Industry Guide 11

A Guide to Radio Frequency Hazards With Electric Detonators

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Acknowledgments

A Guide to Radio Frequency Hazards With Electric Detonators was prepared by J. Hugh Strong, James H. Turner and Michael W. Wortham of the Mine and Quarry Bureau, N.C. Department of Labor. It was developed with the cooperation of the Institute of Makers of Explosives (IME), Washington, DC. All tables in Part 2 were taken from IME Safety Library Publication No. 20. The information in this guide was updated in 2009.

This guide is intended to be consistent with all existing OSHA standards; therefore, if an area is considered by the reader to be inconsistent with a standard, then the OSHA standard should be followed.

To obtain additional copies of this guide, or if you have questions about N.C. occupational safety and health standards or rules, please contact:

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Additional sources of information are listed on the inside back cover of this guide.

The projected cost of the NCDOL OSH program for federal fiscal year 2009–2010 is $17,534,771. Federal funding provides approximately 30 percent ($5,180,700) of this total.

Revised 11/09

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Foreword

The Mine and Quarry Bureau of the N.C. Department of Labor prevents work-related injuries and illnesses by offering training in the safe use of explosives and blasting devices. *A Guide to Radio Frequency Hazards With Electric Detonators* contributes to that objective. It describes hazards of radio frequency energy to the loading and firing of electrically initiated blasting operations and sets forth precautions that should be taken during such operations. Many of these hazards are covered by the state's Occupational Safety and Health Division's standards.

In North Carolina, the N.C. Department of Labor enforces the federal Occupational Safety and Health Act through a state plan approved by the U.S. Department of Labor. NCDOL offers many educational programs to the public and produces publications to help inform people about their rights and responsibilities regarding occupational safety and health.

When reading this guide, please remember the mission of the N.C. Department of Labor is greater than just regulatory enforcement. An equally important goal is to help citizens find ways to create safe and healthy workplaces. Everyone profits when managers and employees work together for safety. This booklet, like the other educational materials produced by the N.C. Department of Labor, can help.

Cherie Berry
Commissioner of Labor

Introduction

The purpose of this guide is to promote safe work practices by assisting people who use electric detonators in assessing hazards of the initiation of commercial electric detonators by radio frequency (RF) energy. This guide also provides tables of safe distances from RF sources for the use of electric detonators.

Part 1 identifies major RF sources. Part 2 offers tables for safe distances between particular RF sources and the use of electric detonators. Adherence to the tables in Part 2 provides the user of electric detonators a high degree of assurance that the blasting layout should be safe from RF initiation.

This guide applies to commercial electric detonators. It does not apply to military electric firing devices. It is recommended that, prior to market introduction, any imported electric detonators be tested for safety properties by an authorized United States laboratory, such as the U.S. Bureau of Mines or Bureau of Explosives.

Information in this guide derives from sources reflecting competent analysis and research and is believed to be accurate. Nevertheless, the reader cannot be guaranteed that the guide will apply to every application or variation in the use of electric detonators. The references section of this guide includes additional sources of information for unusual situations in which electric detonators are used.

The information contained in this guide is based upon many years of practical experience and the latest and most widely accepted publications available in the field. As such, it is believed that all data presented are both accurate and reliable. However, the N.C. Department of Labor makes no warranties, expressed or implied, to the user of this publication. All risks associated with the use of the information are assumed by the user, and the N.C. Department of Labor hereby expressly denies any and all liability for use of this information. This publication is not to be taken as a license to operate or recommendation to infringe any patent.

Though this guide is not intended to be inconsistent with OSH or MSHA standards, if an area is considered by the reader to be inconsistent, the standard should be followed.

1

Electric Detonators and Hazards Posed by Radio Frequency Energy

The normal method of firing an electric detonator is to apply electric energy from a power source such as a blasting machine or power line to the blasting circuit or to the open ends of the detonator wires. This electrical energy flows through the wires to the detonator and causes the resistance wire inside the detonator to heat the primary explosives to the burning (explosion) temperature.

Initiation of Electric Detonators by Radio Frequency Energy

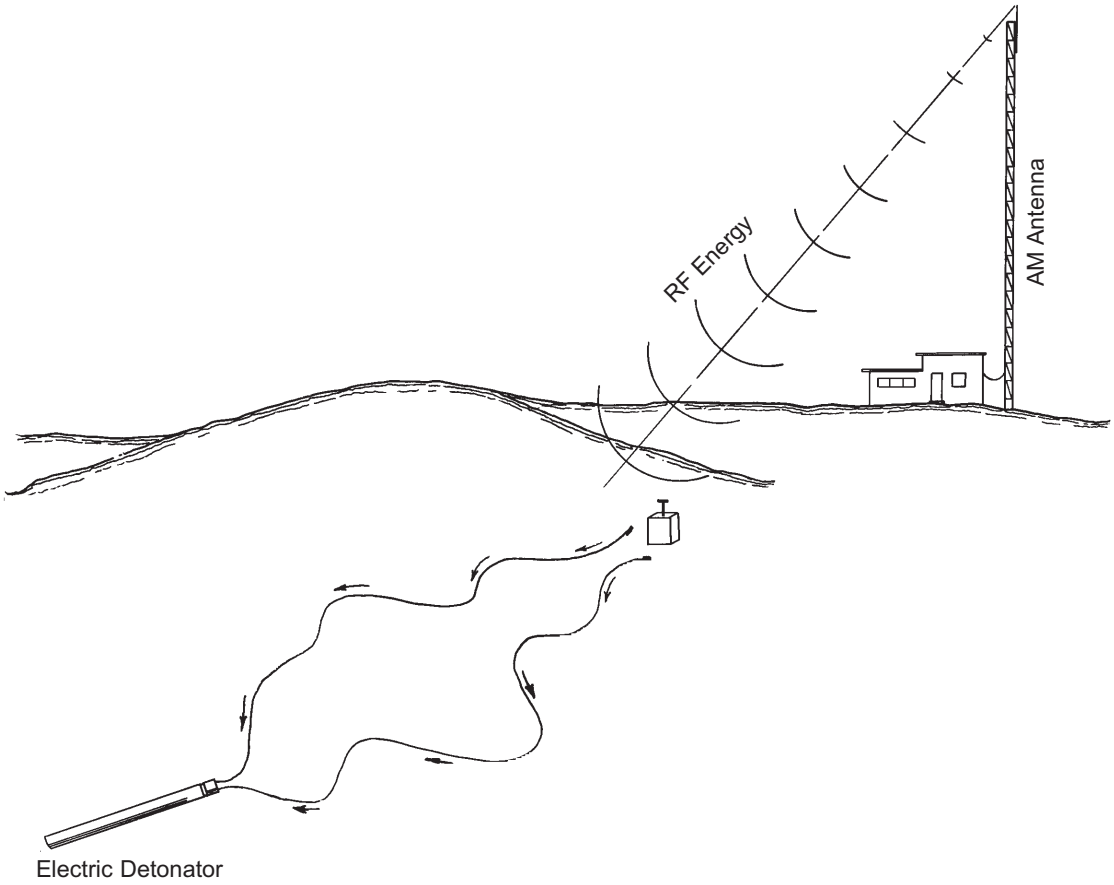
The possibility of premature explosions of electric detonators due to RF energy is remote. Each year throughout the continental United States approximately 100 million such detonators are used with few mishaps. However, there have been authenticated cases in which detonators were prematurely initiated by RF transmission to the detonator wires. Subsequent investigations revealed that the instances would not have occurred if proper safe distances from the RF sources had been maintained.

How RF Energy Initiates Electric Detonators

If the electric detonator wires are located in a strong RF field (near a transmitter that is radiating RF power), the usually insulated but unshielded leg wires or circuit wires will act as an antenna similar to that on a radio or TV set. That is true whether the circuit wires are connected to a blasting machine or not, or whether they are shunted (short circuited ends) or not shunted (open ends). This antenna will absorb RF energy from the transmitter RF field, and the electric current transmitted to the detonator wires will flow into the detonator. (See Figure 1.) Depending on the strength of the RF field and the antenna configuration formed by the detonator wires and its orientation, sufficient RF energy may be induced in the wires to fire the electric detonator.

Figure 1

RF Energy Absorbed by Detonator Leg Wires



Radio Frequency Energy Sources

Radio frequency transmitters include citizens band (CB) radios, cellular telephones, AM and FM radios, radar, and television. These transmitters create powerful electromagnetic fields, which decrease in intensity with distance from the transmitter antenna. Tests have demonstrated that electric detonator wires, under particular conditions and circumstances, may absorb enough electrical energy from such fields to cause their explosion.

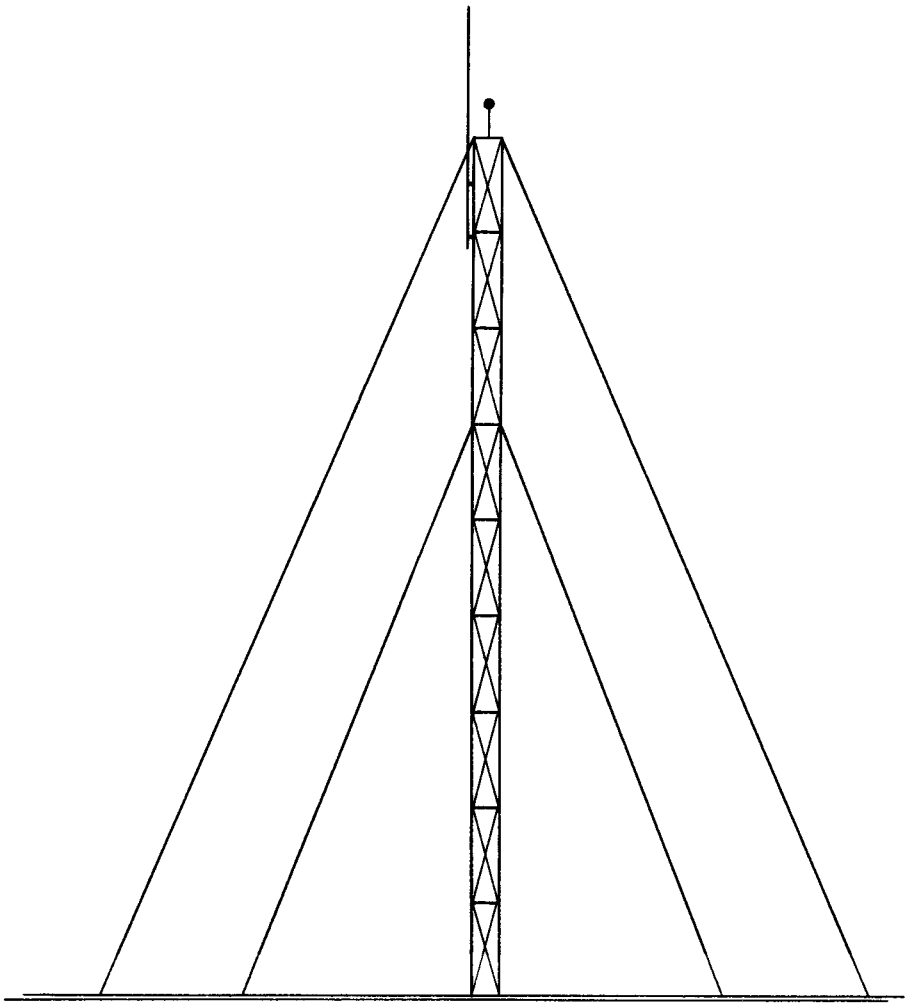
Mobile cellular telephones and CB radios pose unusual problems. In recent years their use has greatly expanded. Mobile cellular telephones transmit RF energy during sending and receiving. Additionally, modern technology has provided pages that transmit and receive RF energy. Safe distances are recommended for the Federal Communications Commission-approved, double sideband (4 watts maximum output power) and single sideband (12 watts peak envelope power) units in Table 6.

Commercial AM Broadcast Transmitters

Commercial AM broadcast transmitters [0.535 to 1.605 MHZ (Megahertz)] are potentially the most hazardous RF energy source. They combine high power and low frequency so that there is little loss of induced RF energy in the detonator lead wires. (See Figure 2.)

Figure 2

Commercial AM Broadcast Transmitter (Vertically Polarized)

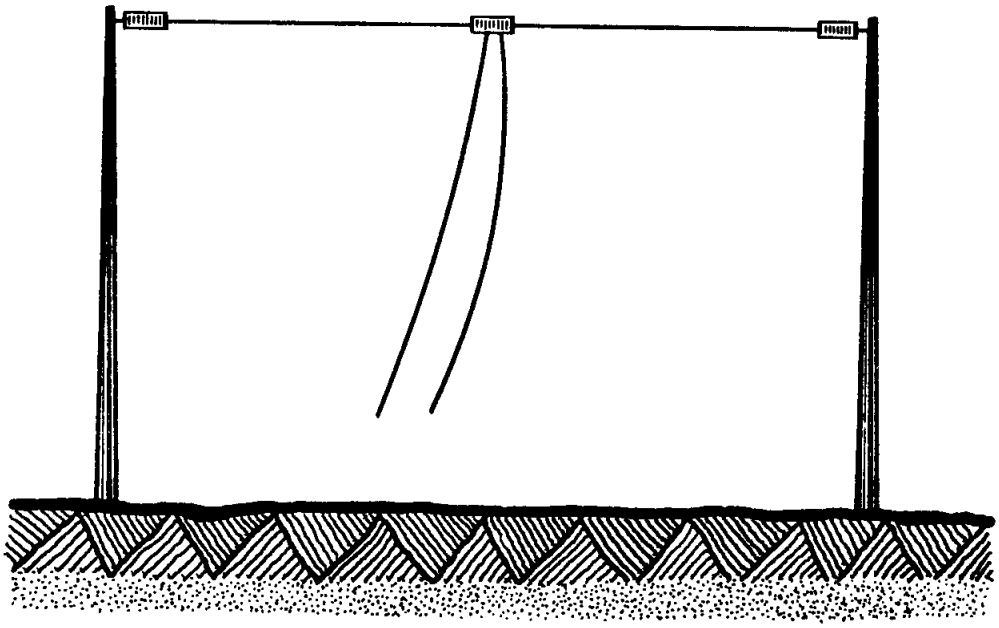


Frequency-modulated FM and TV Transmitters

Frequency-modulated FM and TV transmitters are not likely to create hazardous situations. Although their power is extremely high and the antennas are horizontally polarized, their high frequency currents are rapidly attenuated in the detonator or leg wires. This RF source employs antennas on very high towers, which have the additional effect of reducing the electromagnetic field at ground level. (See Figure 3.)

Figure 3

Frequency-modulated FM and TV Transmitters (Horizontally Polarized)



Mobile Sources of RF Energy

Mobile radios and cellular telephones that transmit RF energy must be rated as a high potential hazard because, although their power is low, they can be brought directly into a blasting area. (See Figure 4.) Transmitting pagers also need to be considered.

Figure 4

Mobile Radios

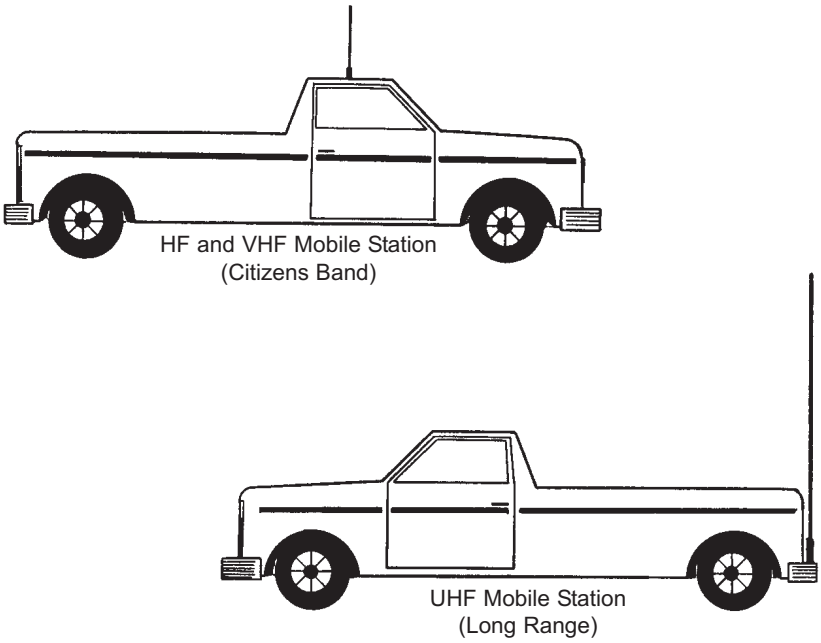
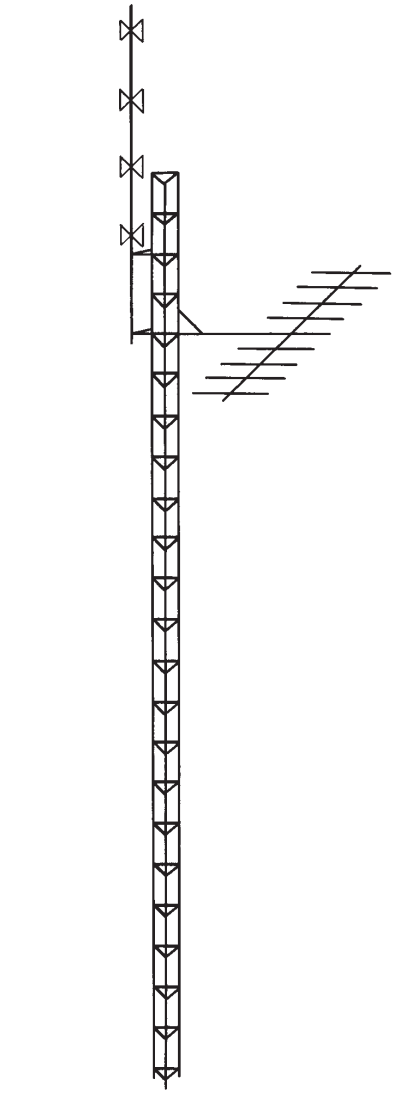


Figure 5 depicts other types of antennas associated with radio services.

Figure 5

Antennas Associated With Radio Services



Mobile Service Base Station

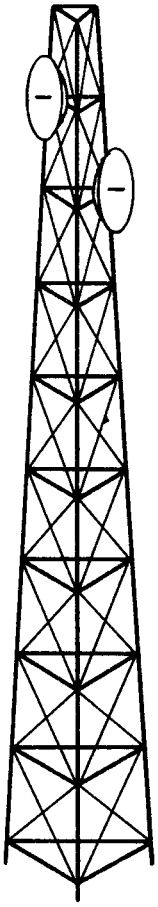
Mobile Service Base Station

Microwave Relays

The hazards of RF energy from microwave relays are small because they operate at a very high frequency, have a restricted radiation pattern, and are not normally located within a blasting area. (See Figure 6.)

Figure 6

A Microwave Relay

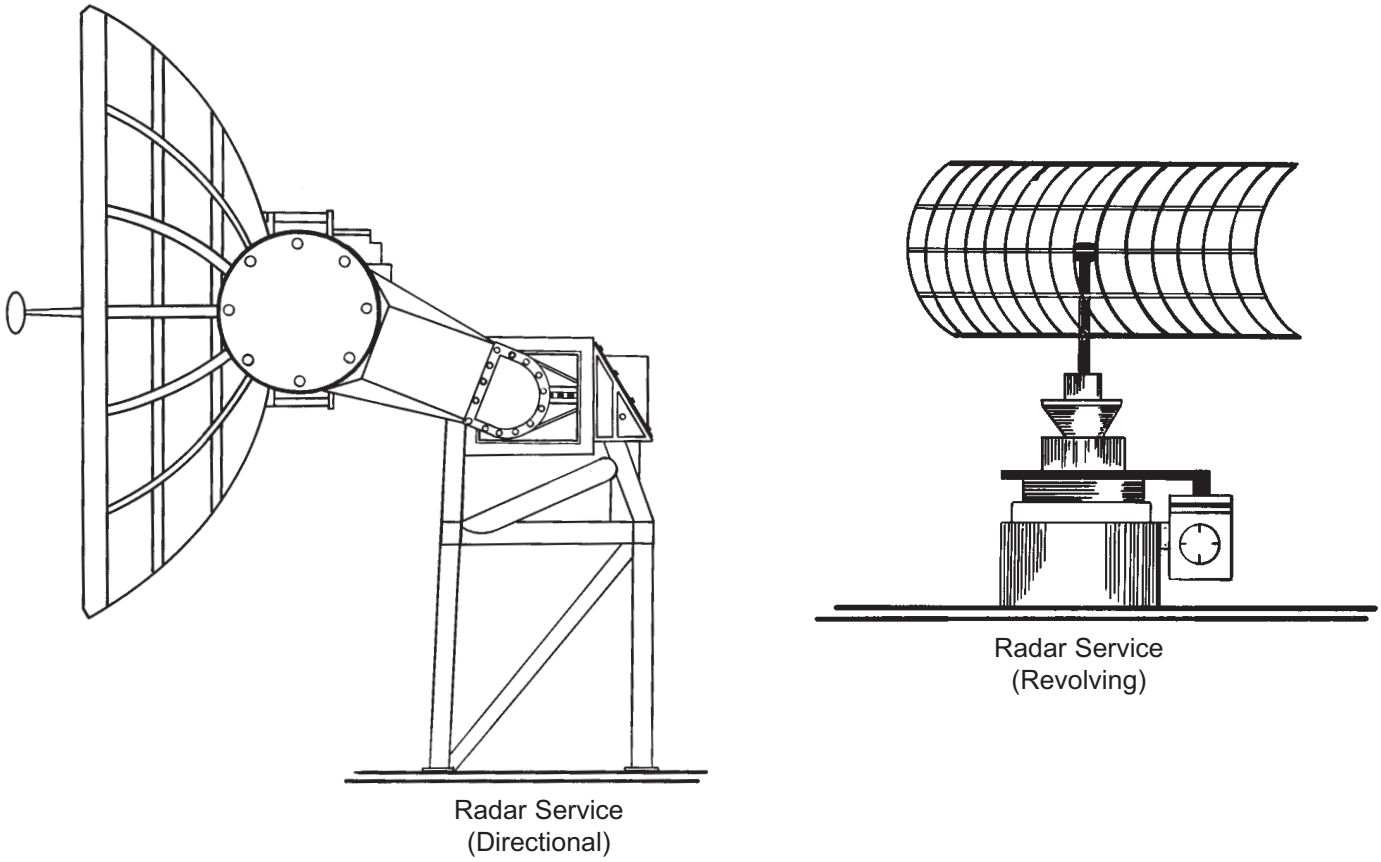


Radar Installations

Radar installations pose a hazard if blasting is done within the radar beam range. Radar installations radiate high power levels through the use of high gain antennas. (See Figure 7.)

Figure 7

Radar Installations



Radio Frequency Pickup Circuits

Electric detonator wire layout can act as RF pickup circuits for the radio frequencies used in AM radio broadcasting and mobile operations. Two sensitive RF pickup circuits that might be created by lead wire configuration at electric blasting operations are known as the dipole circuit and the long wire circuit.

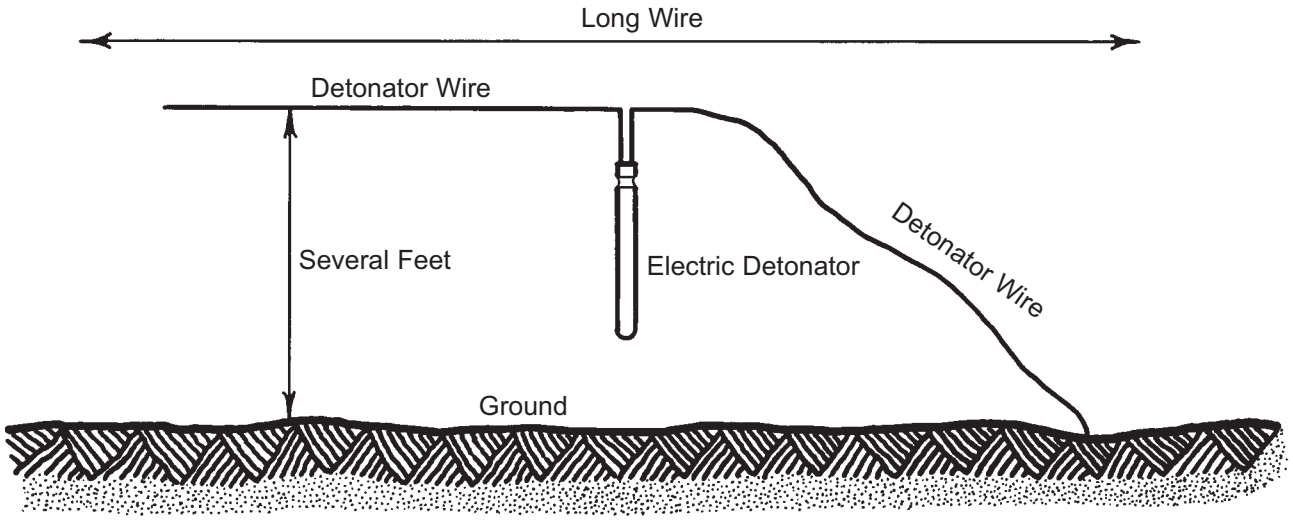
Dipole Pickup Circuit

The dipole circuit is depicted in Figure 8. The dipole circuit presents the most hazardous conditions when:

- The circuit wiring or electric detonator leg wires are elevated several feet off the ground.
- The length of this wiring is equal to one-half the wave length of the radio wave.
- The electric detonator is located at a point where the RF current in the circuit wiring is at a maximum.

Figure 8

Dipole Pickup Circuit



Long Wire Pickup Circuit

The long wire circuit is shown in Figure 9. The long wire circuit condition occurs when the electric detonator is at one end of the wiring that:

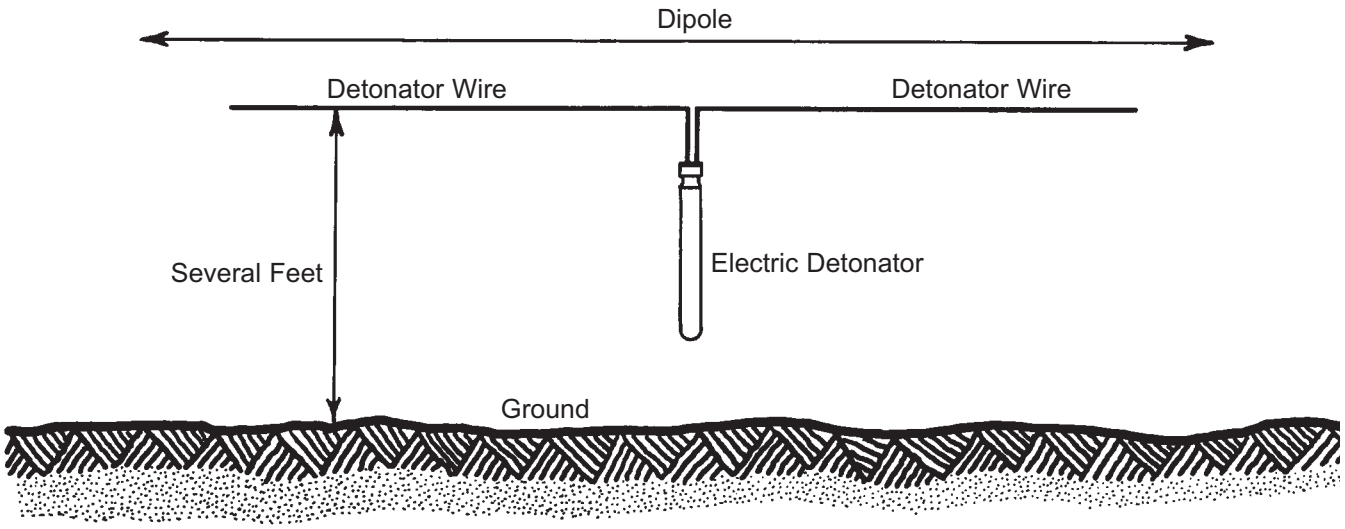
- Is elevated in the air.
- Has a length equivalent to one-quarter of the wavelength of the radio wave.
- Is grounded to the earth through the electric detonator.

To determine the approximate radio wavelength, the transmitter frequency in megahertz (MHz) is divided into 1,000. For example, a CB transmitter operates on a frequency of 26.96 to 27.33 MHz. This, divided into 1,000, yields a wavelength of 36.6 to 37.1 feet.

Both of the previous circuits require that the lead line or detonator wires be suspended above the ground. Both of the circuits (antennas) achieve their maximum current pickup when they are (1) parallel to a horizontal transmitting antenna (FM, TV or amateur radio) or (2) pointed toward a vertical antenna (AM, mobile, etc.)

Figure 9

Long Wire Pickup Circuit



Loop Pickup Circuit

Another sensitive RF pickup circuit, and one commonly encountered in blasting operations, is the loop circuit. This circuit is sensitive to the magnetic portion of the electromagnetic wave. The loop circuit receives the maximum pickup when its long axis is placed in the direction of the transmitting antenna. Safe distance tables for AM broadcast transmitters and mobile transmitters (both using vertical antennas) were derived from the loop configuration. Figure 10 shows a preferred case loop pickup circuit.

Figure 10

Loop Pickup Circuit—Preferred Case

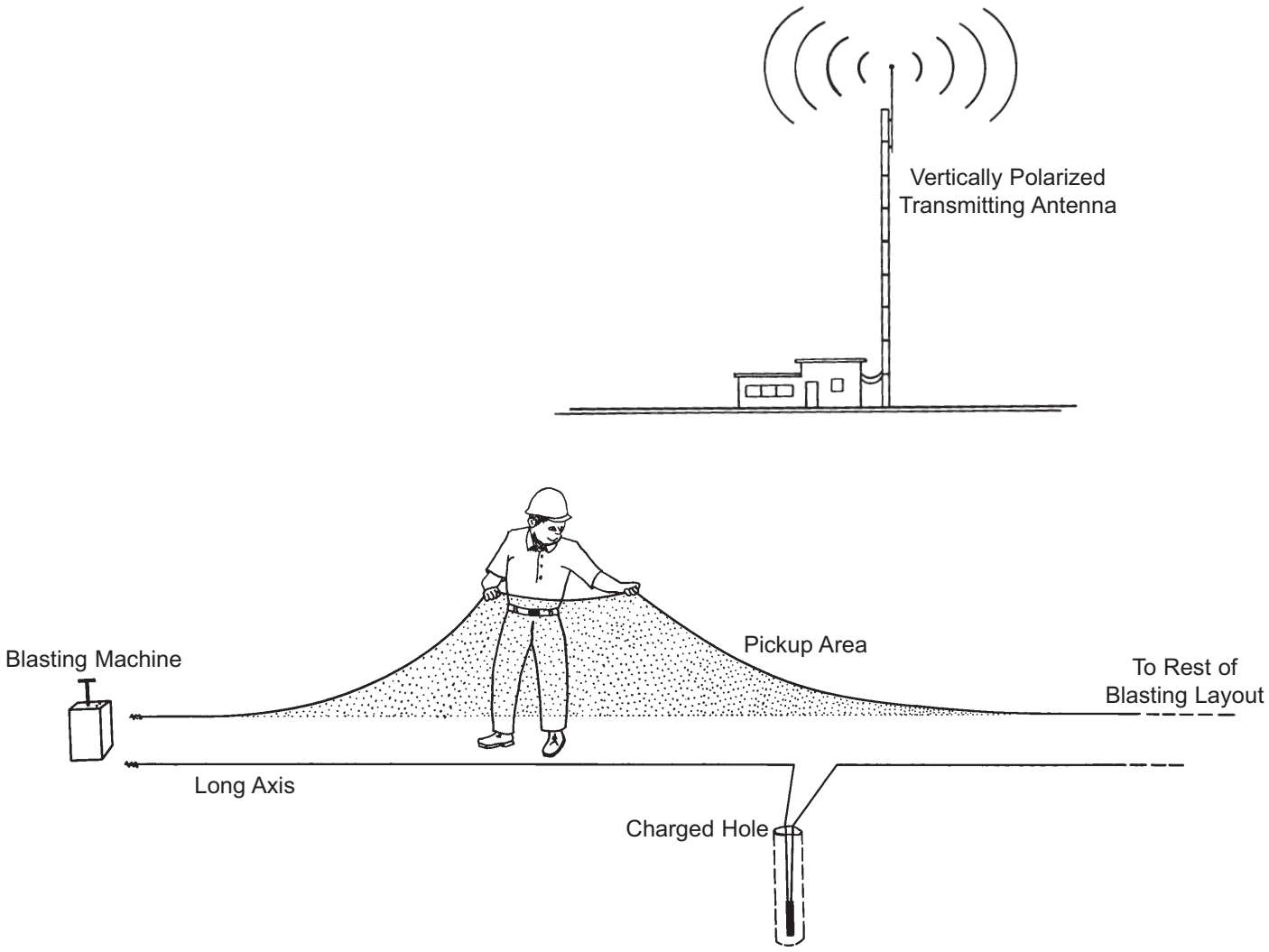
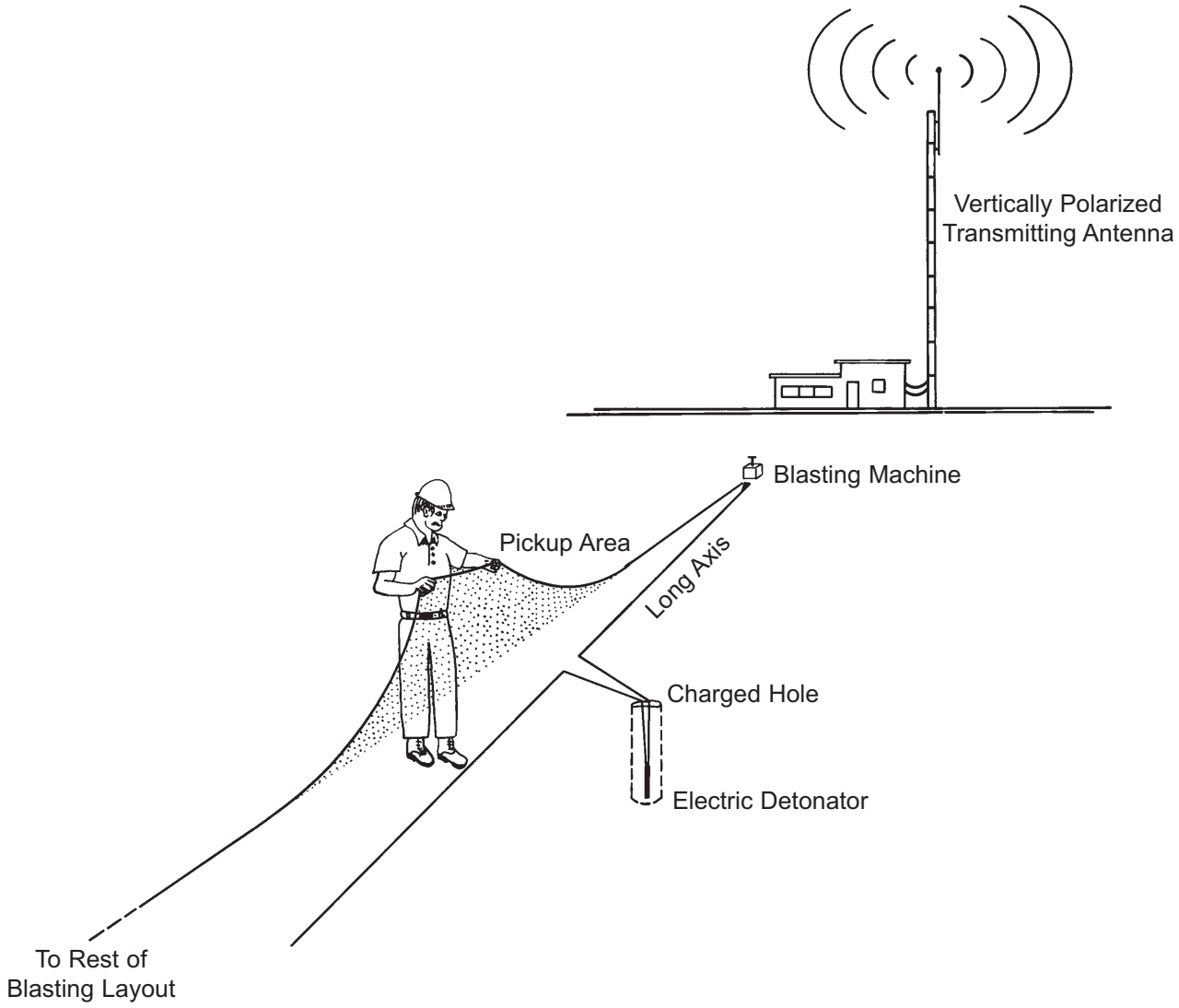


Figure 11 shows an acceptable but less desirable configuration of loop and transmitting antenna. In general, the loop areas can be reduced by picking up both lead wires as in a duplex wire circuit and making all wire splices as close to the ground as possible.

Figure 11

Loop Pickup Circuit—Acceptable but Less Desirable



General Precautions Against RF Energy Sources

The following list of precautions will reduce hazards and increase safety for employees associated with blasting operations near RF energy sources.

1. When blasting electrically at a fixed location such as a mine, quarry or construction site, check to see whether any radio transmitters are located closer to your blasting site than the applicable separation recommended in Part 2 of this guide. Always be on the alert for new transmitters. If possible, check each transmitter before it goes into service to ensure it will not pose a hazard to your blasting operation.
2. Keep mobile transmitters away from blasting areas. If transmitters are allowed on or near the blasting area, a strict policy must be set to ensure that the transmitters are always turned off. This precaution should be followed no matter what frequency or energy (watts) the transmitter employs.
3. If there is a choice, use the higher frequency bands (450–470 MHz) for mobile transmitters. RF pickup is less efficient at these frequencies than at the lower frequencies.

4. Avoid large loops in blasting wiring by running the lead wires parallel to each other and close together.
5. If loops are unavoidable, keep them small and orient them broadside towards the transmitting antenna.
6. Keep wires on the ground in blasting layouts. Bare connecting points should be elevated slightly to prevent current leakage.
7. Arrange all lead lines out of the beam of directional devices such as radar or microwave relay stations.
8. If there is any doubt as to the RF hazards in relation to your blasting operations, a nonelectric blasting system should be used until you have consulted with a person qualified in RF energy as it relates to blasting operations.

Transportation of Electric Detonators

The transportation of electric detonators does not create a hazard from radio energy as long as the detonators are in their original containers. In their original containers, the leg wires of the detonators are folded or coiled so as to provide effective protection against current induction. Also, the metal body of a vehicle virtually eliminates the penetration of RF energy.

If vehicles equipped with radio transmitters are used to transport electric detonators to and from a job: (1) the caps should be carried in an enclosed metal box lined with a non-sparking material and (2) the transmitter should be turned off when the caps are removed from the box.

Citizens Band Transmitters and Cellular Telephones

CB radios were once the most common radio communication in existence. Cellular telephone usage has surpassed CB radio communications. Nevertheless, CB radios can be in operation in both mobile and base units within close proximity of blasting operations. The units are used on the highways, which are at times close to blasting operations. CBs are still used by long-haul truck drivers.

Although the power is low on CB radios and cellular telephones, precautions should be taken in their use around electric blasting operations. CB radios and cellular telephones should not be operated by anyone on the property during blast hole loading operations. In areas close to public roads where it is impossible to control their usage, mine operators and construction crews should restrict the use of electric detonators and use a nonelectric blasting system.

2

Tables of Distances—RF Sources and Electric Detonators

The tables in this part of the guide are offered to assist mine and quarry operators and commercial blasters. The tables include all of the obvious type of RF transmitters that would be encountered around mines, quarries and other blasting operations.

The tables were derived from analytical "worst case" calculations. They are based on an assumed 40-milliwatt no-fire level of commercial detonators. Field tests have shown the tables to be conservative, as would be expected. There are numerous uncertainties involved in field tests respecting the efficiency of RF energy pickup and its delivery to the detonator. Thus, both the N.C. Department of Labor and the Institute of Makers of Explosives strongly recommend that the tables in this guide be followed.

RF Sources Presenting Hazards to Blasting Operations

Commercial AM broadcast transmitters (0.535 to 1.605 MHz*) are potentially the most hazardous. This is because they combine high power and low enough frequency so that there is little loss of RF energy in the lead wires. Frequency-modulated FM and TV transmitters are unlikely to create a hazardous situation. Although their power is extremely high and antennas are horizontally polarized, the high-frequency currents are rapidly attenuated in detonators or lead wires. These RF sources usually employ antennas on top of high towers. This has an additional effect of reducing the electromagnetic field at ground level. Mobile radio, as well as other wireless products, must be rated as a potential hazard because, although their power is low, they can be brought directly into a blasting area. New wireless products, such as cellular phones, Global Positioning Systems, data acquisition systems, and remote vehicle entry systems, are continually being brought to market.

Citizens Band (CB) radios are an unusual problem for several reasons: 1) there are millions of units being used by the general public, 2) their operating frequency is in the range that is considered to be worst-case for typical electric blasting circuits and 3) some irresponsible operators use illegal linear amplifiers to increase their transmission range. Safe distances are recommended for the FCC approved, double sideband (4 watts maximum output power) and single sideband (12 watts peak envelope power) units in Table 6. It is not possible to specify safe distances for the illegal units because they do not operate within established FCC limits that can be used for making definitive worst-case assumptions. Federal regulations require the posting of signs within 1,000 ft. of construction sites warning that two-way radios should be turned off because of blasting. Observance of the posted signs will provide the necessary degree of safety if the units are a maximum of 200 watts peak power. It is recommended, therefore, that all CB operators obey posted signs and turn off their units in observance of posted warnings or if they know that there are blasting operations in the area.

Two way radios and wireless data transmission and control radios are routinely used in mining and blasting operations. When radios are used for this purpose, the minimum separations specified in Table 6 for a particular transceiver (frequency and power)should be maintained. There is little possibility that sources of RF energy such as microwave relay will ever constitute a practical problem. They are all characterized by one or more of the following: (1) location in areas where blasting is unlikely, (2) very high frequency, and (3) restricted radiation patterns. However, particular attention should be paid to all directional RF sources such as fixed and mobile marine radar. Directional RF sources such as radar, use specialized antennas that concentrate the transmitter power in primarily one direction. Such high gain antennas significantly increase the effective radiated power of the transmitter. In the vicinity of high power radar installations, blasting should not be conducted.

*MHz – Megahertz = 1,000,000 cycles per second.

Table 1

Recommended Distances for Commercial AM Broadcast Transmitters (0.535 to 1.605 MHz)

Transmitter Power[1]	Minimum Distance
(watts)	(feet)
Up to 4,000	720
5,000	800
10,000	1,130
25,000	1,790
50,000[2]	2,500
100,000	3,600
500,000	8,000

1. Power delivered to antenna
2. Maximum power of U.S. broadcast transmitters in this frequency range

Table 2

Recommended Distances for Transmitters up to 50 MHz (Excluding AM Broadcast) Calculated for a Specific Loop Pickup Configuration(1)(2)

Transmitter Power[3]	Minimum Distance
(watts)	(feet)
100	790
200	1,120
500	1,770
1,000	2,500
1,500	3,070
5,000	5,590
50,000	17,700
500,000[4]	55,900

1. Based on the configuration shown in Figure 11 using 20.8 MHz, which is the most sensitive frequency
2. This table should be applied to international broadcast transmitters in the 10–25 MHz range
3. Power delivered to antenna
4. Present maximum for international broadcast

Table 3

Recommended Distances for VHF TV and FM Broadcasting Transmitters

Effective Radiated Power (watts)	Minimum Distance (feet)		
	Channels 2 to 6	FM Radio	Channels 7 to 13
Up to 1,000	820	667	502
10,000	1,450	1,190	892
100,000[1]	2,580	2,115	1,585
316,000[2]	3,450	2,820	2,130
1,000,000	4,600	3,770	2,820
10,000,000	8,190	6,690	5,020

1. Present maximum power channels 2 to 6 and FM—100,000 watts.
2. Present maximum power channels 7 to 13—316,000 watts.

Table 4

Recommended Distances for UHF TV Transmitters

Effective Radiated Power (Watts)	Minimum Distance (Feet)
Up to 10,000	600
1,000,000	2,000
5,000,000[1]	3,000
100,000,000	6,000

1. Present maximum power channels 14 to 69—5,000,000 watts.

Table 5

Radio Transmitting Stations[1]

Type	Frequency (Megahertz)	Wavelength (feet)	Transmitter Power (Watts)	Reference Table for Safe Distance
Commercial				
Standard Broadcast (AM)	0.535–1.705	1,820–577	50,000	1
Frequency Modulation (FM)	88–108	11.2–9.1	550,000(2)(3)	3
Television Broadcast (Channel 2 to 6)	54–88	18.2–11.2	100,000[2]	3
Television Broadcast (Channel 7 to 13)	174–216	5.6–4.5	316,000[2]	3
Television Broadcast (Channel 14 to 69)	470–806	2.1–1.22	5,000,000[2]	4
Amateur				
160-Meter Band	1.8–2.0	545–490	1,500	2
80-Meter Band	3.5–4.0	280–246	1,500	2
40-Meter Band	7.0–7.3	140–135	1,500	2
30-Meter Band	10.1–10.15	97	200	2
20-Meter Band	14.0–14.4	70.0–68.2	1,500	2
17-Meter Band	18.068–18.168	54.4	1,500	2
15-Meter Band	21.00–21.45	46.9–46.3	1,500	2
Citizens Band	26.96–27.405	36.6–36.0	4 Watts Carrier or 12 Watts SSB	6
10-Meter Band				
• Mobile	28.0–29.7	35.1–33.0	1,500	6
• Fixed	28.0–29.7	35.1–33.0	1,500	2
6-Meter Band	50.0–54.0	19.7–18.2	1,500	6
2-Meter Band	144–148	6.8–6.65	1,500	6
1¼-Meter Band	219–220	4.49–4.47	50	6[3]
70-Centimeter Band (3)	420–450	2.34–2.19	1,500	6
33-Centimeter Band (3)	902–928	1309–1.06	1,500	6
23-Centimeter Band (3)	1240–1300	0.79–0.76	1,500	6
Automobile Telephone				
VHF Fixed Station	150–160	6.56–5.66	500[2]	6
VHF Mobile Station	158	6.23	60	6
UHF Fixed Station	450–455 & 460–465	2.19–2.12	500[2]	6
UHF Mobile Station	455–46 & 465–470	2.16–2.09	60	6
UHF Mobile Station	459	2.12	60	6
Cellular Telephone	824–849	1.19–1.16	7[2]	6
	869–984	1.13–1.10	7[2]	6
Two-Way Communications				
HF Range Central Station	25–50	39–20	500	2
Mobile Unit	25–50	39–20	500	6
VHF Range Central Station	148–174	6.6–5.6	600	6
Mobile Unit	148–174	6.6–5.6	180	6
LF Range (Aviation)	0.2–0.4	5,000–2,500	2,000	1
HF Range (Aviation)	4–23	246–43	50,000	2
VHF Range (Aviation)	118.0–135.9	8.3–7.24	50	100 feet
UHF Range (Aviation)	225–500	4.4–2.0	100	50 feet
Radio Telegraph	6–23	164–43	50,000	2
Microwave Relay	2,000–12,000	0.5–0.08	50	See Page 5

1. Partial list
2. Present maximum effective radiated power
3. Use 150.8–161.6 MHz column

Table 6

Recommended Distances of Mobile Transmitters and Cellular Telephones Including Amateur and Citizens' Band

MINIMUM DISTANCE (Feet)

Transmitter Power[1] (Watts)	**MF** 1.7 to 3.4 MHz Fixed Mobile, Maritime	**HF** 28 to 29.7 MHz Amateur	**VHF** 35 to 36 MHz Public Use 42 to 44 MHz Public Use 50 to 54 MHz Amateur	**VHF** 144–148 MHz 150–161.6 MHz Public Use	**UHF** 450 to 470 MHz Public Use Cellular Telephones Above 800 MHz
1	15	47	37	12	8
5	32	105	82	27	18
10	46	148	116	38	25
50	102	331	259	85	55
100	144	468	366	120	78
180[2]	193	627	491	161	104
200	204	661	518	170	110
250	228	739	579	190	123
500[3]	322	1,045	818	268	174
600[4]	353	1,145	897	294	190
1,000	455	1,478	1,157	379	245
1,500[5]	557	1,810	1,417	464	300
10,000[6]	1,438	4,673	3,659	1,198	775

Table 6 (Continued)

Citizens Band, Class D Transmitters, 26.96-27.41 MHz

Type	**Recommended Minimum Distance** **Hand-Held**	**Vehicle-Mounted**
Double Sideband—4 watts transmitter power	5 ft.	65 ft.
Single Sideband, 12 watts peak envelope power	20 ft.	110 ft.

1. Power delivered to antenna.
2. Maximum power for two-way mobile units in VHF (150.8 or 161.6 MHz range) and for two-way mobile and fixed station units in UHF (450 to 460 MHz range).
3. Maximum power for major VHF two-way mobile and fixed station units in 35 to 44 MHz range.
4. Maximum power for two-way fixed station units in VHF (150.8 to 161.6 MHz range).
5. Maximum power for amateur radio mobile units.
6. Maximum power for some base stations in 42 to 44 MHz band and 1.6 to 1.8 MHz band.

Appendix A

Standards and Regulations for the Use of Electric Detonators around Radio Frequency Hazards

North Carolina Occupational Safety and Health Standards for the Construction Industry

13 NCAC 07F .0703—General Provisions. (k) Precautions shall be taken to prevent accidental discharge of electric detonators from current induced by radar, radio transmitters including 2-way radios and mobile telephones, lightning, adjacent powerlines, dust storms, or other sources of extraneous electricity. These precautions shall include: (1) See Section 1926.906(a) and (b).(3) (i) The prominent display of adequate signs, warning against the use of mobile radio transmitters, (e.g., telephones and 2-way radios) on all roads within 1,000 feet of electric blasting operations. If adherence to the 1,000-foot distance would create an operational handicap, then a competent person (as defined in 29 CFR 1926 Subparts L and P) shall be consulted to evaluate the particular situation, and alternative provisions may be made which are designed to prevent any premature firing of electric detonators. A description of any such alternatives shall be reduced to writing and shall be certified by the competent person consulted as meeting the purposes of this subdivision. The description shall be maintained at the construction during the duration of the work, and shall be available for inspection by representatives of the Commissioner of Labor. (ii) Examples of signs which would meet the requirements of paragraphs (i) and (k)(3) of this section are the following:

North Carolina Occupational Safety and Health Standards for General Industry

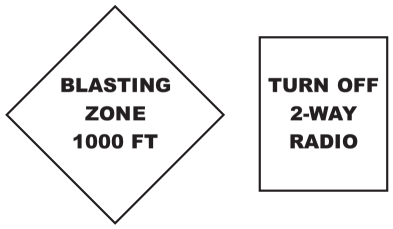
Subpart H—Hazardous Materials: 29 CFR 1910.109(e)(1)(vii)—Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning, adjacent powerlines, dust storms, or other sources of extraneous electricity. These precautions shall include: (b) The posting of signs warning against the use of mobile radio transmitters on all roads within *350 feet* of the blasting operations.

Federal Occupational Safety and Health Standards

The federal occupational safety and heal standards for general industry, 29 CFR 1910.109(e)(1)(vii) and (e)(1)(vii)(b) are the same as the North Carolina standards. The standards for the construction industry are: Subpart U—Blasting and the Use of Explosives: 29 CFR 1926.900(k)—Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning, adjacent powerlines, dust storms, or other sources of extraneous electricity. These precautions shall include: (1) Detonators shall be short-circuited in holes which have been primed and shunted until wired into the blasting circuit. (3)(i) The prominent display of adequate signs, warning against the use of mobile radio transmitters, on all roads within 1,000 feet of blasting operations. Whenever adherence to the 1,000-foot distance would create an operational handicap, a competent person shall be consulted to evaluate the particular situation, and alternative provisions may be made which are adequately designed to prevent any premature firing of electric blasting caps. A description of any such alternatives shall be reduced to writing and shall be certified as meeting the purposes of this subdivision by the competent person consulted. The description shall be maintained at the construction site during the duration of the work, and shall be available for

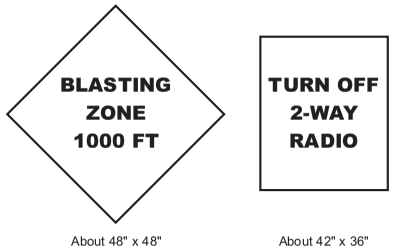
National Fire Code

Chapter 7—Use of Explosive Materials for Blasting: 7-1.15 Precautions shall be taken to prevent accidental discharge of electric detonators from current induced by radar and radio transmitters, lightning, adjacent powerlines, dust storms, or other sources of extraneous electricity. These precautions shall include: (a) The posting of signs warning against the use of mobile radio transmitters on all roads within 350 feet (107 m) of blasting operations. (b) Observance of the latest recommendations with regard to blasting in the vicinity of radio transmitters or powerlines, as set forth in IME Safety Library Publication No. 20, Safety Guide for the Prevention of Radio Frequency Hazards in the Use of Electric Blasting Caps.



(4) Ensuring that mobile transmitters including telephones and 2-way radios which are less than 100 feet away from electric detonators, in other than original containers, shall be de-energized and effectively prevented from operating, (e.g., locked); (5) The Blaster-in-Charge shall comply with the recommendations of IME with regard to blasting in the vicinity of radio transmitters as stipulated in Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Commercial Electric Detonators (Blasting Caps), IME Safety Library Publication No. 20, 2000, which is incorporated herein by reference, including any subsequent amendments and editions.

inspection by representatives of the Secretary of Labor. (3)(ii) Specimens of signs which would meet the requirements of paragraph (k)(3) of this section are the following:



(4) Ensuring that mobile radio transmitters which are less than 100 feet away from electric blasting caps, in other than original containers, shall be deenergized and effectively locked; (5) Compliance with the recommendations of The Institute of the Makers of Explosives with regard to blasting in the vicinity of radio transmitters as stipulated in Radio Frequency Energy-A Potential Hazard in the Use of Electric Blasting Caps, IME Publication No. 20, March 1971.

Glossary

Amateur Service. A service of intercommunications and technical investigations carried on by duly authorized persons interested in radio techniques.

Aviation Services. Services of fixed and land stations and mobile stations on land and on board aircraft primarily for the safe expedition and economical operation of aircraft.

Broadcasting Service. A radio communication service in which the transmissions are intended for direct reception by the general public.

Citizens Band Radio. A radio communication service of fixed, land and mobile stations intended for personal or business radio communication, radio signaling, and control of remote objects or devices.

Fixed Service. A service of radio communication between specified fixed points.

Fixed Station. A station in the fixed service.

International Broadcast Service. A service whose transmissions are intended to be received directly by the general public in foreign countries.

Land Station. A station in the mobile service intended to be used while in motion or during halts at unspecified points.

Maritime Services. Services intended for maritime radio communication and including fixed stations, land stations, and mobile stations on land and on board ships.

Megahertz. 1,000,000 cycles per second.

Mobile Service. A service of radio communication between mobile and land stations, or between mobile stations.

Mobile Station. A station in the mobile service intended to be used while in motion or during halts at unspecified points.

Standard Frequency Terms and Bands.

High Frequency Band (HF): 3–30 MHz
Gigahertz (GHz): 1 GHz = 1,000,000,000 cycles per second
Medium Frequency Band (MF): 0.3–3 MHz
Megahertz (MHz): 1 MHz = 1,000,000 cycles per second
Ultra High Frequency Band (UHF): 300–3,000 MHz
Very High Frequency Band (VHF): 30–300 MHz

References

Atlas Powder Company. *Handbook of Electric Blasting.* Dallas, Texas, 1985.

E.I. Dupont de Nemours. *Dupont's Blasters' Handbook.* 175th Anniversary Ed. Wilmington, Delaware, 1977.

Institute of Makers of Explosives. *Safety Library Publication No. 20.* Washington, D.C., 1988.

National Fire Code. *Use of Explosive Material for Blasting.* Chapter 7.

North Carolina Administrative Code. Chapter 7, Office of Occupational Safety and Health.

North Carolina OSHA Standards for General Industry. 29 CFR 1910.

North Carolina OSHA Standards for the Construction Industry. 29 CFR 1926.

The following industry guides are available from the N.C. Department of Labor's Occupational Safety and Health Division:

#1. *A Guide to Safety in Confined Spaces*
#2. *A Guide to Procedures of the N.C. Safety and Health Review Commission* (downloadable PDF **ONLY**)
#3. *A Guide to Machine Safeguarding*
#4. *A Guide to OSHA in North Carolina*
#5. *A Guide for Persons Employed in Cotton Dust Environments* (downloadable PDF **ONLY**)
#6. *A Guide to Lead Exposure in the Construction Industry* (downloadable PDF **ONLY**)
#7. *A Guide to Bloodborne Pathogens in the Workplace*
#8. *A Guide to Voluntary Training and Training Requirements in OSHA Standards*
#9. *A Guide to Ergonomics*
#10. *A Guide to Farm Safety and Health* (downloadable PDF **ONLY**)
#11. *A Guide to Radio Frequency Hazards With Electric Detonators* (downloadable PDF **ONLY**)
#12. *A Guide to Forklift Operator Training*
#13. *A Guide to the Safe Storage of Explosive Materials* (downloadable PDF **ONLY**)
#14. *A Guide to the OSHA Excavations Standard*
#15. *A Guide to Developing and Maintaining an Effective Hearing Conservation Program*
#16. *A Guide to Construction Jobsite Safety and Health/Guía de Seguridad y Salud para el Trabajo de Construcción*
#17. *A Guide to Asbestos for Industry*
#18. *A Guide to Electrical Safety*
#19. *A Guide to Occupational Exposure to Wood, Wood Dust and Combustible Dust Hazards* (downloadable PDF **ONLY**)
#20. *A Guide to Cranes and Derricks*
#23. *A Guide to Working With Electricity*
#25. *A Guide to Personal Protective Equipment*
#26. *A Guide to Manual Materials Handling and Back Safety*
#27. *A Guide to the Control of Hazardous Energy (Lockout/Tagout)*
#28. *A Guide to Eye Wash and Safety Shower Facilities*
#29. *A Guide to Safety and Health in Feed and Grain Mills* (downloadable PDF **ONLY**)
#30. *A Guide to Working With Corrosive Substances* (downloadable PDF **ONLY**)
#31. *A Guide to Formaldehyde* (downloadable PDF **ONLY**)
#32. *A Guide to Fall Prevention in Industry*
#32s. *Guía de Protección Contra Caídas en la Industria (Spanish version of #32)*
#33. *A Guide to Office Safety and Health* (downloadable PDF **ONLY**)
#34. *A Guide to Safety and Health in the Poultry Industry* (downloadable PDF **ONLY**)
#35. *A Guide to Preventing Heat Stress*
#38. *A Guide to Safe Scaffolding*
#40. *A Guide to Emergency Action Planning*
#41. *A Guide to OSHA for Small Businesses in North Carolina*
#41s. *Guía OSHA para Pequeños Negocios en Carolina del Norte (Spanish version of #41)*
#42. *A Guide to Transportation Safety*
#43. *A Guide to Combustible Dusts*

Occupational Safety and Health (OSH)
Sources of Information

You may call 1-800-NC-LABOR (1-800-625-2267) to reach any division of the N.C. Department of Labor; or visit the NCDOL home page on the World Wide Web: http://www.nclabor.com.

N.C. Occupational Safety and Health Division

Mailing Address:
1101 Mail Service Center
Raleigh, NC 27699-1101
Local Telephone: (919) 807-2900 Fax: (919) 807-2856

Physical Location:
111 Hillsborough St.
(Old Revenue Building, 3rd Floor)

For information concerning education, training and interpretations of occupational safety and health standards contact:

Education, Training and Technical Assistance Bureau

Mailing Address:
1101 Mail Service Center
Raleigh, NC 27699-1101
Telephone: (919) 807-2875 Fax: (919) 807-2876

Physical Location:
111 Hillsborough St.
(Old Revenue Building, 4th Floor)

For information concerning occupational safety and health consultative services and safety awards programs contact:

Consultative Services Bureau

Mailing Address:
1101 Mail Service Center
Raleigh, NC 27699-1101
Telephone: (919) 807-2899 Fax: (919) 807-2902

Physical Location:
111 Hillsborough St.
(Old Revenue Building, 3rd Floor)

For information concerning migrant housing inspections and other related activities contact:

Agricultural Safety and Health Bureau

Mailing Address:
1101 Mail Service Center
Raleigh, NC 27699-1101
Telephone: (919) 807-2923 Fax: (919) 807-2924

Physical Location:
111 Hillsborough St.
(Old Revenue Building, 2nd Floor)

For information concerning occupational safety and health compliance contact:

Safety and Health Compliance District Offices

Raleigh District Office (313 Chapanoke Road, Raleigh, NC 27603)
Telephone: (919) 779-8570 Fax: (919) 662-4709

Asheville District Office (204 Charlotte Highway, Suite B, Asheville, NC 28803-8681)
Telephone: (828) 299-8232 Fax: (828) 299-8266

Charlotte District Office (901 Blairhill Road, Suite 200, Charlotte, NC 28217-1578)
Telephone: (704) 665-4341 Fax: (704) 665-4342

Winston-Salem District Office (4964 University Parkway, Suite 202, Winston-Salem, NC 27106-2800)
Telephone: (336) 776-4420 Fax: (336) 776-4422

Wilmington District Office (1200 N. 23rd St., Suite 205, Wilmington, NC 28405-1824)
Telephone: (910) 251-2678 Fax: (910) 251-2654

****To make an OSHA Complaint,* **OSH Complaint Desk:** (919) 807-2796***

For statistical information concerning program activities contact:

Planning, Statistics and Information Management Bureau

Mailing Address:
1101 Mail Service Center
Raleigh, NC 27699-1101
Telephone: (919) 807-2950 Fax: (919) 807-2951

Physical Location:
111 Hillsborough St.
(Old Revenue Building, 2nd Floor)

For information about books, periodicals, vertical files, videos, films, audio/slide sets and computer databases contact:

N.C. Department of Labor Library

Mailing Address:
1101 Mail Service Center
Raleigh, NC 27699-1101
Telephone: (919) 807-2848 Fax: (919) 807-2849

Physical Location:
111 Hillsborough St.
(Old Revenue Building, 5th Floor)

N.C. Department of Labor (Other than OSH)

1101 Mail Service Center
Raleigh, NC 27699-1101
Telephone: (919) 733-7166 Fax: (919) 733-6197