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*REPORT OF INVESTIGATIONS/2011
SUPPLEMENT*

Radio 101: Operating Two-Way Radios Every Day and in Emergencies *Student Handbook*

Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health



Student Handbook

Radio 101: Operating Two-Way Radios Every Day and in Emergencies

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NIOSH [1999]. The emergency communication triangle. By Mallett LG, Vaught C, Brnich MJ Jr. Pittsburgh, PA: U.S. Department Of Health And Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 99-157. <http://www.cdc.gov/niosh/mining/products/product34.htm>.

Medium frequency has a delay of 1–2 seconds (or more depending on how far the signal has to travel). If two radio mics are keyed at the same time on an MF system, the message may not go through, and there is no way of knowing and no warning that both sides tried to communicate at the same time.

Through-the-Earth (TTE)

The antenna for this system is a long, looped wire. In general, the bigger the circle enclosed by the antenna, the better reception you will get.

TTE is a slower system with less bandwidth—most likely there will only be text communication when using this type of system. This system is susceptible to interference. TTE would most likely be used as an emergency backup system only.

Student Handbook

Radio 101: Operating Two-Way Radios Every Day and in Emergencies

Types of Radio Traffic

When learning how to use the radio, it is important to know that there are three types of radio traffic. These include:

- **Routine traffic** – the regular, daily radio traffic one would hear on the mine radio including basic emergencies such as an injured employee, but whose injuries are not life threatening.
- **Emergency traffic** – radio traffic about an emergency situation (e.g., a miner with a fractured arm or the loss of ventilation on a working section). In these situations, a miner would call out that they have emergency radio traffic. Then the dispatcher or communications person would clear the airways for this person to state the problem.
- **Mayday** traffic—describes radio traffic when a major mine emergency occurs (e.g., explosion, fire) or someone is in danger of death (e.g., heart attack, pinned by machinery or roof fall). The term “Mayday” is repeated three times, “Mayday, Mayday, Mayday”. In this case the dispatcher should respond by asking all other traffic to cease, except for the Mayday traffic.

The handbook is presented in two sections:

- routine traffic (or basic use)
- emergency and Mayday traffic

Note: *Your mine may have different designated terms for each type of radio traffic; if this is the case, then you should use those designated terms.*

Routine Traffic

Issues with Basic Use of Mine Communications Systems

According to a group of miners who were asked about using radios in a mine, the radio is easy to use—"you just push the button and talk." However, in the past there have been some difficulties associated with using radios to communicate. When we asked miners, they noted the following problems that can occur when using the communications systems in mines on an everyday basis:

- Miners underground do not always call out when there is a problem, such as when the carbon monoxide (CO) alarms go off.
- Finding radio units with dead batteries, which then cannot be used.
- People not answering the phone on the sections. "They can hear it; they just ignore it. In fact, the dispatcher will page them again and say 'there's not work involved, answer it!'"
 - One story shared was about someone's child who was injured in a car accident. No one inside the mine would answer the phone because they thought there was work to do. They had to announce the message about the accident over the airwaves to get the father's attention to answer the phone.
- The lack of good maintenance on the system. For example, if someone is loading supplies and hits a communications cable, it needs to be fixed.
- People chattering on the line so when it is really needed it is not available.
- People inadvertently or unknowingly holding down the mic button so the line is busy, such as when the radio is in someone's pocket.
- People not knowing what signals mean.

Wireless Communications Systems

Following are some simple tips for users of these systems. For detailed information on the components of these systems and how they work, see NIOSH's Tutorial on Wireless Communication and Electronic Tracking, which is located at: <http://www.cdc.gov/niosh/mining/topics/electrical/commtrackingtutorial/commtrackingtutorial.htm>

Leaky Feeder

Leaky feeder communications systems use two-way radios and a special antenna cable called a leaky feeder. The cable runs from outside the mine (surface) to all working sections (underground). The main control, called the "head end," is located on the surface. At predetermined locations along its length, the leaky feeder has signal amplifiers (boosters) designed to help maintain signal strength. Communication in a leaky feeder system goes through the head end. Depending on the individual mine, a leaky feeder system may have one or more lines into the mine.

Assuming there is only one line in and out of the mine, if there is a break in the line, miners on the side of the break away from the head end will not be able to communicate even with other workers on the same side of the break. In other words, if there is a break in the line, anyone in by the break will not be able to use the system. However, if there is an additional alternate line into the mine, then miners in by a break in one line may be able to move to the alternate line and communicate through it.

Handhelds for this system sound a warning tone if two devices are keyed at the same time.

Medium Frequency (MF)

Compared to other communications systems, medium frequency systems depend much more on the environment to work, such as through the pager phone wire, water pipes, power lines, etc.). There must be metal available in the mine for the signal to travel.

Tips for Using Your Radio in an Emergency

- Every message must be clear, concise, and timely.
- Provide regular status reports or updates about the incident.
- Timing of updates:
 - Community emergency responders suggest the first progress report be given about 10 minutes after the initial report.
 - For the next hour of the incident, provide an update every 10 to 15 minutes and whenever a significant escalation of operations occurs. The transmission of additional alarms would be defined as escalation and would require the Incident Commander to inform the communications center of the reasons for this additional response.

- For example, at a mine that has a pager system that flashes different lights for different messages, miners did not know the meaning of each different light signal.
- People not remembering to keep portable radio units with them as they move around the mine and forgetting to bring them back.
 - One miner reported his mine had lost 50 units in the mine within a six-month period.

Maybe you can think of similar problems at your own mine! The goal of this training is to teach you some “rules of the radio” that can improve the efficiency and effectiveness of the radio in a mine.

How to Use the Radio

- Push and hold the transmit button before starting to talk.
- Wait a few seconds before you start talking.
- Hold the radio 3–4 inches away from your mouth.
- Do not yell into the radio.
- Speak slowly and clearly.
- Remember only one person can talk at a time.
 - Simultaneous communication will cancel each talker out, and both talkers will be unaware that their messages did not go through.

What to Say

- Message Content
 - Communicate where you are and your request/problem.
 - Use location identifiers (e.g., Crosscut 23).
 - Know what you want to say before you press the transmit button.

How to Say It

- Be brief and efficient:

Reduce the use of air time as much as possible.

- Keep the length of the transmission to a minimum.
- Communicate essential information only.

Use this standard protocol for speaking:

- *Sender*: “Hey Fred, it’s me George.” (receiver’s name first, then yours)

Here is what to say during an emergency.

- Ask for radio waves by saying “Emergency traffic” or “Mayday, Mayday, Mayday” (or the codes designated by your mine).
- Tell the receiver of your call WHO you are.
- Tell the receiver of your call exactly WHERE the problem is located.
- Tell the receiver of your call WHAT is happening at the scene of the problem.
- After this, give the details of the situation including:
 - MINERS: details about the miners involved (e.g., “Two miners are hurt.”)
 - EVENT: details about the event (e.g., “The miners are pinned under a roof fall.”)
 - RESPONSE: details about the response that is occurring (e.g., “We’re trying to get the rock off of them.”), how many people are there, what equipment is there and/or needed.
- If you will be bringing someone out of the mine, ask the dispatcher or communications person to clear all vehicle traffic to allow you to exit the mine quickly.
- Note that these instructions on what to communicate correspond to the NIOSH Emergency Communication Triangle [NIOSH, 1999].

How to Say It

- After stating “Emergency traffic” or “Mayday, Mayday, Mayday,” follow the same protocol for speaking as you would on a daily basis.

locations in the mine. There can even be problems transmitting from one entry to the next.

What to Say

It is important to know how your radio works and how to physically use it. This was covered in the section “How to use the radio.” In addition to this knowledge, it is equally important to know what information to communicate during an emergency. Most messages will consist of:

- Orders and instructions to perform tasks for controlling the situation.
- Reports about the conditions and progress encountered.
- Requests for additional resources to fulfill assigned tasks.

- *Receiver*: “Go ahead, George.”
- *Sender*: State the message (only pertinent, specific information).
- *Receiver*: Repeat the information back.
- *Sender*: Correct or confirm the information.
- *Receiver*: Simply states what will be done (e.g., “We’re sending Engine 1, estimated time of arrival 4 minutes”).

For example:

- *Section mechanic*: “Hey, Fred, this is Mike on F20 Panel.”
- *Maintenance foreman*: “Go ahead, Mike.”
- *Section mechanic*: “Fred, I need five water spray nozzles for the continuous miner and three shuttle car cable splice kits.”
- *Maintenance foreman*: “Okay, that’s five water spray nozzles for the miner and three shuttle car cable splice kits, correct?”
- *Section mechanic*: “Yes, that’s correct.”
- *Maintenance foreman*: “Okay, Mike, I will bring them when I come to F20 Panel in about an hour.”

Tips for Using Your Radio on a Daily Basis

- Politeness does not matter; efficiency is more important.
 - You do not have to say “please” and “thank you.”
- Avoid jargon and codes.
- Use established protocols for identification, communication, and signoff.
 - Repeat back what you heard to ensure you have understood the message being sent.
- Be brief, listen, speak slowly and clearly, acknowledge receipt of information.
 - Brevity is important, **but** messages must be relayed verbatim.
- Only transmit relevant information.
- Keep the radio with you at all times as you move around the mine.
- Be aware that, in addition to the intended audience, other people may overhear your message.
- Limit your talking to essential communication to avoid “clogging” the line or “overtalking.”
 - Do not have personal or casual conversations on the radio.
 - Do not talk too much.
- Do not swear or shout.
- Many wireless systems are line-of-sight. If possible, move to transmit line-of-sight to the next radio.
- Antennas can be easily damaged; protect them as much as possible.

Emergency and Mayday Traffic

Issues with Emergency Use of Two-Way Radios

Miners and mine rescue experts were asked about using radios in emergency situations. These individuals shared their thoughts and ideas on emergency radio use including problems they have encountered. Here are some of the topics that were discussed:

- There tend to be different interpretations of the term “emergency”. Though the miners said there are true emergencies, such as life-threatening injuries, fires, and so forth, they also said there can be production emergencies. While miners contend they do not have a problem using radios during true emergencies, they find operators tend to treat production emergencies with the same urgency.
- When an emergency occurs at a mine, there can be an inundation of radio traffic over the airways. Personnel outside in the communications or command center are trying to get information about what is happening. Likewise, miners are trying to find out as much as they can about the situation.
- When there is an emergency, people sometimes talk over each other. This occurs when someone is talking on the radio and another person on the line will try to talk at the same time. When this happens, neither message gets through.
- Some radio communications systems may not be reliable. Therefore, some miners do not have confidence that the radio communications system in place at their mine will work when they need it.
- Depending on the type of radio system in place, there can be problems with limited transmission distance. Depending on the system and how it is set up, there can be “dead spots” (where communications are unavailable) in certain