

5. Regulations & Guidelines for RF Radiation

The following is a brief overview of the regulations and guidelines that address RF radiation and are intended to protect workers, at federal, state, and local levels.

5.1 Federal Communications Commission Guidelines

[The Federal Communications Commission](#) (FCC) has jurisdiction over all registered transmitting services except those operated by the Federal Government. Under the National Environmental Policy Act of 1969, the FCC is required to consider human exposure to RF radiation because transmitting devices that fall within its jurisdiction have “a high potential for creating significant RF exposure to humans.”

The FCC requires telecommunications providers – the owners of the equipment, their licensees – to conduct RF emission compliance studies where their devices are located to ensure that they do not pose a health risk. The resulting report should include the steps that are being taken to protect workers and the general public.

The FCC’s exposure guidelines are outlined in **OET Bulletin 65 “[Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields](#)”**⁸ The health and safety portion of this guidance document reflects the recommendations of the Institute for Electrical and Electronics Engineers (IEEE) voluntary standards and the National Council on Radiation Protection and Measurements, and are based on thresholds for known adverse effects and include “prudent margins of safety.” The FCC guidelines include information on the maximum permissible exposure (MPE) limits, what owners of RF generating telecommunications equipment must do to comply with occupational and public exposure limits, methods to determine compliance, signage requirements, and other policies designed to protect telecommunications workers and the general public. The FCC does not set health and safety standards or specific training requirements, and it does not certify training programs.⁹

Maximum Permissible Exposure Limits (MPE)

The FCC has different Maximum Permissible Exposure (MPE) limits for two different tiers of exposure groups.

The first tier is the “**General Population/Uncontrolled exposure limits.**” These exposure limits apply to the public and individuals exposed as a consequence of their employment, but who may not have been made fully aware of the potential for exposure or cannot exercise control over their exposure. Construction workers fall into this category. According to the FCC, when telecommunications equipment are mounted on rooftops, RF emissions could exceed higher

⁸ OET 65 accessed 2015-2016. This document is expected to be updated at the conclusion of FCC rulemaking – dockets 13-84 & 03-137.

⁹ There is currently no government agency that certifies RF radiation training programs.

than desirable guideline levels on the rooftop itself and such levels might become an issue for maintenance or other personnel working on the rooftop.

Source: *FCC Consumer Guide – Human Exposure to Radio Frequency Fields: Guidelines for Cellular and PCS sites*, accessed April 28, 2016.

<https://transition.fcc.gov/cgb/consumerfacts/rfexposure.pdf>

The second tier under MPE limits is “**Occupational/controlled exposure limits.**” The FCC defines this group as persons exposed as a consequence of their employment, and who have been made fully aware of the potential for exposure, and can exercise control over their exposure. Telecommunications industry workers would fall into this category.

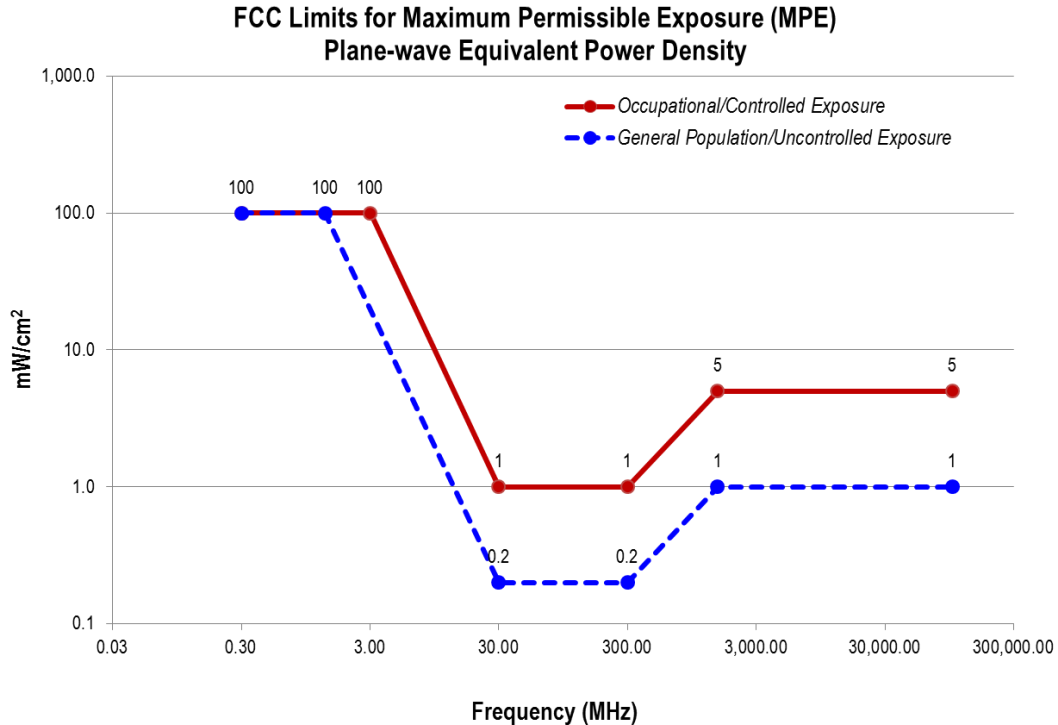
According to the FCC, “Persons who are only “transient” visitors to the rooftop, such as air conditioning technicians and other construction workers on rooftops, could also be considered to fall within the occupational/controlled criteria as long as they also are “made aware” of their exposure and exercise control over their exposure.

Source: *FCC – OET Bulletin 65 Edition 97-01 page 55*, accessed April 28, 2016.

https://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf

As shown on Figure 5-A, the FCC’s occupational/controlled exposure limits are higher – less restrictive – than the limits for the general population. The occupational/controlled exposure limits are higher because those workers are aware of the hazard, can identify it, and control their exposures. The limits are lower – more restrictive – for the general population and construction workers for the opposite reasons.

Figure 5-A



Source: OET Bulletin 65, Appendix A, Figure 1, April 28, 2016.

https://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf

The MPE also changes based on frequency. In their guidance documents, the FCC notes that frequency and the distance from the radiation beam influence the level of exposure and potential health risks. Frequency matters because when it comes to the health effects, different frequencies affect humans differently. The most harmful and restrictive frequency range is between 30 MHz and 300 MHz. According to the FCC, this is the most harmful to humans because it is the range where humans absorb RF radiation most efficiently. Distance is important because the power density decreases the farther away from the source, both horizontally and vertically. Exposure drops the greater the distance or the higher the antenna is above the workers.

Sources:

- *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
- *FCC Policy on Human Exposure to Radiofrequency Electromagnetic Fields - Guidelines for Cellular and PCS Site, accessed April 28, 2016.*
<https://www.fcc.gov/consumers/guides/human-exposure-radio-frequency-fields-guidelines-cellular-and-pcs-sites>

It is important to keep in mind that when multiple antennas are present the exposures are cumulative. The antenna owner (the licensee) should provide their own workers, the general public, and others (including construction and maintenance workers on the property) with the information needed to ensure they are not entering a hazardous area. However, it is prudent for construction employers and their employees to always assume it is a “worst-case” situation unless the building owner or licensee(s) can provide documentation showing it is not.

The assumptions for a worst-case scenario would be that all antennas are operating simultaneously and continuously at the maximum licensed power, and that the worker is working in the main transmitting beam within a few feet of an antenna and being exposed to RF radiation above the MPE.

Source: RF Safety FAQ, accessed April 28, 2016. <https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety#Q6>

FCC Enforcement Example

Although the FCC may not have the resources to inspect all sites, it will fine antenna owners found to be in violation of the requirements to protect members of the public and workers. In 2015, for example, the FCC responded to a complaint from the owner of an office building that building staff had difficulty gaining RF exposure safety assistance from the carriers that use the rooftop. The FCC inspected and found there were no RF exposure notices or signs mounted near or in the penthouse or patios warning of the hazard in the adjacent areas. The only signs were two warning signs mounted on the door leading directly to the antenna area. They also learned that the property owner, manager, and maintenance staff had not received RF exposure safety training. The inspectors were told by the property manager that she and other building workers work on the rooftop, including the antenna area, from time to time but, due to inadequate signage and barriers, they are not aware of areas to avoid or steps to take to limit RF exposure. The FCC fined the antenna owners a total of \$85,000 for failing to:

- Adequately prevent public access to the areas immediately in front of the antenna station where radiofrequency (RF) emissions exceed what is permissible for exposure to the general population;
- Comply with the requirement of the FCC’s RF maximum permissible exposure (MPE) limits;
- And have adequate warning signage and barriers that comply with the FCC’s stated expectations for restricting access to areas that present a potential public safety hazard.

Find other cases of FCC citations here: <https://transition.fcc.gov/eb/sed/rfse.html>

Sources:

- FCC – T-Mobile License LLC Notice of Apparent Liability for Forfeiture, accessed April 28, 2016. https://apps.fcc.gov/edocs_public/attachmatch/DA-15-1298A1.pdf
- FCC – Wirelesco, L.P. Notice of Apparent Liability for Forfeiture, accessed April 28, 2016. https://apps.fcc.gov/edocs_public/attachmatch/DA-15-1299A1.pdf

- FCC – Visionary Related Entertainment, L.L.C. Notice of Apparent Liability for Forfeiture, accessed April 28, 2016. https://apps.fcc.gov/edocs_public/attachmatch/DA-07-548A1.pdf

5.2 OSHA Standards

Although OSHA is the regulatory body for workplace safety and health standards, it has no specific standards for radiofrequency and microwave radiation for the construction industry. Its nonionizing radiation standard (1926, Subpart D, [1926.54](#) and [1910.97](#)), includes an exposure limit (10mW/cm²), but this limit is expressed in voluntary language and has been ruled unenforceable. The telecommunications standards ([1910.268](#)) include requirements to protect workers, but “these standards do **not** apply to construction work.”

In the absence of a specific construction standard, OSHA may take enforcement actions related to RF radiation exposure through:

- The “**general duty clause**,” (Section 5(a)(1) of the OSH Act) which states: “Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees.”
- The **personal protective equipment standard** (1926.28), which states: “The employer is responsible for requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions...”

Note: The hazard communication standard (1926.59), which requires employers to communicate information about chemical hazards and appropriate protective measures to their employees, does not cover certain categories of chemicals, including non-ionizing radiation. However, some states, such as Minnesota, include radiofrequency in their own state-level hazard communication standards and regulations.

Sources:

- *OSHA Safety and Health Topics – Radiofrequency and Microwave Radiation*, accessed April 28, 2016. <https://www.osha.gov/SLTC/radiofrequencyradiation/standards.html>
- *OSHA Hazard Classification Guidance for Manufacturers, Importers, and Employers*. <https://www.osha.gov/Publications/OSHA3844.pdf>

5.3 Voluntary Standard: Institute of Electrical and Electronics Engineers (IEEE)

The Institute for Electrical and Electronics Engineers (IEEE) has developed voluntary standards for RF radiation that are recognized by the American National Standards Institute (ANSI), and have been made available free of charge to the public through a program with the U.S. Department of Defense.

These standards are referenced in FCC documents and address steps owners of antennas and other RF-generating devices should take to protect workers and the general public – including construction workers not employed by the owner – from exposures to RF Radiation.

These [voluntary standards include](#):

- C95.1 – Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz
- C95.2 – Standard for Radio Frequency Energy and Current Flow Symbols
- C95.3 – Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz-300 GHz
- C95.7 – Recommended Practice for Radio Frequency Safety Programs, 3kHz to 300 GHz

The IEEE standard C95.7 – **Recommended Practice for Radio Frequency Safety Programs, 3kHz to 300 GHz** – was updated in 2014 and provides guidance for antenna owners on:

- How to develop a RF Safety Program for preventing exposures in excess of the FCC’s maximum permissible exposure limit
- How to integrate the information in the other three standards into the plan
- How to characterize potential exposures
- How to identify appropriate controls
- What should be covered in a training program

A free copy of the standards can be downloaded from the [IEEE website](#) through the IEEE Get Program.

Sources:

- IEEE C95.7™-2014: Recommended Practice for Radio Frequency Safety Programs - 3 kHz to 300 GHz, accessed April 28, 2016. <http://standards.ieee.org/findstds/standard/C95.7-2014.html>
- IEEE Get Program, accessed April 28, 2016. <http://standards.ieee.org/getieee/C95/download/C95.7-2014.pdf>

5.4 State, Local & Other Requirements

In addition to OSHA, IEEE voluntary standards, and FCC requirements, many states, cities, universities and other institutions have their own RF requirements. Some of the requirements are through state OSHA plans, and others have been developed and are enforced by other state or local agencies or departments.

Examples of states with their own RF requirements include:

- Arizona - http://apps.azsos.gov/public_services/Title_12/12-01.pdf
- Alaska - <http://www.labor.state.ak.us/lss/pads/radio.htm>
- California - <https://www.dir.ca.gov/title8/5085.html>
- Massachusetts- <http://www.mass.gov/eohhs/docs/dph/reqs/105cmr122.pdf>
- Minnesota - http://www.dli.mn.gov/osh/PDF/ertk_construct.pdf

- Oregon - http://www.orosha.org/pdf/rules/division_2/1910-97.pdf
- Virginia - http://vita.virginia.gov/uploadedfiles/VITA_Main_Public/Library/PSGs/RF_Radiation_Human_Exposure_Compliance_Plan.pdf
- Washington - <http://app.leg.wa.gov/wac/default.aspx?cite=296-62-09005>

Appendix A contains information from the California, Minnesota, and Virginia requirements as examples of what might be found in state-level requirements.

Examples of cities with their own RF requirements include:

- San Francisco - <https://www.sfdph.org/dph/files/EHSdocs/Radiofrequency/HealthandReqs2010Memo.pdf>
- Philadelphia - <http://www.phila.gov/finance/units-riskmanagementtemplates.html>

Philadelphia Template Programs – Minimum Requirements: Radio Frequency

The City of Philadelphia’s Office of Risk Management’s Safety and Loss Prevention Unit is responsible for ensuring citywide development, implementation, and maintenance of safety and health programs to control and minimize hazards that could result in injury or illness to the city’s workforce. This Unit has developed template safety programs that provide minimum safety requirements for a variety of hazards – including RF radiation. The RF radiation program is intended to protect workers from potential injuries associated with Radio Frequencies (RF) above 300 kHz. The basic elements of the city’s program are: identifying potential hazards, use of signs, inspections and monitoring, assignment of responsibility, training, and a requirement for medical surveillance. Medical surveillance includes:

- A medical exam after exposures
- An annual medical evaluation by a licensed healthcare professional
- A means to report the occurrence of RF burns, implanted medical devices... or the sensation of non-routine heating as a means of identifying potential problem areas.

Source: Philadelphia Office of Risk Management - Template Programs - Minimum Requirements, accessed April 28, 2016. <http://www.phila.gov/finance/units-riskmanagementtemplates.html>

Examples of universities with their own RF requirements include:

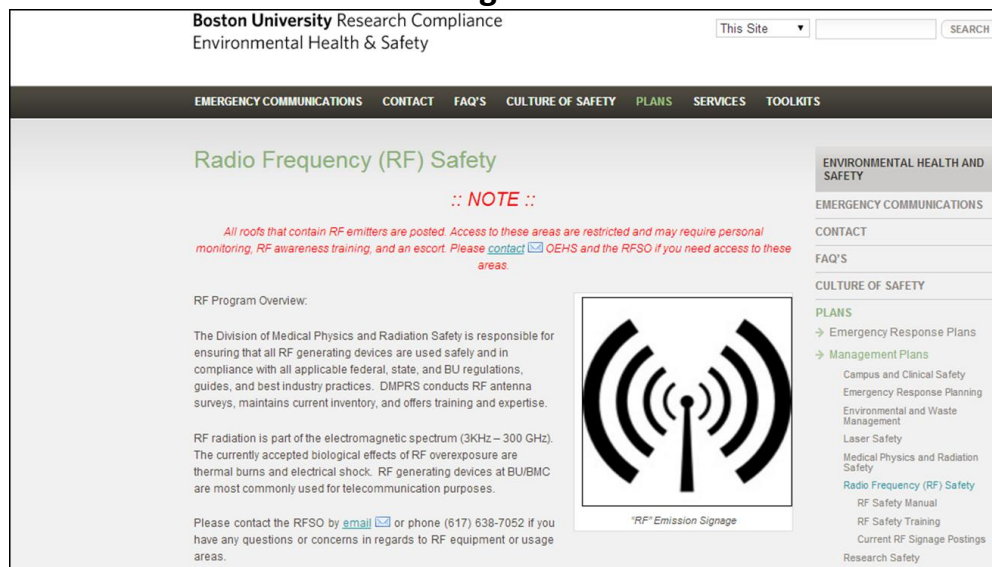
- Cornell - https://sp.ehs.cornell.edu/lab-research-safety/radiation/rf-microwaves/Documents/RF_Microwave_Safety_Program_Guide.pdf
- Texas State University - <http://www.fss.txstate.edu/ehsrm/safetymanual/radiation/rfrad.html>
- UC Berkeley - <http://ehs.berkeley.edu/laser-safety/non-ionizing-radiation-safety-manual>
- UC San Francisco - <http://ehs.ucsf.edu/print/655>
- Boston University - <http://www.bu.edu/ehs/plans/management-plans/rf-safety/>

Boston University's Building Owner RF Radiation Requirements

Boston University's office of Environmental Health and Safety's Division of Medical Physics and Radiation Safety is responsible for ensuring that all RF generating devices are used safely and in compliance with all applicable federal, state, and university regulations, guides, and best industry practices. This division conducts RF antenna surveys, maintains a current inventory of the location of these devices on campus, and offers training.

The University has a special section of their website (Figure 5-B) focused on RF radiation safety that includes: their awareness training program and manual; information on the location of RF radiation devices; a statement that *"All roofs that contain RF emitters are posted. Access to these areas are restricted and may require personal monitoring, RF awareness training, and an escort;"* and information on whom to contact if work needs to be performed within a restricted area.

Figure 5-B



The screenshot shows the Boston University Research Compliance website. The header includes the site name and a search bar. A navigation menu lists: EMERGENCY COMMUNICATIONS, CONTACT, FAQ'S, CULTURE OF SAFETY, PLANS, SERVICES, and TOOLKITS. The main content area is titled "Radio Frequency (RF) Safety" and features a red "NOTE" stating: "All roofs that contain RF emitters are posted. Access to these areas are restricted and may require personal monitoring, RF awareness training, and an escort. Please contact OEHS and the RFSO if you need access to these areas." Below this, there is an "RF Program Overview" section with text about the Division of Medical Physics and Radiation Safety's responsibilities. To the right of the text is a black and white icon of a radio tower with signal waves, labeled "RF Emission Signage". A sidebar on the right contains a menu with categories: ENVIRONMENTAL HEALTH AND SAFETY, EMERGENCY COMMUNICATIONS, CONTACT, FAQ'S, CULTURE OF SAFETY, and PLANS. Under PLANS, there are links for "Emergency Response Plans" and "Management Plans", with sub-links for "Campus and Clinical Safety", "Emergency Response Planning", "Environmental and Waste Management", "Laser Safety", "Medical Physics and Radiation Safety", "Radio Frequency (RF) Safety", "RF Safety Manual", "RF Safety Training", "Current RF Signage Postings", and "Research Safety".

Sources:

Radio Frequency (RF) Safety, accessed April 28, 2016.

<http://www.bu.edu/ehs/plans/management-plans/rf-safety/>

Radio Frequency (RF) Safety RF Compliance Studies, accessed April 28, 2016.

<http://wirelessestimator.com/content/industryinfo/64>