

7. Protective Measures for RF Radiation

Once RF generating devices have been identified, the next challenge is how to create a safe working environment for the construction workers. When deciding on the best protective measures to take consider:

- The **distance** from antennas,
- Whether or not the antennas are emitting RF radiation in one **direction** or multiple directions,
- The **angle** of the antenna. It is important to be aware that the angle of some antennas can be remotely adjusted, meaning the job may not be in the path of the antenna when work starts– but a change in the antenna’s angle could put workers in harm’s way while working, and
- The **height** of the antennas from the work surface.

Given that power levels and, as a result, exposure levels are always fluctuating, it is best to exercise caution:

- Assume all antennas are active and operating at full power, unless you have specific information in writing from the licensee that this is not the case.
- Stay away from the source and the direction the RF radiation is being emitted. If you work on a mobile broadcasting truck, do not go up the ladder or on the truck’s roof when the antenna is energized unless the mast is up 8 feet or more and the antenna is not pointing downward. If the work is near a cylindrical or rod-shaped antenna that emits RF radiation in all directions, be particularly cautious since there is no safe place near the antenna. If the work is near a rectangular or dish-shaped antenna, which only emits RF radiation in one direction, then you can work safely as long as the antenna is not pointing at you or your work area. This also applies to antennas on nearby buildings – not just the building you are working on.
- Request to have the antennas powered down or moved.
- Use a personal RF monitor and, if the antenna cannot be powered down or moved, use RF protective clothing. Use of personal monitors and protective clothing should be part of a larger RF safety program.

7.1 Maintain a Safe Distance

Distance is important because the power density decreases the farther away from the source, both horizontally and vertically. Therefore, exposure drops the greater the distance or the higher up the antenna is from you. To maintain a safe distance:

- Follow the instructions on posted signs. Know how to recognize and understand the information on the signs
- Do not cross fences/barriers set up to restrict access
- Pre-plan work tasks and travel routes to limit trips through and time spent in RF fields.
- Limit the time spent performing tasks near antennas. Your risk increases the longer you spend in the RF field. The goal is to get in and out as quickly as possible.

- Remember – when antennas are active they are energized or “HOT.” Touching an active antenna can result in a serious RF burn that may be more severe internally than it appears on the surface. If you notice symptoms of RF exposure, move to a new location.

If signs or barriers are not present and the antenna owner(s) or building management cannot demonstrate otherwise, always assume that all antennas are active and stay at least six feet away from a single antenna facing the direction of work, and at least 10 feet away from two or more antennas facing the direction of work.

If the work is near a cylindrical or rod-shaped antenna that emits RF radiation in all directions, be particularly cautious since there is no safe place near the antenna. If working near a rectangular panel antenna or dish-shaped antenna, pay attention to the direction the antenna is pointed – and thus the direction of the RF radiation. Employees can work safely as long as the antenna is not pointing at the work area. This also applies to antennas on nearby buildings – not just the building in the designated work area. If you work on a mobile broadcasting truck, do not go up the ladder or on the truck’s roof when the antenna is energized unless the mast is up 8 feet or more and the antenna is not pointing downward.

If you have access to information on the types of antennas and their power levels, follow the FCC’s “Estimated Worst Case” distance from single cellular antenna or personal communications services (PCS) as shown in Figure 7-A. (Note: PCS refers to wireless, voice and/or data communications systems, typically incorporating digital technology, and paging base station antennas). The types of antennas and distances are based on effective radiated power (ERP), measured in watts. ERP is the amount of energy going out into the air from the antenna.

Figure 7-A

Cylindrical Antennas				Panel Antennas			
Single omni-directional, cellular base-station antenna		Single omni-directional paging or narrowband PCS antenna		Single sectorized, cellular base-station antenna		Single sectorized, Broadband PCS base station antenna	
ERP* (watts)	Minimum Distance (feet)	ERP^ (watts)	Minimum Distance (feet)	ERP# (watts)	Minimum Distance (feet)	ERP# (watts)	Minimum Distance (feet)
.5	3.4	50	3.4	.5	1.6	.5	1.2
5	10.8	250	7.5	5	5	5	3.8
25	24.1	1000	15.1	25	11.3	25	8.6
100	48.2	3500	28.2	100	22.6	100	17.2

*watts per channel based on maximum total of 96 channels per antenna

^ based on maximum total of 1 channel per antenna

watts per channel based on maximum total of 21 channels per sector

NOTE: ERP = effective radiated power

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Source: FCC - A Local Government Official’s Guide to Transmitting Antenna RF Emission Safety: Rules, Procedures, and Practical Guidance, accessed April 28, 2016.
http://wireless.fcc.gov/siting/FCC_LSGAC_RF_Guide.pdf

7.2 Power-Down or Move the Antenna

If workers cannot maintain a safe distance because of the location of the work, the employer should contact the antenna owner or contact person on the warning sign(s) or provided by the site owner or manager and:

- Describe the work being performed near the RF radiation generating antennas
- Express your concern about an exposure hazard
- Request a site power down or written confirmation that it is safe to perform work

If there are multiple antennas, repeat this process with each antenna owner.

The FCC's guidelines recommend "reducing or shutting off power when work is required in a high RF area, switching to an auxiliary transmitter (if available) while work on a main system is in progress or incorporating appropriate shielding techniques" as options to reduce exposures. In multi-transmitter locations, all licensees are responsible for compliance with FCC guidelines including preventing the public and workers from exposure to harmful RF levels.

Some antennas, such as those used for broadcasting, may have an auxiliary antenna at another location that can be used while the antenna at the worksite is powered down.

7.3 Use a Personal RF (Field) Monitor

Another safeguard is to use a personal RF monitor to identify the presence of RF radiation when conducting an initial assessment and while work is underway. These devices can alert workers to potential exposures over the MPE limits by sounding an alarm, flashing lights, or vibrating when the exposure level is exceeded. These monitors are only useful, however, if workers are trained on how to use them and they are used and maintained in accordance with the manufacturer's instructions. For example, monitors should be worn outside of protective clothing.

There are several brands on the market. One of the most recognizable brands is Narda Safety Test Solutions, which, according to their product literature, follows the "RF/microwave frequency limits promoted by the US FCC [and] IEEE (C95.1)." The Nardalert S3 Personal Monitor (Figure 7-B), for example, can be purchased online for around \$2,000. (Source: <http://www.narda-sts.us/index.php>). They can also be rented; prices and terms vary. (Source: TRS-RenTelco https://www.trs-rentelco.com/Model/NAR_A8862_E.aspx; Electro Rent North America <http://www.electrorent.com/products/narda-microwave>.)

Figure 7-B



Nardalert S3 Personal Monitor

Photo courtesy of Narda Safety Test Solutions <http://www.narda-sts.us/index.php>

Sources:

- TRS-Ren Telco - Narda - A8862 Radio Frequency Personal Radiation Monitor, accessed April 28, 2016. https://www.trs-rentelco.com/Model/NAR_A8862_E.aspx%20TRS-RenTelco
- Electro Rent North America – Narda Microwave, accessed April 28, 2016. <http://www.electrorent.com/products/narda-microwave>
- Narda Safety Test Solutions <http://www.narda-sts.us/>

* CPWR does not endorse any specific products.

7.4 Use Protective Clothing

According to the FCC: *“use of RF protective clothing may be considered an acceptable mitigation technique for occupational exposures as long as sufficient precautions are taken to comply with all of the clothing manufacturer’s recommendations and caveats...As with any personal protective equipment, RF protective clothing should be considered as a method of choice only when other engineering and administrative controls cannot be used to reduce exposure or are otherwise impractical.”* (Source: OET 65)

Personal protective clothing along with a monitor should only be used if there is no alternative but to work in an area that exceeds the FCC's maximum permissible exposure limit, and if use of the clothing is part of an overall safety program. Such a situation would arise when an antenna cannot be turned off, or is utilized under intermittent operation that cannot be locally controlled. If these conditions exist, a full RF protective suit should be used, including an integrated hood, overshoes, socks, and gloves.

It is important to keep in mind that protective clothing will not protect at exposures 1,000% or more above the maximum permissible exposure limit, and users can experience electrical shock or arc flash because the clothing is made of fabric that includes stainless steel fibers that are highly conductive. Protective clothing will only work if it is worn properly. When worn with a personal monitor, the monitor should be worn on the outside of the protective suit. Otherwise, the monitor will not work properly. It is important to be aware that use of protective clothing may impede mobility.

One example is [UniTech](#), shown in Figure 7-C. UniTech's website states that it is a CE-certified protective garment to reduce exposure to high frequency electromagnetic radiation [and] is tested in conformance with U.S. ANSI/IEEE standard.

Figure 7-C

UniTech RF Garment



Photo courtesy of UniTech Services Group
<http://www.unitechus.com/services/rf-protection/>

Sources:

- UniTech Services Group, <http://www.unitechus.com/services/rf-protection>
- FCC OET Bulletin 65:
https://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf

* CPWR does not endorse any specific products.

7.5 Other Resources

There are several other resources available to contractors for help with assessing the risk and exposure levels:

- Employers can request that NIOSH conduct a Health Hazard Exposure Assessment (<http://www.cdc.gov/niosh/hhe/>). (Figure 7-D) NIOSH would need access to a project site at a variety of times because of the fluctuation in RF radiation during any given period.

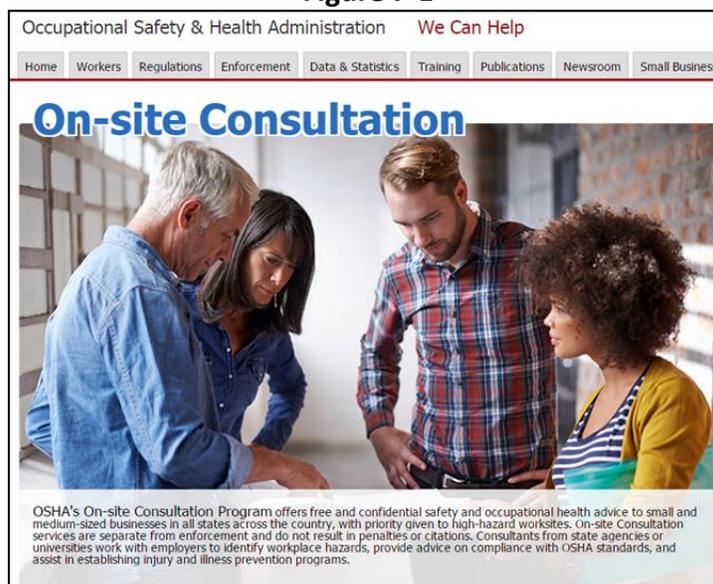
Figure 7-D



*Source: NIOSH - Health Hazard Evaluations (HHEs), ACCESSED April 28, 2016.
<http://www.cdc.gov/niosh/hhe/>*

Employers can also take advantage of OSHA's [onsite consultation program](#). (Figure 7-E) Through this program, OSHA offers small and medium-sized employers free, confidential help with identifying and addressing hazards. OSHA will help identify the hazard, suggest general approaches or options for solving the safety or health problem, identify the kinds of help available if further assistance is needed, provide a written report summarizing findings, and provide training for employees. OSHA **will NOT issue** citations or propose penalties for violations of OSHA standards, report possible violations to OSHA enforcement staff, or guarantee that the workplace will "pass" an OSHA inspection.

Figure 7-E

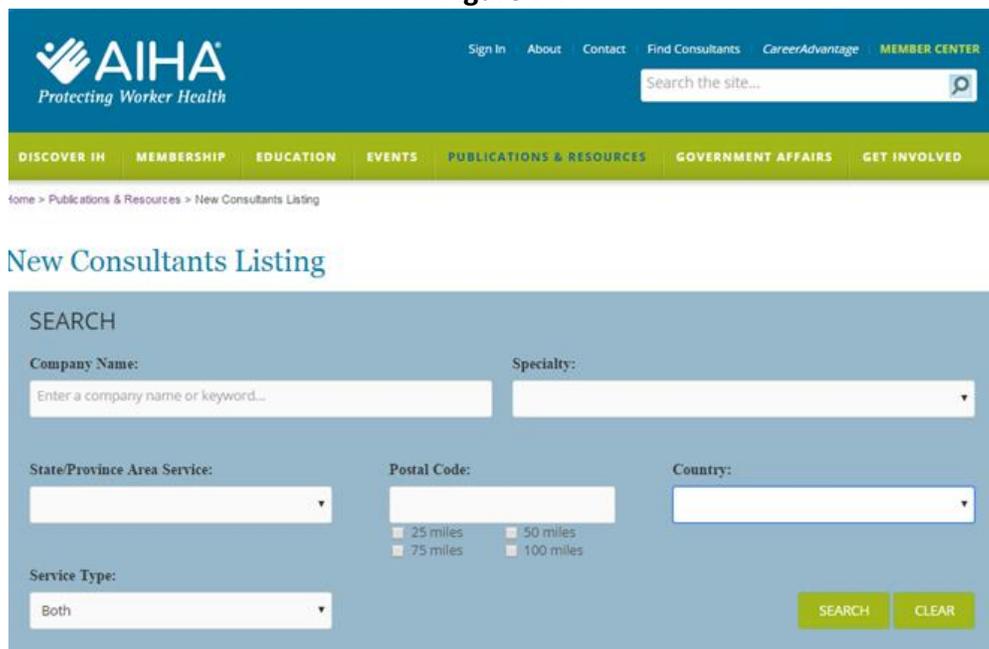


Source: OSHA's Consultation Directory, accessed April 28, 2016.

https://www.osha.gov/dcsp/smallbusiness/consult_directory_text.html

Additionally, the American Industrial Hygiene Association (AIHA) has an [online searchable database](#) of consultants. (Figure 7-F) Employers can search for a consultant that specializes in exposure monitoring for non-ionizing radiation.

Figure 7-F



Source: AIHA – New Consultants Listing, accessed April 28, 2016.

<https://www.aiha.org/publications-and-resources/Pages/New-Consultants-Listing.aspx>