Chapter 3
Remedial Electronic Counter-Countermeasures Techniques

3-1. Introduction

Remedial ECCM techniques (Table 3-1) reduce the effectiveness of enemy efforts to jam our radio nets. They apply only to enemy jamming efforts or any unidentified or unintentional interference that disrupts our ability to communicate. There are no remedial ECCM techniques that apply to other actions the enemy might use to disrupt or destroy our communications. We must prevent enemy jamming and interference--after the enemy has gathered information about us, we cannot get it back.

Table 3-1. Summary of remedial ECCM techniques.

I. Recognize jamming/interference.
- Determine whether the interference is internal or external to the radio.
- Determine whether the interference is jamming or unintentional.
- Report jamming/interference incidents.

II. Overcome jamming/interference.
- Continue to operate.
- Improve the signal-to-jamming ratio.
- Adjust the receiver.
- Increase the transmitter power output.
- Adjust or change the antenna.
- Establish a retransmission station.
- Relocate the antenna.
- Use an alternate route for communications.
- Change frequencies.
- Acquire another satellite.

3-2. Types of Jamming Signals

Jamming is an effective way for the enemy to disrupt our command, control, and communications on the battlefield. All the enemy needs to jam us is a transmitter tuned to our frequency with enough power to override friendly signals at our receivers. Jammers operate against receivers--not transmitters. There are two modes of jamming: spot and barrage. Spot jamming is concentrated power directed toward one channel or frequency. Barrage jamming is power spread over several frequencies or channels at the same time. Jamming can be difficult, if not impossible to detect. For this reason, we must always be aware of the possibility of jamming and be able to recognize it. The two types of jamming most commonly encountered are obvious and subtle jamming.

a. Obvious jamming. This is normally very simple to detect. The more commonly used jamming signals of this type are described below. Do not try to memorize them; just be aware that these and others exist. When experiencing a jamming incident, it is more important to recognize and overcome the incident than to identify it formally.

(1) Random noise. This is synthetic radio noise. It is random in amplitude and frequency. It is similar to normal background noise and can be used to degrade all types of signals. Operators often mistake it for receiver or atmospheric noise and fail to take appropriate ECCM actions.

(2) Stepped tones. These are tones transmitted in increasing and decreasing pitch. They resemble the sound of bagpipes. Stepped tones are normally used against single-channel AM or FM voice circuits.

(3) Spark. The spark signal is easily produced and is one of the most effective for jamming. Bursts are of short duration and high intensity. They are repeated at a rapid rate. This signal is effective in disrupting all types of radio communications.

(4) Gulls. The gull signal is generated by a quick rise and slow fall of a variable radio frequency and is similar to the cry of a sea gull. It produces a nuisance effect and is very effective against voice radio communications.

(5) Random pulse. In this type of interference, pulses of varying amplitude, duration, and rate are generated and transmitted. They are used to disrupt teletypewriter, radar, and all types of data transmission systems.

(6) Wobbler. The wobbler signal is a single frequency which is modulated by a low and slowly varying tone. The result is a howling sound that causes a nuisance effect on voice radio communications.

(7) Recorded sounds. Any audible sound, especially of a variable nature, can be used to distract radio operators and disrupt communications. Music, screams, applause, whistles, machinery noise, and laughter are examples.

(8) Preamble jamming. This type of jamming occurs when a tone resembling the synchronization preamble of the speech security equipment is broadcast over the operating frequency of secure radio sets. Preamble jamming results in all radios being locked in the receive mode. It is especially effective when employed against radio nets using speech security devices.

b. Subtle jamming. Subtle jamming is not obvious; no sound is heard from our receivers. They cannot receive an incoming friendly signal, even though everything appears normal to the radio operator. Subtle jamming takes advantage of design features of the AN/PRC-77 and AN/VRC-12 series radios. In order to activate the receiver of an AN/PRC-77 in the SQUELCH mode or an AN/VRC-12 series radio in the NEW SQUELCH ON mode, a 150-hertz tone must be transmitted to them along with the carrier signal. In addition to this squelch feature, the AN/PRC-77 and AN/VRC-12 series radio receivers lock onto the strongest carrier signal received and eliminate the reception. of all other signals. For example, if we have an AN/PRC-77 in the SQUELCH mode and an AN/VRC-12 series radio in the NEW SQUELCH ON mode and they receive a jamming signal without the 150-hertz tone, the receivers of these radios will not be activated by any signal as long as the jamming signal is stronger than any other signal being received. In effect, the threat jammers block out these radios' ability to receive a friendly transmission without the operator being aware it is happening. This is called squelch capture and is a subtle jamming technique. The radio operator can readily detect jamming in all other function control modes and the other modes must be checked. Often, we assume that our radios are malfunctioning instead of recognizing subtle jamming for what it is.

3-3. Recognizing Jamming

a. Radio operators must be able to recognize jamming. Again, this is not always an easy task. Threat jammers may employ obvious or subtle jamming techniques. Also, interference may be caused by sources having nothing to do with enemy jamming. Interference may be caused by the following:

- Unintentionally by other radios (friendly and enemy).
- Other electronic or electric/electromechanical equipment.
- Atmospheric conditions.
- Malfunction of the radio.
- A combination of any of the above.

(1) Internal or external interference. The two sources of interference are internal and external. If the interference or suspected jamming can be eliminated or substantially reduced by grounding the radio equipment or disconnecting the receiver antenna, the source of the disturbance is most likely external to the radio. If the interference or suspected jamming remains after grounding or disconnecting the antenna, the disturbance is most likely

internal and is caused by a malfunction of the radio. Maintenance personnel should be contacted to repair it. External interference must be checked further for enemy jamming or unintentional interference.

(2) Jamming or unintentional interference. Unintentional interference may be caused by other radios, some other type of electronic or electric/electromechanical equipment, or atmospheric conditions. The battlefield is so crowded with radios and other electronic equipment that some unintentional interference is virtually unavoidable. Also, the static electricity produced by atmospheric conditions can negatively affect radio communications. Unintentional interference normally travels only a short distance, and a search of the immediate area may reveal the source of this type of interference. Moving the receiving antenna for short distances may cause noticeable variations in the strength of the interfering signal. These variations normally indicate unintentional interference. Conversely, little or no variation normally indicates enemy jamming. Regardless of the source, actions must be taken to reduce the effect of interference on our communications.

b. In all cases, suspected enemy jamming and any unidentified or unintentional interference that disrupts our ability to communicate must be reported. This applies even if the radio operator is able to overcome the effects of the jamming or interference. The format for reporting this information is the MIJI report. Instructions for submitting a MIJI report are in Chapter 4 and are usually listed in the SOI. As it applies to remedial ECCM techniques, the information provided to higher headquarters in the MIJI report can be used to destroy the enemy jamming efforts or take other action to our benefit.

c. The enemy can use two types of jamming signals: powerful unmodulated or noise-modulated signals. Unmodulated jamming signals are characterized by a lack of noise. Noise-modulated jamming signals are characterized by obvious interference noises. The following procedures will help radio operators determine whether their radios are being threatened by enemy jamming.

(1) AN/PRC-77.

(a) Turn the function control from the SQUELCH OFF to the ON position.

(b) Lack of noise may indicate that the radio is being jammed by an unmodulated jamming signal. The operator should temporarily disconnect the antenna. If normal static noise returns when the antenna is disconnected, there is a high probability that the radio is being jammed by an unmodulated signal.

(c) A greater than normal level of noise or an obviously modulated signal may indicate that the radio is being jammed by a noise-modulated jamming signal. The operator should temporarily disconnect the antenna. If normal static noise returns when the antenna is disconnected, the radio most likely is being jammed by a noise-modulated signal.

(d) If the above tests indicate there is a high probability the radio is being jammed, the operator should follow the local SOP to reestablish communications and initiate a MIJI report informing higher headquarters of the incident.

(2) AN/VRC-12 series radio.

(a) Turn the squelch control from the NEW SQUELCH ON to the NEW SQUELCH OFF mode.

(b) Lack of noise and an unlighted call light may indicate that the radio is being jammed by an unmodulated jamming signal. The operator should temporarily disconnect the antenna. If normal static noise returns and the call light goes off when the antenna is disconnected, the radio is most likely being jammed by an unmodulated signal.

(c) A greater than normal level of noise or an obviously modulated signal may indicate that the radio is being jammed by a noise-modulated jamming signal. The operator should temporarily disconnect the antenna. If normal static noise returns, and the call light goes off when the antenna is disconnected, there is a high probability that the radio is being jammed by a noise-modulated signal.

(d) If the above tests indicate that there is a high probability that the radio is being jammed, the operator should follow the local SOP to reestablish communications and initiate a MIJI report informing higher headquarters of the incident.

(3) Other unique organizational radios. Signal officers should coordinate with organic military intelligence units for assistance in developing appropriate tests for special capacity radios or radios that are unique to that specific organization. Examples of these are nonstandard issue, off-the-shelf commercial, intermediate high frequency radios (IHFR), or SINCGARS radios. Signal officers should ensure that their unit radio operators are trained to use these radios.

3-4. Overcoming Jamming

The enemy constantly strives to perfect and use new and more confusing forms of jamming. Our radio operators must be increasingly alert to the possibility of jamming. Training and experience are the most important tools operators have to determine when a particular signal is a jamming signal. Exposure to the effects of jamming in training or actual situations is invaluable. The ability to recognize jamming is important, because jamming is a problem that requires action. Once it is determined that jamming is being used against our radios, the following actions must be taken. If any of the actions taken alleviate the jamming problem, we simply continue normal operations and make a MIJI report to higher headquarters.

a. Continue to operate. Stop for a moment and consider what the enemy is doing during his typical jamming operation. Usually, enemy jamming involves

a period of jamming followed by a brief listening period. He is attempting to determine how effective his jamming has been. What we are doing during this short period of time when he is listening will tell him how effective his jamming has been. If the operation is continuing in a normal manner, as it was before the jamming began, the enemy will assume that his jamming has not been particularly effective. On the other hand, if he finds us excitedly discussing our problem on the air or if we have shut down our operation entirely, the enemy may very well assume that his jamming has been effective. Because the enemy jammer is monitoring our operation this way, we have a simple yet very important rule that applies when we are experiencing jamming. Unless otherwise ordered, never shut down operations or in any other way disclose to the enemy that you are being adversely affected. This means normal operations should continue even when degraded by jamming.

b. Improve the signal-to-jamming ratio. The signal-to-jamming ratio is the relative strength of the desired signal to the jamming signal at the receiver. Signal refers to the signal we are trying to receive. Jamming refers to the hostile or unidentified interference being received. It is always best to have a signal-to-jamming ratio in which the desired signal is stronger than the jamming signal. In this situation, the desired signal cannot be significantly degraded by the jamming signal. The following will improve the signal-to-jamming ratio to our benefit.

(1) Adjust the receiver. When jamming is experienced, we should always check to ensure the receiver is tuned as precisely as possible to the desired incoming signal. A slight readjustment of the receiver may provide an improved signal-to-jamming ratio. Specific methods that apply to a particular radio set are explained in the appropriate operator's manual. Depending on the radio being used, some of these methods are--

- Adjust the beat frequency oscillator (BFO).
- Adjust the bandwidth.
- Adjust the gain or volume control.
- Fine tune the frequency.

(2) Increase the transmitter power output. The most obvious way to improve the signal-to-jamming ratio is to increase the power output of the transmitter emitting the desired signal. In order to increase the power output at the time of jamming, the transmitter must be set on something less than full power when jamming begins. We must remember that using low power as a preventive ECCM technique depends on the enemy not being able to detect our radio transmissions. Once the enemy begins jamming our radios, the threat of being detected becomes academic. We should use the reserve power on our terrestrial line-of-sight radios to override the enemy's jamming signal. Tactical satellite communications terminals will not increase their transmit power.

(3) Adjust or change the antenna. Antenna adjustments can appreciably improve the signal-to-jamming ratio. When jamming is experienced, the radio operator should ensure the antenna is optimally adjusted to receive the desired incoming signal. Specific methods that apply to a particular radio set are in the appropriate operator's manual. Depending on the antenna being used, some of these methods are--

- Reorient the antenna.
- Change the antenna polarization. (Must be done by all stations.)
- Install an antenna with a longer range.

(4) Establish a retransmission station. A retransmission station can increase the range and power of a signal between two or more radio stations. Depending on the available resources and the situation, this may be a viable method to improve the signal-to-jamming ratio.

(5) Relocate the antenna. Frequently, the signal-to-jamming ratio may be improved by relocating the antenna and associated radio set affected by the jamming or unidentified interference. This may mean moving a few meters or several hundred meters. It is best to relocate the antenna and associated radio set so that there is a terrain feature between them and any suspected enemy jamming location.

c. Use an alternate route for communications. In some instances, enemy jamming will prevent us from communicating with a radio station with which we must communicate. If radio communications have been degraded between two radio stations that must communicate, there may be another radio station or route of communications that can communicate with both of the radio stations. That radio station or route should be used as a relay between the two other radio stations.

d. Change frequencies. If a communications net cannot overcome enemy jamming using the above measures, the commander (or designated representative) may direct the net to be switched to an alternate or spare frequency. If practical, dummy stations can continue to operate on the frequency being jammed to mask the change to an alternate frequency. This action must be preplanned and well coordinated. During enemy jamming, it is very difficult to coordinate a change of frequency. All radio operators should know when and under what circumstances they are to switch to an alternate or spare frequency. If this is not done smoothly, the enemy may discover what is happening and try to degrade our communications on the new frequency.

e. Acquire another satellite. In many cases, a satellite communications terminal can see more than one satellite in a given theater. If one satellite is being jammed, then the operator should request permission to access another satellite until the jamming ceases or until the enemy jammer is neutralized.