 Hz
Tone-28	118.8 Hz
Tone-29	173.8 Hz
Tone-30	179.9 Hz
Tone-31	186.2 Hz
Tone-32	203.5 Hz

[\(see next section\)](#)

[\(see HB Table of Contents\)](#)

[\(see Forms or Forms Samples\)](#)