

Radiofrequency (RF) Radiation Awareness Guide for the Construction Industry



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Overview

Workers who perform tasks on rooftops, sides of buildings, news gathering trucks, and other structures where cellular antennas and other RF (radiofrequency) generating devices are present may be at risk of exposure to hazardous levels of RF radiation. RF radiation is an invisible hazard since it cannot be seen, smelled, or touched.

This Guide is one part of a program to raise construction employers' and workers' awareness of the potential risks associated with exposure to RF radiation, and provide information on how to identify the hazard and take steps to work safely.

In addition to this Guide, the complete **Radiofrequency (RF) Radiation Awareness Program for the Construction Industry** includes a:

- PowerPoint Presentation — Radiofrequency (RF) Radiation Awareness Program for the Construction Industry Overview;
- Video — Safe Transmission: RF Awareness for the Construction Industry;
- Hazard Alert Card — RF Radiation – An invisible danger (available in English and Spanish); and
- Toolbox Talk — RF Radiation Awareness.

This Guide builds on the information covered in the presentation by providing additional details on how to:

- Assess the hazard;
- Find regulations and guidance documents;
- Determine if an RF generating device is present; and
- Find protective equipment.

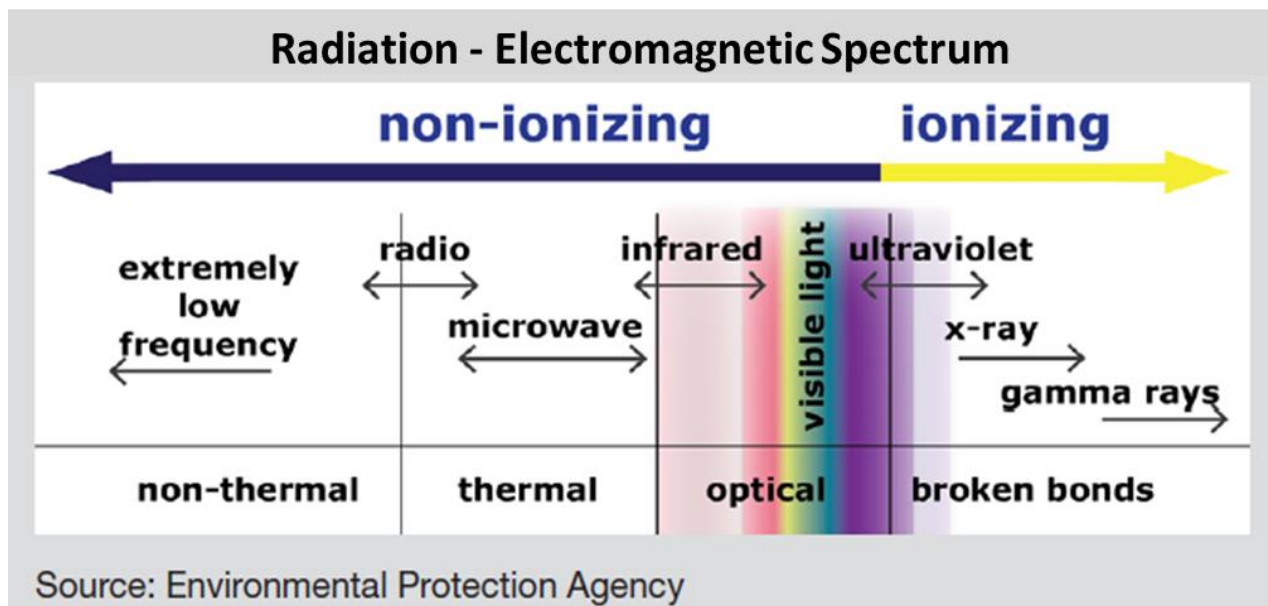
1. What is Radiofrequency (RF) Radiation?

There are two types of radiation – **ionizing** radiation and **non-ionizing** radiation. Both are forms of electromagnetic energy, but ionizing radiation has more energy than non-ionizing radiation.

Ionizing radiation, like x-rays or gamma rays, has enough energy to cause chemical changes by breaking chemical bonds. Sources of this type of radiation can be found in hospitals, nuclear energy plants, and nuclear weapons facilities.

Non-ionizing radiation causes molecules to vibrate, which generates heat. **RF radiation is a type of non-ionizing radiation and the focus of this Guide.**

Figure 1-A



The diagram in Figure 1-A shows the electromagnetic spectrum from extremely low frequency (non-ionizing) to gamma rays (ionizing). There are different types of non-ionizing radiation. At one end is “extremely low frequency” or ELF radiation, which can be emitted through electric currents from overhead power lines and equipment powered by electricity.

At the other end is radiofrequency (RF) radiation. According to the Centers for Disease Control and Prevention (CDC), “Even though [ELF and RF] are both non-ionizing radiation, RF radiation is much higher frequency than ELF radiation and therefore potentially more harmful.”¹

¹ *Frequently Asked Questions about Cell Phones and Your Health*, accessed April 28, 2016. http://www.cdc.gov/nceh/radiation/factsheets/224613_faq_cell-phones-and-your-health.pdf

RF radiation collectively refers to **radio waves** and **microwaves** and is characterized by wavelength and frequency. The **frequency** of each wave is measured in Hertz (Hz) – cycles per second. KiloHertz (KHz) are low frequency – 1,000 cycles per second. **Megahertz** (MHz) are 1 million cycles per second, and gigahertz (GHz) are at the high end – 1 billion cycles per second.

The RF and microwave parts of the electromagnetic spectrum are generally defined as that part of the spectrum where electromagnetic waves have frequencies in the range of about 3 kilohertz (3 kHz) to 300 gigahertz (300 GHz). As shown in Figure 1-A, microwave radiation has higher frequencies than radiofrequency, but the two are often grouped together.

In general, signals with longer wavelengths travel a greater distance and penetrate through and around objects better than signals with shorter wavelengths. Low frequencies have longer wavelengths. Higher frequencies have shorter wavelengths.

Frequency matters because, when it comes to the health effects, different frequencies affect humans differently. According to the FCC, frequencies between 30 and 300 megahertz appear to be the most harmful to humans because it is the range where humans absorb RF radiation most efficiently.²

Distance is also important because the power density decreases farther away from the source. The amount of **RF power** generated is measured in watts and a common measure of RF radiation **power density** is milliwatts per square centimeter (mW/cm²).³

2. Common Uses for RF Radiation

Common uses of RF radiation include:

- Microwave ovens;
- Radar;
- Industrial heating and sealing processes;
- Medical applications; and
- Telecommunications & broadcast services. This latter category includes cellular antennas and base stations, radio and television broadcasting, radio communications for police and fire departments, microwave point-to-point radio links, and satellite communications.

According to the Federal Communications Commission, “[t]he most important use for RF energy is in providing telecommunications services.”⁴ This use of RF radiation is the one we are most concerned about because telecommunications equipment is frequently installed on rooftops, sides of buildings, and/or on other elevated structures where work is performed.

² FCC OET Bulletin 65 page 8

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

³ How To Understand The Different Measurement Units That Are Used To Measure EMFs, accessed April 28, 2016.

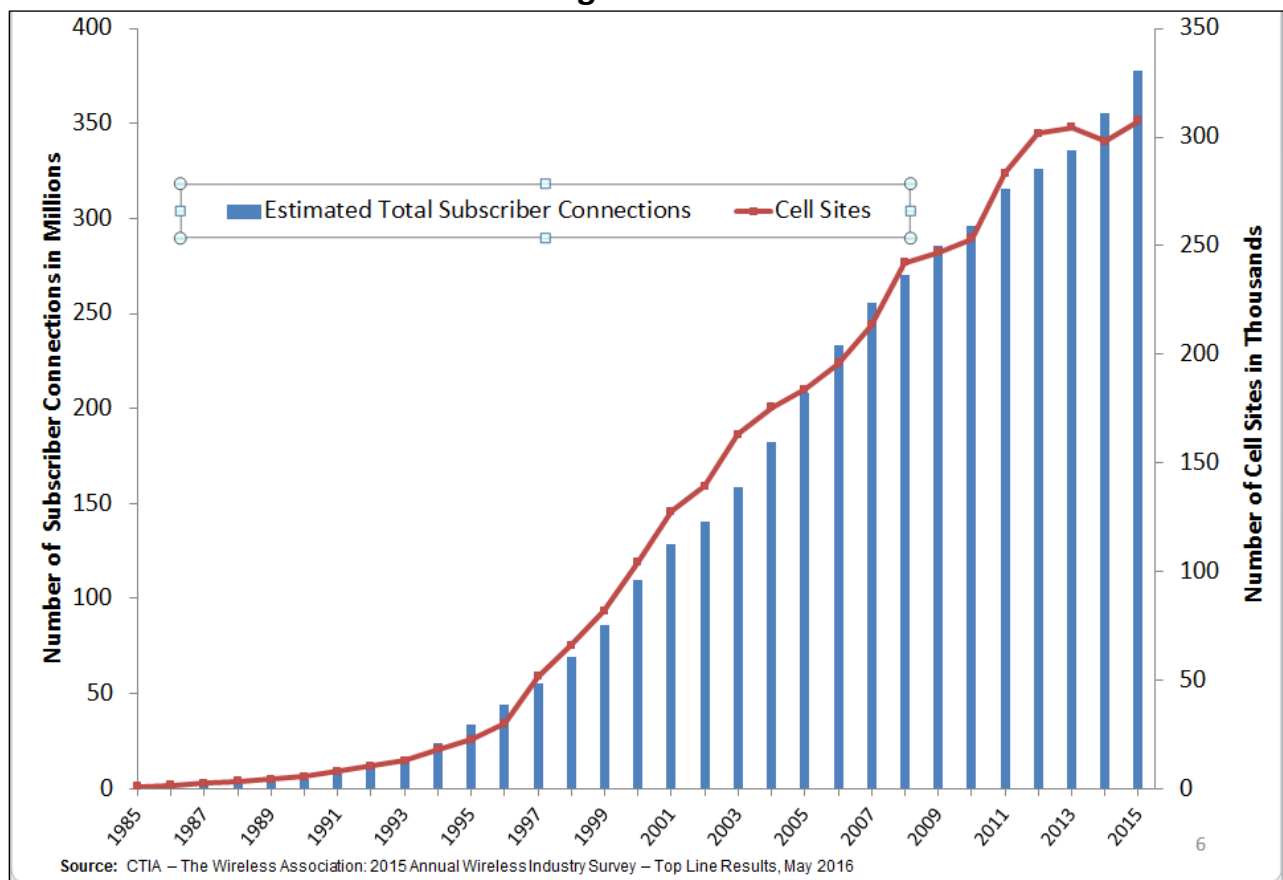
<http://www.electricsense.com/3772/how-to-understand-the-different-measurement-units-that-are-used-to-measure-emfs/>

⁴ FCC RF Safety FAQ. <https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety#Q1>

As demand for cellular service has grown, there has been a significant increase in the number of cellular sites in a relatively short period of time. According to CTIA – The Wireless Association, between 1985 and 2015, the estimated number of cellular subscriber connections grew exponentially from 340,213 to more than 377 million*, and the number of cellular antenna sites increased from 913 to more than 300,000.

In 2014, the number of cell sites dropped off slightly to 298,000 due to consolidation and the replacement of older technologies with new devices, but then the number increased to 307,626 in 2015.⁵ (Figure 2-A)

Figure 2-A



***Note:** One subscriber can have more than one connection.

⁵ CTIA – The Wireless Association. 2015 Annual Wireless Industry Survey – Top Line Results (May 2016) <http://www.ctia.org/docs/default-source/default-document-library/ctia-survey-2015.pdf>

3. Health Effects of RF Radiation

The proliferation of cellular antennas and other RF generating devices has led to concerns about the potential health effects from exposure to RF radiation. The short-term thermal effects of RF radiation on humans are well documented, but less is known about the long-term health effects.

The existing research has focused on the health risks associated with cell phone use and the public's exposure at ground level from RF radiation emitted from antennas located on rooftops, sides of structures, or towers. According to the American Cancer Society, "very few human studies have focused specifically on cellular phone towers and cancer risk." At this time, no available research has focused on occupational exposures to RF radiation among construction workers.

There are, however, several organizations that address the potential health effects of RF radiation, including:

- Occupational Safety and Health Administration (OSHA)
- Federal Communications Commission (FCC)
- World Health Organization – International Agency for Research on Cancer (WHO/IARC)
- Centers for Disease Control and Prevention (CDC)

While these organizations note that non-thermal health effects have not been fully explored, they have (individually or collectively) identified potential thermal and non-thermal effects, including:

- Thermal effects:
 - Blindness
 - Sterility
 - Heating of tissues – eyes and testes are particularly vulnerable
 - Burns
 - Electrical shocks
- Non-thermal effects including: alteration of body's circadian rhythms, immune system, and nature of the electrical and chemical signals communicated through the cell membrane
- *Possibly* carcinogenic to humans (Group 2B)
- Potential for other disorders
- Interference with medical devices such as pacemakers

3.1 Health Effects According to OSHA

According to OSHA: “At sufficiently high power densities, [RF radiation] can cause thermal effects that can cause blindness and sterility... [And] Non-thermal effects, such as alteration of the human body's circadian rhythms, immune system and the nature of the electrical and chemical signals communicated through the cell membrane have been demonstrated.”⁶

In its 2015 Request for Information on Communication Tower Safety, OSHA stated that: “General health effects reviews have found that high levels of exposure to radio frequencies may result in burns... [and] the link between exposure to radio frequencies and cancer, reproductive diseases, and neurological effects has not been thoroughly explored.”

3.2 Health Effects According to the Federal Communications Commission (FCC)

The FCC, which has regulatory authority over the telecommunications industry, relies on other agencies and organizations for guidance on health and safety. However, it acknowledges in its guidelines the potentially harmful thermal effects of RF radiation, noting that:

“[E]xposure to very high levels of RF radiation can be harmful due to the ability of RF energy to heat biological tissue rapidly [and]... two areas of the body, the eyes and the testes, are particularly vulnerable to RF heating.”

“When cellular and PCS antennas are mounted on rooftops, RF emissions could exceed higher than desirable guideline levels on the rooftop itself, even though rooftop antennas usually operate at lower power levels than free-standing power antennas. Such levels might become an issue for maintenance or other personnel working on the rooftop.”

The FCC also notes that pacemakers and other medical devices “could be susceptible to electromagnetic signals that could cause them to malfunction.” As such, individuals with pacemakers are encouraged to check with their doctor before performing work in areas where there is the potential to be exposed to RF radiation.

Sources:

- *FCC Policy on Human Exposure to Radiofrequency Electromagnetic Fields*, accessed April 28, 2016. <https://www.fcc.gov/general/radio-frequency-safety-0>
- *RF Safety FAQ*, accessed April 28, 2016. <https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety>
- *PPE and other Controls to Prevent RF Burns and Shock Hazards during Construction near an AM Radio Broadcast Antenna*, accessed April 28, 2016. <https://www.aiha.org/aihce07/handouts/rt214lamson.pdf>

⁶ *The Safety and Health Topics section of OSHA's website on radiofrequency and microwave radiation*, accessed April 28, 2016. https://www.osha.gov/dts/hib/hib_data/hib19900905.html

3.3 Health Effects According to the World Health Organization (WHO) – International Agency for Research on Cancer (IARC)

The World Health Organization’s International Agency for the Research on Cancer (IARC) has also been studying the potential health effects of exposure to RF radiation. The possible IARC classifications are listed in Figure 3-A. In 2011, IARC classified radiofrequency electromagnetic fields as Group 2B “possibly carcinogenic to humans based on an increased risk for glioma, a malignant type of brain cancer associated with wireless phone use.”

Figure 3-A

Group 1	Carcinogenic to humans
Group 2A	Probably carcinogenic to humans
Group 2B	Possibly carcinogenic to humans
Group 3	Not classifiable
Group 4	Probably not carcinogenic to humans

The Chairman of the IARC Working Group noted that while they are still accumulating evidence, the existing evidence “is strong enough to support” the 2B classification and the conclusion:

“...that there could be some risk, and therefore we need to keep a close watch for a link between cell phones and cancer risk... Given the potential consequences for public health of this classification and findings... it is important that additional research be conducted into the long-term, heavy use of mobile phones... Pending the availability of such information, it is important to take pragmatic steps...”

The IARC 2B decision, though largely based on studies of cell phone users, reportedly applies to all RF exposures regardless of the source.

A more recent study released in 2014, “Occupational Exposure to Extremely Low-Frequency Magnetic Fields and Brain Tumor Risks in the INTEROCC Study,” focused on ELF, which is another form of non-ionizing radiation. This study found a “positive association between ELF in the recent past and glioma.” As noted earlier, according to the CDC, “RF radiation is much higher frequency than ELF radiation and therefore potentially more harmful.”

As more research and studies are done, the IARC classification of a substance can change. For more information, visit: <http://monographs.iarc.fr/ENG/Classification/>.

Source: *Electromagnetic Fields (EMFs), Extremely Low-Frequency (ELF) and Radiofrequency (RF): What are the Health Impacts?*, accessed April 28, 2016.
<http://www.globalresearch.ca/electromagnetic-fields-emf-extremely-low-frequencies-elf-and-radio-frequencies-rf-what-are-the-health-impacts/5335801>

3.4 Symptoms of Overexposure

While there is uncertainty about the long-term health effects of exposure to RF, there is consensus around the thermal effects. Thermal effects occur when the body cannot deal with the heat buildup caused by the RF radiation quickly enough. This buildup is dependent on the frequency and intensity of the RF radiation fields as well as the length of time the worker is exposed and how close he or she is working from the source. Symptoms of overexposures include, but are not limited to:

- Labored breathing
- Perspiring – immediate sensation of intense heating of the parts of the body exposed
- Pain
- Headache
- Numbness
- Paresthesia – a tingling or numbness, skin crawling, or itching
- Malaise or an overall sense of feeling mentally or physically unwell
- Diarrhea
- Skin erythema – a reddening of the skin due to inflammation

In addition to these symptoms, workers who come in direct contact with an antenna may suffer severe burns since active RF antennas are energized (or *hot*). The resulting burns can be deep and may be worse than they appear. Any construction worker experiencing these symptoms should move to a new location immediately, and if the symptoms persist, see a doctor.

Sources:

- *City of Philadelphia, Safety Program Templates - Radio Frequency– September 2008, accessed May 3, 2016. <http://www.phila.gov/finance/units-riskmanagementtemplates.html> [available online as a document].*
- *Erythema Frequently Asked Questions, accessed April 28, 2016. https://rpop.iaea.org/RPOP/RPoP/Content/InformationFor/HealthProfessionals/5_InterventionalCardiology/erythema.htm*

4. At Risk Workers

The proliferation of cellular antennas and other RF-generating devices in areas where construction and maintenance work is regularly performed creates the potential for construction and maintenance workers to be exposed to harmful levels of RF radiation. At risk workers include:

- Roofers
- HVAC technicians
- Electricians
- Masons

- Painters
- Carpenters
- Laborers
- Maintenance staff
- Those who work in or around mobile news trucks or transmitting cameras
- Anyone who works on rooftops, sides of buildings, and other locations where RF generating antennas are located⁷

Given the potential risk for early symptoms (e.g., overheating) to be written off to weather conditions, the strenuous nature of the work, or an unrelated health issue such as the flu, as well as the unknowns about the long-term health effects of exposure to RF radiation, it is important to take steps to identify sources and avoid or address potentially hazardous situations.

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

⁷ Please note: Information on potential exposures from solar panels will be added as more is known.

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

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 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.

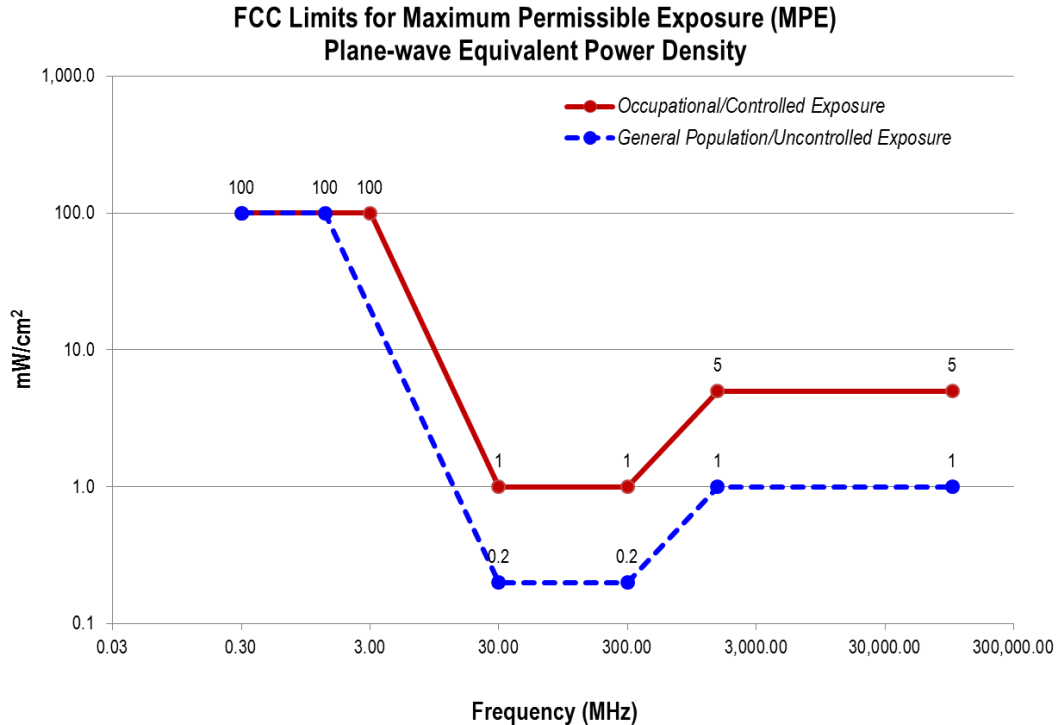
Source: FCC – OET Bulletin 65 Edition 97-01 page 55, accessed April 28, 2016.

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.

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

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 *[updated]*

OSHA is the regulatory body for workplace safety and health standards. Its nonionizing radiation standards -- 1926, Subpart D, [1926.54](#) and [1910.97](#), include an exposure limit of (10mW/cm²). The limit in the general industry standard 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.”

OSHA may also 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 [updated April 2017].*
<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 website for Boston University Research Compliance Environmental Health & Safety. The page title is "Radio Frequency (RF) Safety". A prominent note states: "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." The page includes an "RF Program Overview" section, a diagram of an "RF" Emission Signage, and a sidebar with navigation links such as "EMERGENCY COMMUNICATIONS", "CONTACT", "FAQ'S", "CULTURE OF SAFETY", "PLANS", "SERVICES", and "TOOLKITS".

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>

6. Hazard Identification for RF Radiation

Regulations, guidelines, and programs are intended to prevent workers and the public from exposure to hazardous levels of RF radiation, but they are only protective if employers and their employees are able to identify whether or not a hazard is present. The two main challenges facing construction employers are:

- Identifying the presence of RF generating devices in the areas where work needs to be performed; and

- Once identified, determine if the FCC’s exposure limits are being exceeded and what steps to take to protect their employees.

As shown in Figure 6-A, antennas that generate RF radiation come in different shapes and sizes, and emit RF radiation in different directions. Some may even be concealed, which only creates additional challenges.

Figure 6-A



The following sections describe several steps that construction employers can take to identify the presence of RF generating devices.

6.1 Check with the Building Owner

One step that construction employers can take is to ask the building owner or site manager if antennas or other RF generating devices are present. Although site owners and managers are not responsible for site compliance with the FCC’s human exposure guidelines regulations (the antenna owner is responsible), they should know whether telecommunications equipment is present, the contact information for the owner of each device, and if and where signs are posted.

As noted in Section 5.1, the FCC requires telecommunications providers – the licensees or owners of the equipment – to conduct radiofrequency (RF) emission studies to ensure that their sites do not present a health risk. This compliance study and report is supposed to be

maintained on site, and should contain information on the hazardous areas and contact information for the antenna owner or their designee.

Boston University, for example, maintains a [publicly accessible online list](#) that includes the location of RF devices (address & campus) and the type and quantity of required sign(s). (Figure 6-B) For example, the antenna located at 840 Harrison Ave. requires one warning sign and two caution signs. The website also includes whom to contact for more specific information about the antennas.

Figure 6-B

Current RF Signage Postings

<i>Address</i>	<i>Campus</i>	<i>Sign Required</i>	<i>Qty.</i>	<i>Sign Required #2</i>	<i>Qty. #2</i>
840 Harrison Ave.	BUMC	Warning	1	Caution	2
72. E Concord	BUMC	Notice	1		
750 Albany St	BUMC	Warning	1		
855 Comm. Ave.	CRC	Caution	1		
765 Commonwealth Ave.	CRC	Warning	1	Caution	2
725 Commonwealth Ave	CRC	Caution	1	Notice	2
675 Commonwealth Ave	CRC	Caution	1	Notice	1
44 Cummington St.	CRC	Notice	1		
700 Commonwealth Ave.	CRC	Warning	1	Notice	3
110 Cummington	CRC	Caution	1		
881 Comm. Ave	CRC	Notice	1		
33 Harry Agganis Way	CRC	Notice	1		
512 Beacon St.	CRC	Notice	1		

*Last updated 06/17/2015

Sources: *RF Compliance Studies, accessed April 28, 2016.*

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

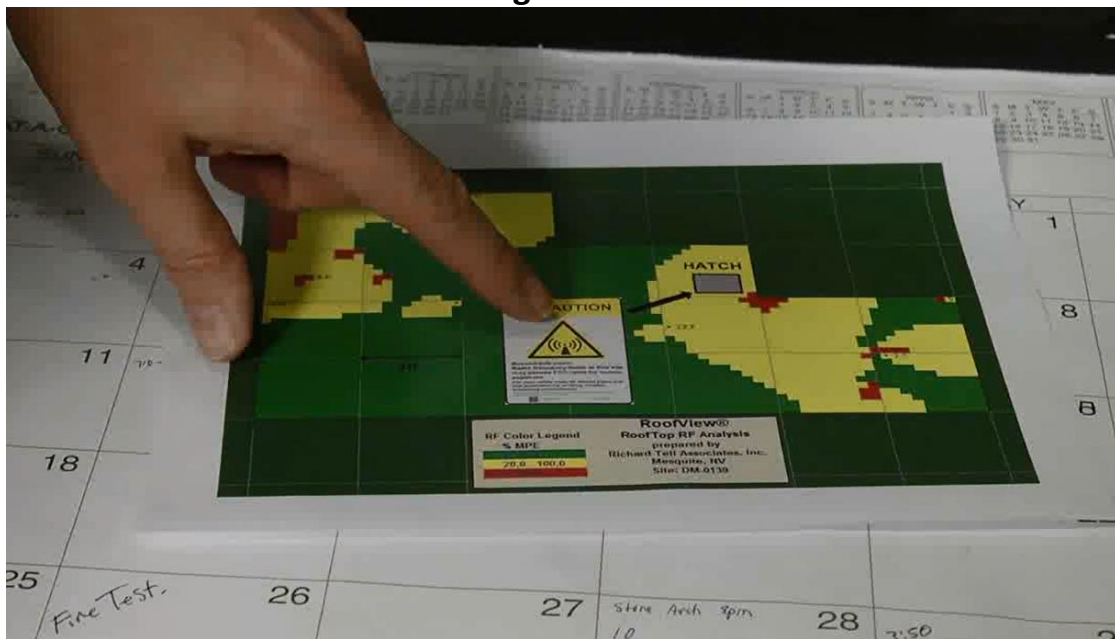
Boston University – Current RF Signage Postings, accessed April, 2016.

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

6.2 Surveys and Plot Plans

The FCC requires RF radiation surveys for registered antennas. Ideally, the building owner, property manager, or antenna owner will have a copy of the survey. These surveys show the location of the antenna, the exposure levels around the antenna, and the location of signs. (Figure 6-C)

Figure 6-C

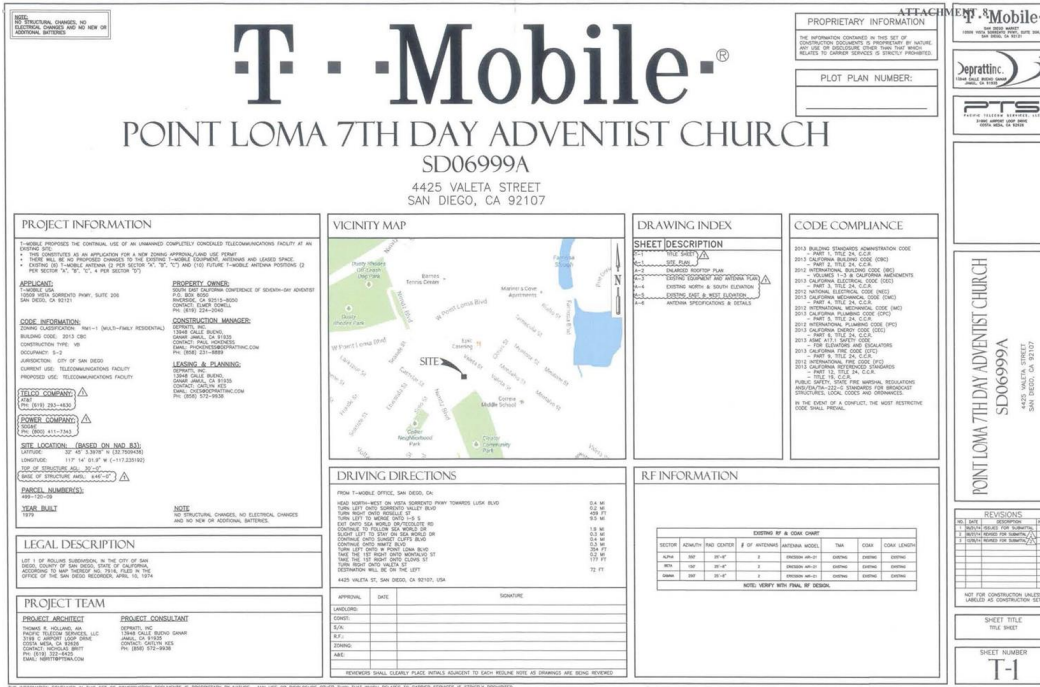


Source: Video – Safe Transmission: RF Awareness for the Construction Industry

Plot plans are another source for details on the placement of the antennas. These plans are often included in applications for permits from a local government and may be provided to the building owner/property manager. The following is an example of a plot plan posted online as part of a permit application in San Diego. (Figure 6-D & 6E) It includes an overview of the project – a proposal to add 10 additional antennas to a church that already contains 6 antennas, the aerial site plan, enlarged rooftop plan, antenna and equipment plan, sides views (north, south, east, west), and the antenna specifications.

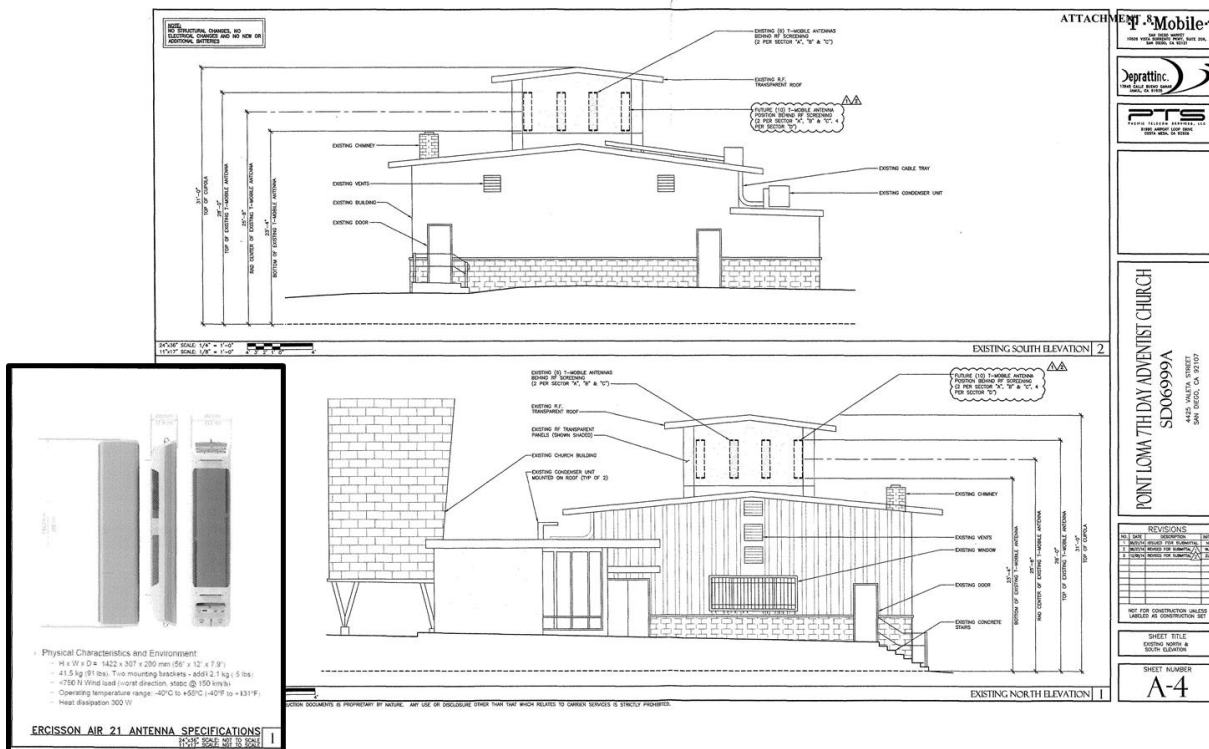
Source: This example comes from a permit application in San Diego. To see the complete plot plan and other application materials, including location maps, photo survey, planning board minutes, and the conditional use permit, visit: <https://www.sandiego.gov/sites/default/files/legacy/development-services/pdf/hearingofficer/reports/2015/HO-15-021.pdf>

Figure 6-D



The image in Figure 6-E shows the north and south elevation of the site. The detailed drawing shows where existing antennas currently are on the church and where the proposed antennas would be added.

Figure 6-E



6.3 Signage

Signs and barriers should be visible to prevent individuals from unknowingly entering areas where exposures could exceed permissible exposure limits. The FCC's guidance document allows antenna owners to restrict or control access to potentially hazardous areas by using fences and warning signs, as long as the signs are prominent and provide information on the potential risk for exposure and instructions on methods to minimize the exposure risk.

The ANSI C95.2-1966 sign format is included in several state documents on RF radiation, including California, Oregon, and Arizona, and in OSHA's general industry standard on non-ionizing radiation – 1910.97(a)(3)(iii). The FCC also currently recommends the ANSI C95.2-1966 format as described in "Radiofrequency Radiation Hazard Warning Symbol;" however, a newer format, included in the FCC's proposed rules, has become more common place. As of May 2016, the FCC's proposed rules (Dockets 13-84 & 03-167) recommend signs that, in accordance with the IEEE Std. C95.7-2005, include:

- The signal work and color (e.g., NOTICE – Blue; Caution -- Yellow)
- RF energy advisory symbol
- Explanation (e.g., Radio frequency fields beyond this point may exceed the FCC general public exposure limit...)
- Behavior necessary to comply (e.g., Obey all posted signs...)
- Whom to contact and the contact information for the device, if for example, it needs to be moved or powered down

The signs should be mounted in places that are visible and demarcate areas of limited or no accessibility based on exposure levels. Areas that exceed human limits should also have a permanent barrier – a plastic chain does not qualify according to ANSI Z244. The IEEE Standard C95-7 contains guidance on where to place signs.

The following are examples of signs used to alert construction workers and the public of RF radiation hazards (Figure 6-F), and examples of what these signs may look like in practice and the kind of information provided on them (Figure 6-G).

- The blue "Notice" signs state that the fields beyond that point may exceed the FCC's general public maximum permissible exposure limit.
- The yellow "Caution" sign states that the area beyond that point may exceed the FCC's occupational maximum permissible exposure limit.
- The Warning sign indicates that any point beyond the sign exceeds the FCC's **human** exposure limits – 10x the occupational exposure limit.

Figure 6-F



Source: FourSeasons/123rf.com

Figure 6-G

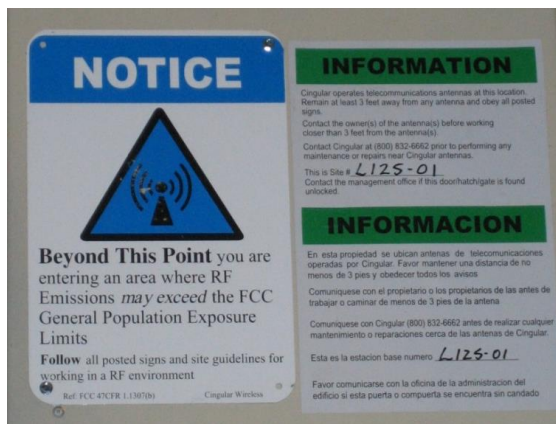


Image Source: Robert Cooper/Wikimedia Commons/CC-BY-2.0



Image Source: Image courtesy of OSHA Presentation "Non-Ionizing Radiation: standards and Regulations," slide 132, Oct. 2002



Image Source: Marc Smith/Wikimedia Commons/CC-BY-2.0

Unfortunately, signs are not always prominently posted or posted at all. Although this is a violation of the FCC requirements, as well as many state, local, and owner requirements, these situations do exist.

Sources:

- Radio-Frequency Radiation Hazard Warning Symbol, accessed April 28, 2016. https://www.osha.gov/OshStd_gif/10qfg_11.gif
- FCC ET Docket No. 13-84 and No. 03-137. First Report and Order, Further Notice of Proposed Rulemaking and Notice of Inquiry 13-39A, March 2013. <https://www.fcc.gov/document/fcc-review-rf-exposure-policies>
- IEEE C95.7™-2014: Recommended Practice for Radio Frequency Safety Programs - 3 kHz to 300 GHz, accessed April 28, 2016. <http://standards.ieee.org/news/swire/sep14.html#std5>

6.4 Conduct a Visual Inspection

At a minimum, employers should do a visual pre-task inspection of the work area to try and determine if an RF hazard exists.

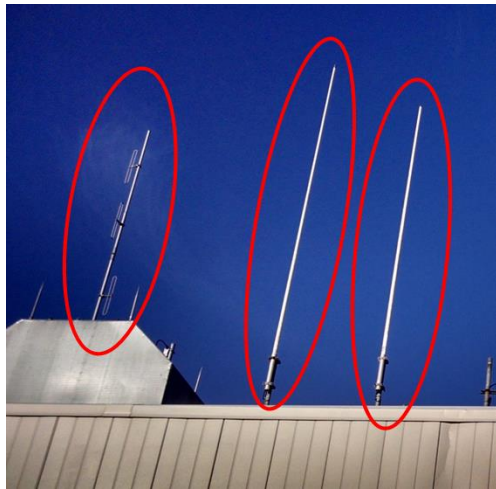
The challenge for construction employers and their employees is that it is not always easy to identify RF generating devices or the hazardous areas because these devices come in different shapes and sizes, and emit RF radiation in different directions. The three types of most concern include:

- Cylindrical or rod-shaped antennas,
- Rectangular panel, dish-shaped, and microwave antennas, and
- Hidden antennas, sometimes referred to as “stealth” antennas.

The following are examples of RF generating devices that construction employers and their employees may encounter:

Cylindrical or Rod-shaped Antennas:

Emit RF radiation in more than one direction up to 360 degrees making it difficult to avoid the RF field.



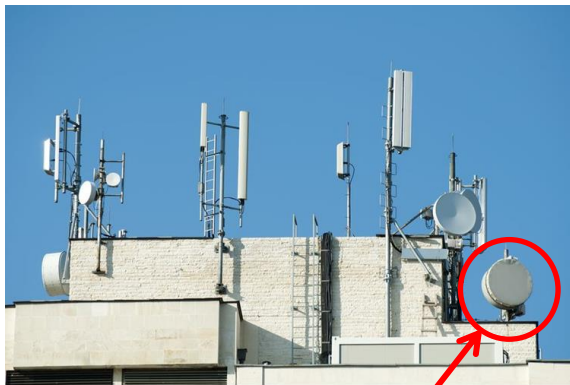
Rectangular Panel Antennas, Dish-shaped, and Microwave Antennas:

Send out RF radiation in one direction. These antennas send out RF radiation in one direction. If the antenna is not facing you or your work area, you are not being exposed. It is important not to confuse dish-shaped transmitting antennas with dish-shaped television receiving antennas, which do not generate RF radiation.

Drum-shaped microwave antennas, like the one circled on the slide, are particularly dangerous and should be avoided. They also emit RF radiation in a single direction out from the face of the antenna, but the RF emitted is much more potent than RF from cellular, satellite, and cylindrical rod antennas.



Anton Petrov/Wikimedia Commons/public domain



deyangeorgiev/123rf.com

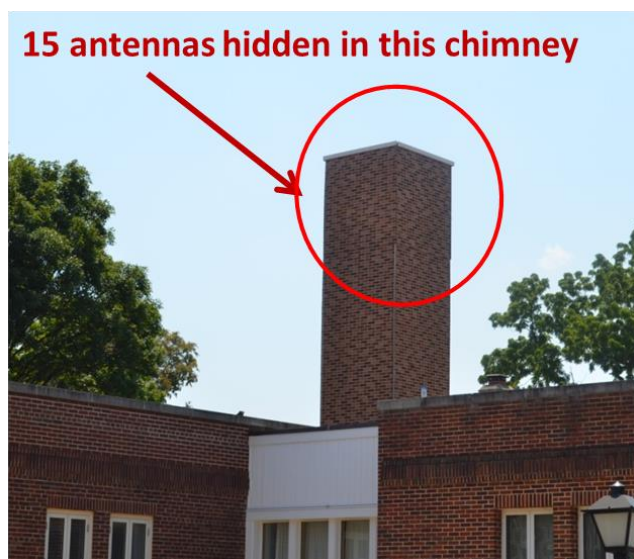
Microwave dish-shaped transmitting antenna

Hidden or "Stealth" Antennas:

Stealth" or hidden antennas are the most difficult to identify because they are designed to blend into their surroundings for aesthetic reasons. These types of antenna can be hidden behind fences, stand-alone fixtures, such as a flag pole or fake tree, a panel that blends into the side of a building, rooftop, sign, or even built on to the top of a chimney. This chimney, which is located on a church, conceals 15 panel antennas. Because these antennas are hard to identify, it is also very difficult to determine the RF radiation emitting direction. These antennas could be cylindrical, panel, or dish-shaped.



Steve Kazella/Wikimedia Commons/CC-BY-3.0



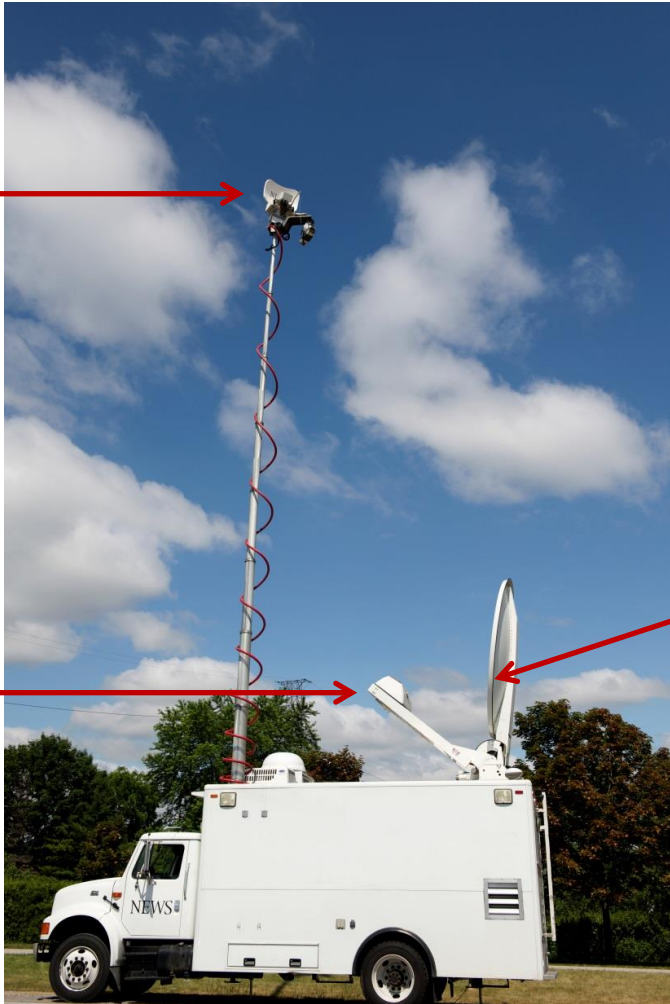
Antennas on Electronic News Gathering Trucks (ENG) & Satellite News Gathering (SNG) Trucks:

ENG and SNG trucks are equipped with antennas that give off RF radiation.

The antennas on the mast of the trucks do not present a hazard unless pointed downward or lower than 8 feet above ground level. The Main Antenna gives off RF radiation in one direction out from the dish and the feed horn gives off extremely high levels.

The area between the main beam and the feed horn is the most hazardous and workers should never be up on the truck when these are energized.

Mast with antenna



Feed Horn: High RF Radiation Fields

Main Antenna Beam: RF Radiation present

Transmitting Cameras:

Cameras used for broadcasting are equipped with transmitting antennas. These transmitters often operate through Ethernet, Wi-Fi, or cellular (through a SIM card).



Photo courtesy of the International Brotherhood of Electrical Workers

These connections fall under the IEEE standard 802[®] Standard for Local and Metropolitan Area Networks. They emit RF similar to cellular phones, and as such must comply with the FCC's specific absorption rate or SAR. SAR is a "measure of the amount of radio frequency energy absorbed by the body."

The equipment should indicate that it is in compliance with the FCC's SAR safety standards. For example:

- *The LiveU website states that "All LiveU products have been thoroughly tested and certified by leading FCC and CE approved labs for SAR and other safety considerations."* <http://www.liveu.tv/general-content/technology>
- *And the Dejero website states that it is "Committed to safety: FCC/IC/CE certified and thoroughly tested in accordance with RF exposure requirements (SAR)."* http://www.dejero.com/assets/files/documents/D-PB114-004_EnGo.pdf

Sources:

- IEEE Std. 802.11 <http://standards.ieee.org/about/get/802/802.1.html>. (available for free)
- IEEE 802.11[™] Wireless Local Area Networks Working Group <http://www.ieee802.org/11/>
- Foster KR (2007). Radiofrequency Exposure from Wireless LANs utilizing Wi-Fi Technology. Healthy Physics Society, Volume 92 (3): 280-289. <http://www.ncbi.nlm.nih.gov/pubmed/17293700>
- FCC. Specific Absorption Rate (SAR) for Cellular Telephones. <https://www.fcc.gov/general/specific-absorption-rate-sar-cellular-telephones>

6.5 Online Resources to Access Antenna Locations

Employers can also take advantage of other private and public sources to find out if towers and antennas are present. The following are examples of online resources, they types of information they include, and how to use them.

AntennaSearch (<http://antennasearch.com/>) is a free, privately maintained online resource. It is easy to use and provides key information on antennas and towers, including the location, the owner, and related contact information. The database covers the entire U.S., can be searched by a specific address, and generates maps showing the location of all existing and planned antennas and towers for the address searched and the surrounding area. The site also generates downloadable spreadsheets that include detailed records for each antenna and tower, including: the street address, licensee or owner of the antenna or tower, the contact person's name and phone number and/or email. The spreadsheet also includes the service type such as mobile-commercial, meaning it is a cellular antenna, the call sign, which is the FCC identifier, and details about the location and frequencies of the devices.

Since this website relies on data collected by the FCC and other public sources, it may not include every antenna or tower, and may not include devices that have recently been moved or replaced. Despite this limitation, it can be a very useful resource when trying to determine if RF generating devices are present or in close proximity to where work will be performed.

The home page (Figure 6-H – retrieved 12/2015) shows the last time the information on the site was updated and is the starting point for finding out if antennas are present. **Step 1) Search** - Enter the street, city, and state (house number and zip code are optional) on the main search page. The site searches within 4 miles of address entered, unless it is a densely populated area. For the example below, the radius was reduced to 1 mile.

Figure 6-H

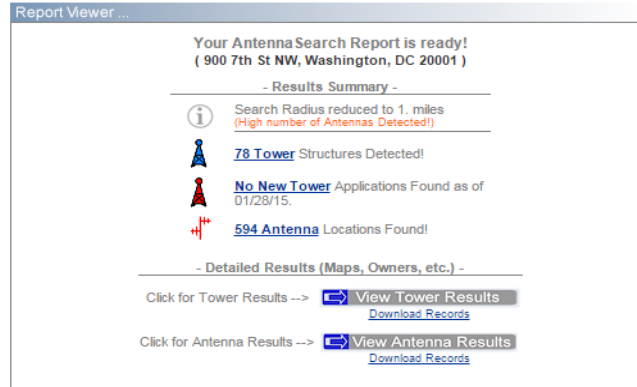
The screenshot shows the AntennaSearch.com website interface. At the top, it says "Welcome to AntennaSearch.com!" and "Your Free online source for ...". Below this are three bullet points: "Detailed information on over 1.9 Million Towers and Antennas in the US", "Includes Google Maps, Ownership Details, Contact Information and more ...", and "Pinpoint Existing Towers, Future Towers and even small, hidden antennas to determine Cell Phone coverage". A map shows the location of Silver Spring, Maryland, with markers for "Existing Tower" and "Future Tower". Below the map is a search form with fields for "Street Address" (862 Wayne Avenue), "City" (Silver Spring), "State" (Maryland), and "Zip (Optional)" (20910). A "GO" button is next to the zip field. Below the search form, it says "All Locations of Cell Phone Towers (Existing and Future) and Antennas within 4.0 miles of your address will be returned - (Database Last updated on: 12/20/2015 - 2,396,381 Towers and Antennas Online!)". Below this is a "Quick Statistics" section with a table:

	Total US	Top State
Towers	593,168	Texas (58,023)
Antennas	1,803,213	California (133,174)

Below the table, it says "(884 Towers and 1,850 Antennas added on 12/20/15 update)". Below the statistics is a "Cell detailed info on" section with three items: "Existing Towers: Registered and Non-Registered structures where antennas are placed. Towers may be used for various services including Cellular, Paging, Microwave and others.", "Future Towers: Newly filed (or pending) applications to construct new towers. Application info includes location coordinates and detailed ownership data.", and "Antennas: The actual emitters of radio signals. Antennas can be placed on towers (multiple) or can be installed stand alone on top of existing buildings. Stand alone antennas are small (well below 200 ft). You may also check multiple antennas to determine which cell phone carriers are located on a particular tower." To the right of this section is a "Use it for" section with three items: "Cell Reception: Even if you have the best cell phone on the market, poor carrier coverage can render it useless. Before you sign up for service, find out whether your cell phone carrier (Cingular, T-Mobile, Verizon, etc.) has good or poor coverage in a given area.", "Research and Planning: Whether you are doing private or commercial research, being able to quickly and easily map tower and antenna locations can be invaluable. Use AntennaSearch to explore tower densities, antenna co-location and much more...", and "Other Uses?: Your imagination is the limit! Feel free to explore and generate as many reports as you need! If you have any questions or special needs simply write us!". At the bottom of the page, there are links for "Home", "FAQs", "Contact", and "Press/News", and a copyright notice: "© 2004-2009 by General Data Resources, Inc."

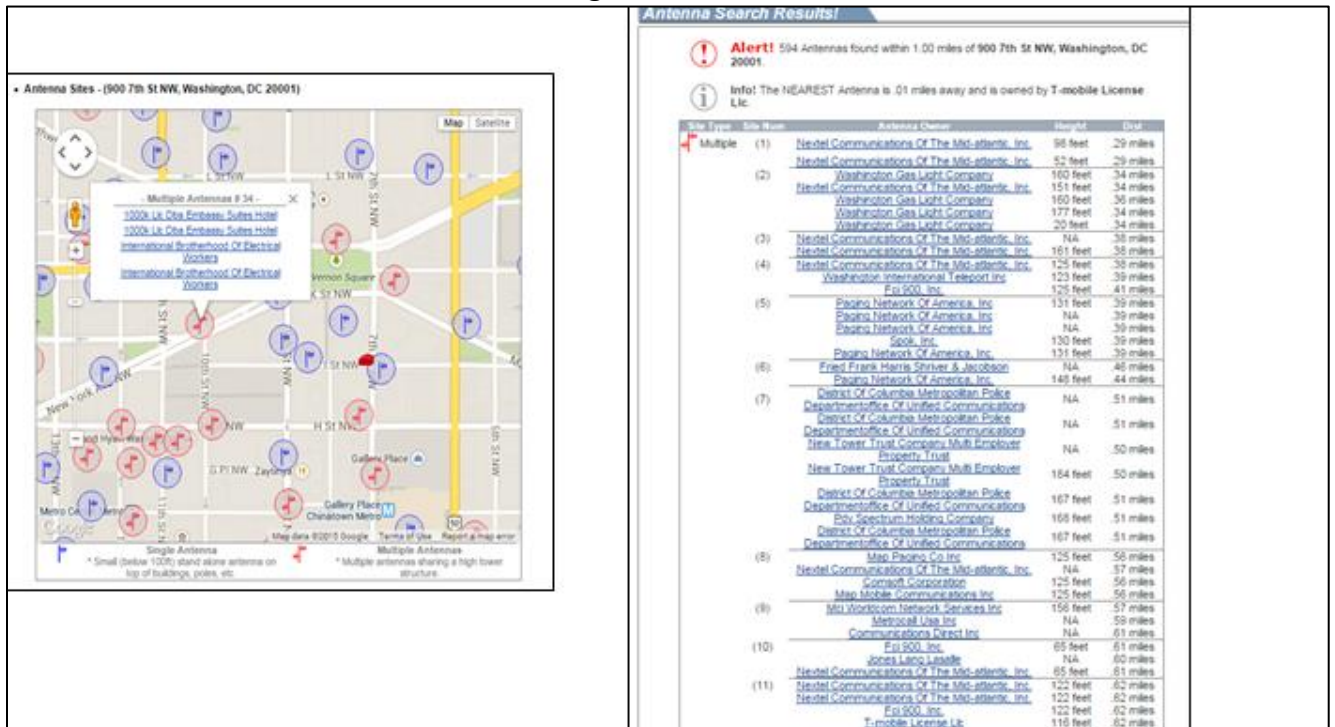
Step 2) Retrieve Results - The results page includes the search radius, the number of towers, and the number of antennas. (Figure 6-I) You can view or download the results for towers or antennas. Each tower could have multiple antennas.

Figure 6-I



Step 3) Map View – Clicking on “view antenna results” or “view tower results” opens a map. You can click any of the sites on the map; red sites have multiple antennas, the blue sites only have one. You can also scroll through the list of antenna owners below the map, which are grouped by site and described by antenna-owner (licensee), overall height, and distance from address. The example below (Figure 6-J) shows the resulting “View Antenna Results” page.


Figure 6-J



Step 4) Get Details – You can find more details by using your cursor to hover over an antenna on the map and click on a location, or click on an antenna owner listed below the map. (Figure 6-K) The results page includes a street view map of the location and tables of information.

Figure 6-K

Antenna Detail - Site (35) ; Item [1]



A →

Ownership Info			
Licensee Contact:	Company:	Federal License Management	Address: 1784 E. 3rd Street Suite 269 Williamsport, PA, 177013862
	Contact:	Eric Z. Wolfe	
	Phone:	(570)505-3884	
	Email:	support@federal-license.com	
Licensee Contact:	Company:	International Brotherhood of Electrical Workers	Attn: Jason Reidenbach - Chief Engineer Address: 900 7th Street NW Washington, DC, 20001
	Contact:	Not Recorded	
	Phone:	(202)430-9495	
	Email:	none	

B →

Transmitter Characteristics			
Service Type:	Mobile-Private	Ground Elev:	190.3 feet
Call Sign:	WOCU741	Height Of Structure:	590.6 feet
Latitude:	38.9014	Overall Height:	600.4 feet
Longitude:	-77.0260	Structure Address:	900 7th Street NW Washington, DC
Structure Type:	NA		
Status:	Unknown		
Date Constructed:	NA		

C →

Transmitter Frequencies					
Emmitter	Class	Freq(Num)	Freq(Mhz)	Power(Output)	Power(Radiated)
1	FB2	1	463.6	25w	40w

- A. The first section provides **ownership information**: the licensee contact is the point of contact for the license, and the licensee is the company that owns the antenna.
- B. The second section provides **transmitter (antenna) characteristics**, including: the FCC call sign; latitude, longitude, and street address; structure type; height of structure; and service type.
- C. The last section includes information on **transmitter frequencies**: the number of emitters, the station class (refers to type of antenna), the frequency of each emitter (in MHz), actual power (output), and effective radiated power (ERP).

Step 5) Download Results – From the initial search results, you can also download the antenna results as a .csv/excel file. The spreadsheet contains all the information provided when you view each antenna, except for the power values and the map (Figure 6-L – partial view of spreadsheet). The antennas are listed by site.

Figure 6-L

	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	
1	latitude	longitude	call_sign	location_i	location_c	location_l	location_o	ground_height	overall_height	structure	licensee_i	licensee	licensee_last	licensee	licensee_fax	licensee_i	licensee	licensee_i	licensee	licensee_i	licensee	
140	38.89789	-77.0194	WQJL857		Washington	Washington	DC			NA	Washington Metro Area Transit Pol		2.02E+09						600 5th St	Washington	DC	20001
141	38.89789	-77.0197	WNEO878	600 5TH ST	WASHINGTON		DC	11.6	147.973	147.9731	NA	WASHINGTON METROPOLITAN AREA TRANSIT		AUTHORITY					600 5TH ST	WASHINGTON	DC	20001
142	38.89789	-77.0194	WQJX861		WASHINGTON	Washington	DC				NA	WASHINGTON METRO AREA TRANS		2.02E+09					600 5TH ST	WASHINGTON	DC	20001
143	38.89789	-77.0194	WRL863	600 5TH ST	WASHINGTON		DC	12	111.554		NA	WASHINGTON METROPOLITAN ARE		2.03E+09					600 5TH ST	WASHINGTON	DC	20001
144	38.89789	-77.0194	KGG518	600 5TH ST	WASHINGTON		DC	12	111.554	111.554	NA	WASHINGTON METROPOLITAN ARE		2.03E+09					600 5TH ST	WASHINGTON	DC	20001
145	38.89789	-77.0191	WII987	9TH G ST	WASHINGTON		DC	11			NA	WASHINGTON METROPOLITAN ARE		2.03E+09					600 5TH ST	WASHINGTON	DC	20001
146	38.89789	-77.0191	KSL841		WASHINGTON	Washington	DC	0			NA	Washington Metro Area Transit Au		2.03E+09	2029622985				600 5th St	Washington	DC	20001
147	38.89789	-77.0194	WPQE751	600 FIFTH	WASHINGTON		DC	12	131.24	150.926	Building	WASHINGTON METROPOLITAN ARE		2.03E+09	2029625299	agnat			600 5TH ST	WASHINGTON	DC	20001
148	38.89728	-77.0203	WPZU699	601 F ST N	WASHINGTON	Washington	DC	14	139.771	139.7706	Building	Washington Sports Entertainment		2.03E+09					MCI Cente	Washington	DC	20004
149	38.89733	-77.02	WPLX742	601 F ST	WASHINGTON		DC	14	88.587	88.587	Building	WASHINGTON SPORTS ENTERTAIN		2.03E+09	2026615219				601 F ST N	WASHINGTON	DC	20002
150	38.89983	-77.0258	WPPH824		Washington	Washington	DC				NA	HYATT CORPORATION DBA GRAND		2.03E+09	2026374959				1000 H ST	WASHINGTON	DC	20001
151	38.89983	-77.0258	WPPH824	1000 H ST	WASHINGTON	Washington	DC	15	196.86	196.86	Building	HYATT CORPORATION DBA GRAND		2.03E+09	2026374959				1000 H ST	WASHINGTON	DC	20001
152	38.89983	-77.0258	WNHM92	1000 H ST	WASHINGTON		DC	15			NA	HYATT CORPORATION DBA GRAND		3.13E+09					1000 H ST	WASHINGTON	DC	20001
153	38.90158	-77.0261	WQGU798	900 10TH	WASHINGTON	Washington	DC	17	131.24	131.24	Building	1000K LLC DBA EMBASSY SUITES HO		2.03E+09					900 10TH	WASHINGTON	DC	20001
154	38.90158	-77.0261	WQGU798		WASHINGTON	Washington	DC				NA	1000K LLC DBA EMBASSY SUITES HO		2.03E+09					900 10TH	WASHINGTON	DC	20001
155	38.90144	-77.026	WQCU741		Washington	Washington	DC				NA	International Brotherhood of Elect		2.02E+09	2022895871	none			900 7th St	Washington	DC	20001
156	38.90144	-77.026	WQCU741	900 7th St	Washington	Washington	DC	58	590.58	600.423	NA	International Brotherhood of Elect		2.02E+09	2022895871	none			900 7th St	Washington	DC	20001
157	38.89789	-77.0175	KSL841		BETWEEN	WASHINGTON	DC	0			NA	Washington Metro Area Transit Au		2.03E+09	2029622985				600 5th St	Washington	DC	20001
158	38.89833	-77.0178	WPVX388	600 5th St	Washington	Washington	DC	13	159.785	178.1583	Building	Washington Metropolitan Area Tra		2.03E+09	2022692031	gojoh			600 Fifth S	Washington	DC	20001

The initial results page also allows you to view or download the tower results. The tower results include ownership information, tower characteristics including the FCC registration number or FAA study number, the structure address, height, and history. Because a tower can have multiple antennas with different owners, the frequency and power information is not included in the tower results.

Source: AntennaSearch, accessed December 2015 and April 28, 2016. <http://antennasearch.com/>

The FCC [Universal Licensing System](http://wireless.fcc.gov/uls/index.htm?job=home) (ULS) (<http://wireless.fcc.gov/uls/index.htm?job=home>) is another online resource. The ULS allows antenna owners to submit their applications online and houses key information in a publicly accessible database including the licensee and their contact information, type of antenna, location, frequencies, and power levels. It also has information for many services such as radio and television broadcast stations and communications base stations. It is important to note that because the FCC gives out some of its licenses for an area – not a specific antenna at an exact location – the ULS is not a comprehensive, transmitter-specific database of all of the services the FCC regulates. (Figure 6-M)

This system can be searched a number of ways. The easiest is by using the FCC Call Sign, which is a unique identifier for each antenna and is one of the items found on AntennaSearch.com’s site.

Figure 6-M

Sources: FCC Universal Licensing System, accessed April 28, 2016. <http://wireless.fcc.gov/uls/index.htm?job=home>

The FCC [Antenna Structure Registration \(ASR\)](#) section of the FCC’s site is similar to the ULS, but provides information on the tower structures registered with the FCC. (Figure 6-N) There are three options for finding a tower: registration number, tower coordinates, or tower location. AntennaSearch includes this information on towers, but only those towers registered with the FCC are listed in the ASR.

Figure 6-N

The ASR Registration Search enables you to search for a wide range of licenses in the Antenna Structure Registration system. The "Search for a Registration" enables you to search on basic elements of a registration, including registration number, FAA study number, FRN, and licensee name. The "Search by Location" enables you to look up a registration based on the location and height of a structure. You can also use the advanced search to perform more sophisticated searches based on numerous criteria.

Source: FCC - Antenna Structure Registration Search, accessed April 28, 2016. <http://wireless2.fcc.gov/UlsApp/AsrSearch/asrRegistrationSearch.jsp>

The FAA [Obstruction Evaluation/Airport Airspace Analysis Database](#) provides further information on towers, registered and unregistered, because it performs Obstruction Evaluation/Airport Airspace Analysis studies for structures built or modified to be over 200 feet above ground level or within a certain distance of an airport. (Figure 6-O) The easiest way to search for past studies is with the “Study Number.” Like the FCC’s “Call Sign,” this is a unique identifier. This FAA number can be found on AntennaSearch.com for unregistered towers or from the FCC ASR search results. The search results include the case number, location, and height. Click on the case number to find the structure type, the location, and frequency and power levels.

Figure 6-O

Provides further information on towers including registered and unregistered

The FAA Study Number retrieved from an FCC search is used as an example.

The ASN (FAA Study Number) retrieves the location. Click on “Case Number” to retrieve details.

Case Number	City	State	Latitude	Longitude	Site Elevation	Structure Height	Total Height
1989-ASA-1303-OE	WASHINGTON	DC	38° 53' 38.40" N	77° 01' 00.91" W	40	168	208

Source: Federal Aviation Administration - Search Archived Cases, accessed April 28, 2016.
<https://oeaaa.faa.gov/oeaaa/external/searchAction.jsp?action=showSearchArchivesForm>

For more information on how to search using the FCC and FAA databases, see **Appendix B**.

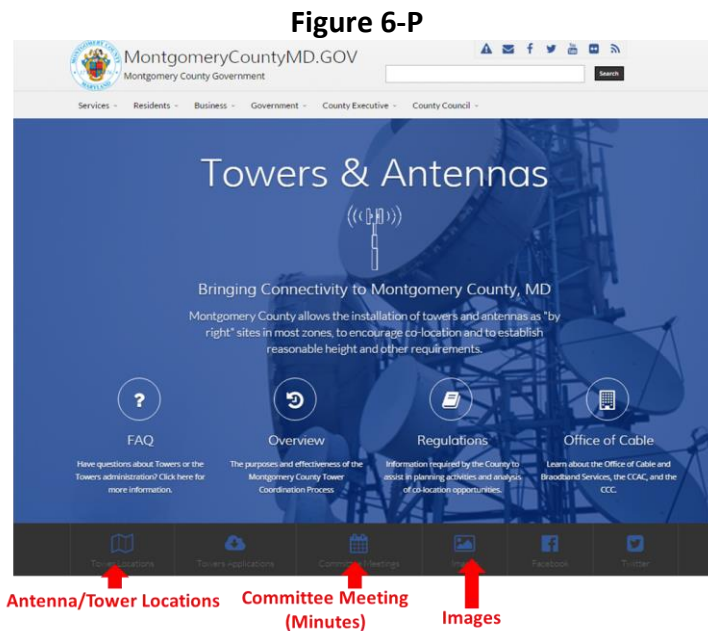
Local Resources to Access Antenna Locations such as state and local departments, agencies and offices that issue building permits, perform inspections, or approve plans may provide information on antennas and towers. These sources may also have information on frequency, power levels, plot plans, photos, or more. The offices can include:

- ❖ Planning & zoning,
- ❖ Permits, Licenses & Inspections
- ❖ Open Data
- ❖ Records
- ❖ Wireless/Telecommunication Facilities, and
- ❖ Building departments.

The information available from these offices or agencies varies from city to city, but usually includes information on the location of the antenna and a point of contact.

The following are two examples of the types of information available from local source.

Montgomery County, MD has a [Transmission Facilities Coordinating Group](#) that makes decisions on tower and antenna applications in the county. Their website, shown here, includes antenna and tower **locations**, access to **minutes** from committee meetings, and **images** of antennas. (Figure 6-P) Clicking on “Tower Locations” in the lower left of the screen downloads an Excel spreadsheet of all applications for antennas and towers since July 1996.




Source: *Montgomery County Government – Towers & Antennas*, accessed April 28, 2016.
<http://www.montgomerycountymd.gov/cable/Towers/home.html>

The spreadsheet includes: the application number, the carrier (the antenna owner), the location description and site name, the address, property owner, and information on application actions.

The example highlighted on the spreadsheet is for a T-Mobile application that was approved to add three 54 inch panel antennas to a 15 foot “faux” chimney at St. Luke Lutheran Church. (Figure 6-Q) The application was approved at the February 9, 2005 committee meeting. Looking up the minutes from the committee meeting on this date provides additional details.

Figure 6-Q

1	A	B	C	D	E	F	G	H	I	J	K			
AppfNo	CarrierName	Description	SiteName	PropertyAddress	PropertyStreet	PropertyCity	Zone	PropertyOwner	Rcvd	Action				
200406-05	T-Mobile	Existing building	Glen Echo Fire Department	5920	Massachusetts Ave	Bethesda	R-60	Glen Echo Fire Department	26-May-04	Recommended				
200406-06	T-Mobile	Existing WSSC tower	WSSC Great Seneca	12800	Great Seneca Hwy	Germantown	RDT	WSSC	26-May-04	Recommended				
200406-07	Montgomery County	Existing building	Wheaton Metro Station		Georgia Ave & Prichard Rd	Wheaton	CB-D-3	Montgomery County	27-May-04	Recommended				
200407-01	T-Mobile	Existing building	MEP Building	15800	Crabbs Branch Way	Rockville	C-O	MEP I & II LLC	01-Jun-04	Recommended				
200407-02	T-Mobile	Existing building	Hampshire West Apts	1415	Hampshire West Ct	Silver Spring	R-20	Southern Mgmt	07-Jun-04	Recommended				
200407-03	T-Mobile	Existing building	St. Luke Lutheran Church	9100	Colesville Rd	Silver Spring	R-60	St. Luke Lutheran Church	21-Jun-04	Recommended				
200407-04	Sprint PCS	Existing transmission tower	PEPCO #102-S	8700	Snouffer School Rd (block of)	Gaithersburg	R-200	PEPCO	21-Jun-04	Recommended				
200407-05	T-Mobile	New 143' monopole	Blake High School	500	Nassau Rd	Chesapeake	RE-3C	MCBS	22-Jun-04	Recommended				
200407-06	T-Mobile	New 100' monopole	Farland Elem. School	14315										
200407-07	T-Mobile	Existing transmission tower	PEPCO #011-N	13139-T										
200407-08	T-Mobile	Existing Sprint monopole	Sherwood High School	300					16-Jun-04	39.96227778	-77.12083333	38°57'46.00"	77°7'15.00"	Bldg
200407-09	T-Mobile	Existing Sprint monopole	Tiden Middle School	11211					16-Jun-04	39.141972	-77.274361	39°8'31.10"	77°16'27.70"	Tower
200407-10	T-Mobile	Existing Sprint monopole	Goshen Church monopole	7700					16-Jun-04	39.038533	-77.049772	39°2'11.52"	77°2'59.18"	Bldg
200409-01	Comcast Wireless	Existing T-Mobile	Wheaton High School	12501					14-Jul-04	39.11416667	-77.15805556	39°8'51.00"	77°9'29.00"	Bldg
									14-Jul-04	39.00833333	-76.98361111	39°0'30.00"	76°59'01.00"	Bldg
									09-Feb-05	39.005	-77.02361111	39°0'18.00"	77°1'25.00"	Bldg
									14-Jul-04	39.185364	-77.182392	39°11'07.31"	77°10'56.61"	Tower
									14-Jul-04	39.1194444	-77.01888889	39°6'43.00"	77°1'08.00"	Monopole
									14-Jul-04	39.08972222	-76.95722222	39°5'23.00"	76°57'26.00"	Monopole
									14-Jul-04	39.12138889	-77.27111111	39°7'17.00"	77°16'16.00"	Tower
									14-Jul-04	39.1485	-77.017194	39°8'54.60"	77°1'01.90"	Monopole
									14-Jul-04	39.03833333	-77.12083333	39°2'18.00"	77°7'15.00"	Monopole
									14-Jul-04	39.209703	-77.157417	39°12'34.93"	77°9'26.70"	Monopole
									11-Aug-04	39.059453	-77.066497	39°3'34.03"	77°3'59.39"	Monopole



DEPARTMENT OF TECHNOLOGY SERVICES

Douglas M. Duncan
County Executive

Alison K. Moore
Chief Information Officer

MEMORANDUM
February 10, 2005

TO: Distribution

FROM: Robert P. Hunicutt, Tower Coordinator
Telecommunications Transmission Facility Coordinating Group (TTEFCG)

SUBJECT: TTEFCG Notice of Action for February 9, 2005 Meeting

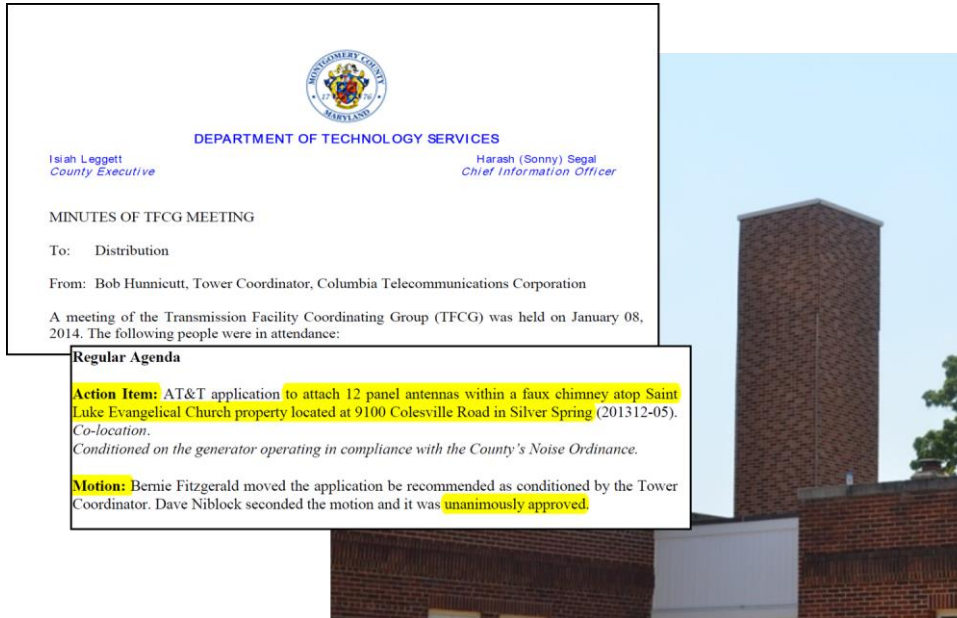
At its meeting of February 9, 2005, the Montgomery County TTEFCG voted to recommend the following applications:

Recommendation conditioned on submission of a structural analysis showing that the faux chimney can accommodate the antennas and cabling, and approval of the siting by the Department of Permitting Services:

52. T-Mobile application to attach three 54" panel antennas to a 15" "faux" chimney extension to an existing chimney on the existing 25' St. Luke Evangelical Lutheran Church building located at 9100 Colesville Road in Silver Spring (Application #200407-03).

The sample Committee meeting minutes from January 2014 minutes shows that AT&T applied and was approved to attach 12 more panel antennas within the same faux chimney at St. Luke's Church as long as the generator complies with the County's Noise Ordinance. (Figure 6-R) The information available on Montgomery County's Transmission Facilities Coordinating Group indicates that there are 15 panel antennas inside the faux chimney at this location.

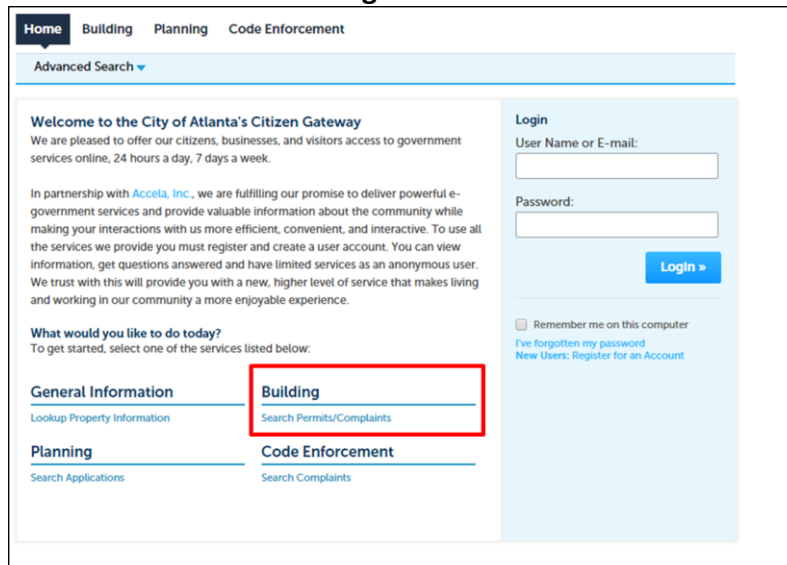
Figure 6-R



Other cities and counties may not have a group or department dedicated to antenna structures, but an employer may be able to find antenna and tower information online or in the offices where building permits are issued, plans approved, or inspections conducted.

The **City of Atlanta** allows you to search for this information online. Permits issued by the city after 2009 can be searched on [Atlanta's Citizen Gateway](#). You do not need to log in to search. Just click Search Permits/Complaints under "Building" on the main tab. (Figure 6-S)

Figure 6-S



Source: City of Atlanta's Citizen Gateway, accessed April 28, 2016.
https://aca.accela.com/Atlanta_Ga/Default.aspx

A user can search with just the address or narrow their search by including the type of building permit. For example, in Atlanta a “Commercial Miscellaneous Non-Structural” permit includes most devices on non-historic buildings. (Figure 6-T) If you do not know the type of permit, you can leave this field blank and all permits for the address you entered will be retrieved.

Figure 6-T

The screenshot shows the 'General Search' form with the following fields and annotations:

- Permit Type:** A dropdown menu set to 'Commercial Miscellaneous Non-Strn', highlighted by a red box.
- Street No.:** Two input boxes containing '10' and '- 10', highlighted by a red box.
- Quadrant:** A dropdown menu set to '--Select--', highlighted by a red box.
- Street Name:** An input box containing 'Park', highlighted by a red box.
- Street Type:** A dropdown menu set to 'PL', highlighted by a red box.
- Yellow Annotation 1:** 'Commercial Misc. Non-Structural permits include most antenna devices.'
- Yellow Annotation 2:** 'Only street number and name are necessary. If multiple addresses appear, you can narrow it down with quadrant or street type'

For permit information between 2000 and 2009, you can search another online permit [section](#) of Atlanta’s website. The records are organized by year, and within that by street name. Each record contains the permit number, date, owner, and scope. The permit scope in the example below states that it was to “Add/Alter Communications Tower.” (Figure 16-U)

Both Atlanta search options provide the owner, description, date, and permit number, as well as how to contact the Office of Buildings, which issues these permits, if more information is needed.

Figure 6-U

Home Government Residents Visitors Doing Business Newsroom How Do I...

Mayor's Office
Atlanta City Council
Departments
Aviation
Corrections
Finance
Fire
Human Resources
Information Technology
Law
Parks & Recreation
Planning & Community Development
Office of Buildings
Office of Housing
Office of Planning
View Online Permit Information

Government » Departments » Planning & Community Development

View Online Permit Information

Listen

Font Size: + - + Share & Bookmark Print [+] Feedback

All Permits (Plumbing, Electrical, HVAC, & BUILDINGS) must be posted on the job site in a conspicuous place.

TO SEARCH PERMITS

...issued since November 30, 2009, please use our new online permitting web page. Click to launch [Accela Citizen Access](#) in a new browser window.

...issued prior to November 30, 2009, use the links below:

Permits issued in 2009:
Street Names: [A-G](#) [H-M](#) [N-S](#) [T-Z](#)

Permits issued in 2008:
Street Names: [A-G](#) [H-M](#) [N-S](#) [T-Z](#)

Permits issued in 2007:
Street Names: [A-G](#) [H-M](#) [N-S](#) [T-Z](#)

Permits issued in 2006:
Street Names: [A-G](#) [H-M](#) [N-S](#) [T-Z](#)

Permit No: BB200900084 NPU: E02 Issued: 01/12/2009
Address: 159 ARMOUR DR NE
Inspector: BUILDING ZONE 5 Scope: ADD/ALTER COMMUNICATIONS TOWER
Contractor: INFINITY CONSTRUCTION SOLUTIONS Cost: \$50,000.00
Owner: AMERICAN TOWER

OFFICE OF BUILDINGS 55 Trinity Avenue
3rd Floor - Suite 3900
Atlanta, Georgia 30303
Phone: (404) 330-6150

Michael Nagy
Interim Director
mnagy@atlantaga.gov

CONTACT US
[Click here](#) for a list of Contacts for the Office of Buildings

*Source: City of Atlanta - View Online Permit Information, accessed April 28, 2016.
<http://www.atlantaga.gov/index.aspx?page=327>*

Information on the local resources available for the following list of metropolitan areas is included in **Appendix C**.

- ❖ Atlanta, GA
- ❖ Boston, MA
- ❖ Chicago, IL
- ❖ Dallas-Fort Worth, TX
- ❖ Denver, CO
- ❖ Houston, TX
- ❖ Los Angeles, CA
- ❖ Madison, WI
- ❖ New York City Metro Area
- ❖ Philadelphia, PA
- ❖ Phoenix, AZ
- ❖ Pittsburgh, PA
- ❖ Portland, OR
- ❖ Sacramento, CA
- ❖ Saint Louis, MO
- ❖ Salt Lake City, UT
- ❖ San Francisco, CA
- ❖ Twin Cities, MN
- ❖ Washington, DC Metro Area

If you have information for where to find information on antennas in your city or county, please send it to cpwr-r2p@cpwr.com so it can be added to the appendix.

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

53

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.

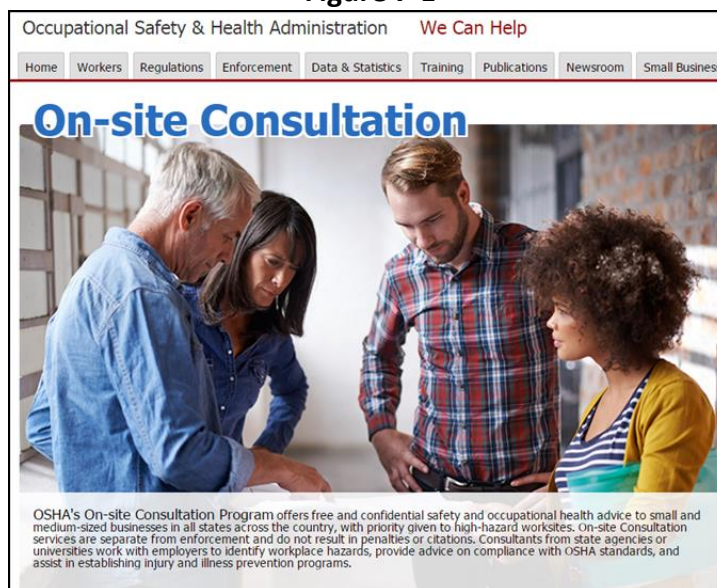
Figure 7-D



*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

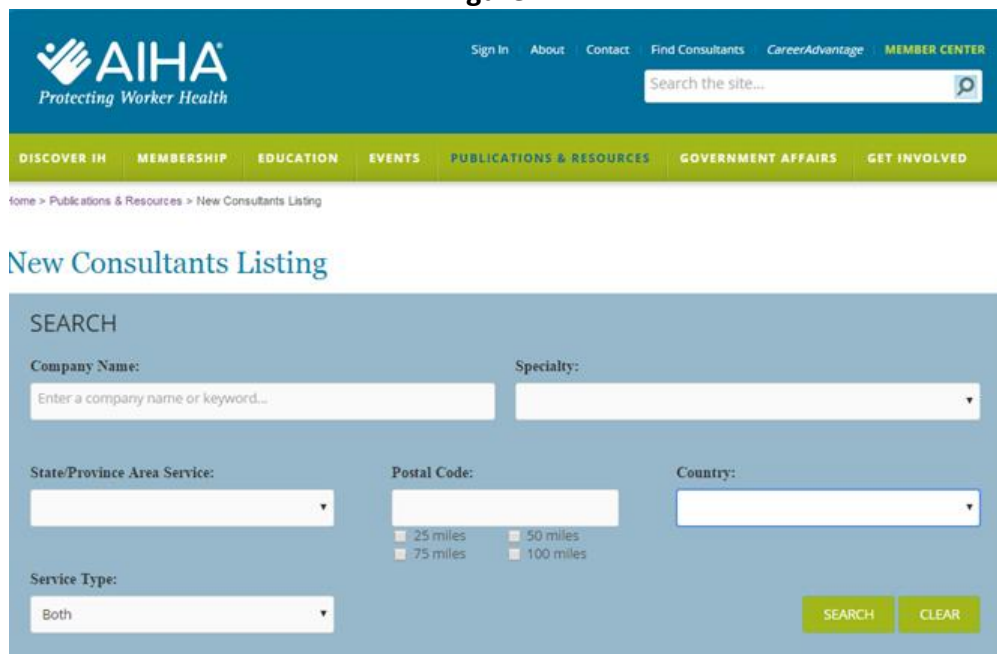


Source: OSHA's Consultation Directory, accessed April 28, 2016.

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>

8. Summary

In summary, construction employers and their employees should be concerned about RF radiation if they perform work on rooftops, sides of buildings, or on structures where telecommunications equipment is present because:

- RF radiation is invisible, it cannot be seen, smelled, or touched.
- RF radiation devices come in different shapes and sizes, and some are intentionally concealed for aesthetic reasons.
- Power levels generated by these devices vary - levels can be well below the FCC's MPE limits when work begins and then spike to dangerous levels without warning.
- The risk increases with the number of devices present, the closer a worker is to the device(s), and the more time that is spent in close proximity.
- Symptoms of the thermal effects of overexposure are often attributed to strenuousness of the work or a non-occupational illness.
- RF radiation may interfere with medical devices such as pacemakers.
- There is limited research on the long-term health effects of RF radiation and possible non-thermal effects of occupational exposure to RF. None is currently available for construction occupations.

To determine if RF generating devices are present:

- Look for signs and/or barriers
- Ask the building owner or site manager if antennas are present and their locations, and request the RF radiation surveys required by the FCC.
- If signs and RF Radiation surveys are not available, conduct your own pre-task safety assessment. If you are unsure about your potential exposure, use a personal monitor and wear protective clothing.

If work needs to be performed within a potentially hazardous area:

- Check the site survey or plot plan for potential exposure levels
- Pre-plan work tasks and travel routes so you can limit trips through the RF field and time spent on tasks there – the goal is to get in and out as quickly as possible
- Contact the building manager and the antenna licensee to have the equipment powered down or moved. Do not begin work until you receive verification that the antenna has been powered down or moved.

If the device owner and building owner are unresponsive:

- Contact the FCC to file a complaint – 1-888-225-5322 (press 5)
- Use personal monitors while work is being performed and if an alarm sounds, stop work and leave the area immediately
- If work must be performed in a potentially hazardous area, use personal monitors and protective clothing.

Employers should train their employees to:

- Understand the hazard
- Recognize devices
- Follow the instructions on signs and barriers
- Stay away from antennas -- never touch an antenna, do not stop in front of or close to an antenna, or take breaks on the rooftop where antennas are present
- If signs and barriers are not available, stay at least 6 feet away from a single antenna and at least 10 feet away from a cluster of antennas
- Use personal monitors and protective clothing properly if work cannot be performed a safe distance from the antenna(s)
- Recognize the symptoms and understand the risks associated with wearing a pacemaker or other medical device.

Both employers and employees should know what to do and where to go if they suspect they are in danger.

- Leave the work area immediately

Workers should know to:

- Contact their supervisor
- Contact their union

Employers should know to:

- Contact the building managers and the antenna licensee to have the equipment powered down or moved, and, if they are unresponsive, to contact the FCC to file a complaint.

Appendices

A. States with Their Own RF Requirements - Examples

Alaska's Permissible Exposure Limits

The State of Alaska's permissible exposure limit is specified in Article I of Subchapter 4, Occupational Health and Environmental Control Code [04.0106(a)], Alaska Occupational Safety and Health Standards. For normal environmental conditions and for incident electromagnetic energy of frequencies from 10 MHz to 100 GHz, the radiation protection guide is 10 mW/cm (milliwatts per square centimeter) as averaged over any possible six-minute period.

Further information can be obtained from the Alaska Department of Labor, Occupational Safety and Health Section.

Source: Physical Agent Data Sheet (PADS) - Radio Frequency/Microwave Radiation. accessed August 4, 2016. <http://labor.state.ak.us/lss/pads/radio.htm>

California's General Industry Standard

California's general industry standard (Subchapter 7 – General Industry Safety Orders, Group 14, Article 104) applies to devices with frequencies between three MegaHertz and 300 GigaHertz, includes exposure limits, requires warning signs described in the IEEE-ANSI voluntary standard, and specifies that the signs have to be legible at a distance of 32 feet when radiation levels may be in excess of the exposure limits.

Source: CCR, Title 8, Section 5085, Subchapter 7, Group 14, Article 104 – Nonionizing Radiation - §5085. Radiofrequency and Microwave Radiation. accessed April 28, 2016. <https://www.dir.ca.gov/title8/5085.html>

Minnesota's Employee Right-to-Know Act

Minnesota's requirements are covered by its Employee Right-to-Know Act. Although Minnesota OSHA stopped using the Act for hazardous chemicals when it adopted OSHA's standard (1910.1200), it has continued to use the Act for non-ionizing radiation. It requires employers to identify sources of non-ionizing radiation and provide their employees, who have a reasonable potential for exposure during the normal course of their work, with information and training to employees with a "reasonable potential" for exposure "during the normal course of the employees' work assignment. The Act specifies that the training must cover:

- Identifying sources
- Exposure limits
- Health effects
- Emergency procedures
- Safety procedures
- Control measures
- Personal protective equipment

Sources:

- Minnesota OSHA - Employee Right-to-Know on construction sites, accessed April 28, 2016. http://www.dli.mn.gov/osha/PDF/ertk_construct.pdf
- Minnesota OSHA - Safety Lines, accessed April 28, 2016. http://www.dli.mn.gov/OSHA/PDF/76_0712sl.pdf

The Commonwealth of Virginia Radio Frequency Radiation Exposure Compliance Plan

In Virginia, the state's Department of Information Technology developed the Commonwealth of Virginia Radio Frequency Radiation Exposure Compliance Plan to ensure that all radio-transmitting sites that the Commonwealth of Virginia owns, manages, or has transmitting equipment located at comply with the FCC requirements.

This Compliance Plan requires:

- The identification of problem areas
- Establishment of safety zones
- Training
- Use of signs
- Personal monitors
- Use of safety procedures including, deactivating antennas, using lockout/tagout procedures, use of RF protective clothing, personal monitoring devices etc.
- Taking steps to mitigate exposures such as relocating the antennas
- Designating a site safety officer to ensure compliance

This document states that “Unless a worker has direct knowledge that an antenna is either a receive antenna or has been deactivated, the worker should consider antennas to be active and energized.”

Sources:

- *Commonwealth of Virginia RF Radiation Exposure Compliance Plan for Building- and Tower-based Antenna Sites, Mobiles and Maintenance*, accessed April 28, 2016. http://vita.virginia.gov/uploadedfiles/VITA_Main_Public/Library/PSGs/RF_Radiation_Human_Exposure_Compliance_Plan.pdf
- *Virginia Information Technologies Agency - Non-ITRM Policies, Standards and Guidelines*, accessed April 28, 2016. <http://vita.virginia.gov/default.aspx?id=5520>
- *DTP ALERT Radio Frequency Exposure*, accessed April 28, 2016. *Guidelines* http://vita.virginia.gov/uploadedfiles/VITA_Main_Public/Library/PSGs/Alert-RadioFreqExposureGuidelines.pdf

B. How to Use the FCC & FAA Databases

The FCC provides information on licenses and antenna structures in two databases: the Universal Licensing System (ULS) and the Antenna Structure Registration (ASR). Searching for a license provides a lot of information, but the most useful for us are a point of contact and information on the frequencies and power levels.

➤ **FCC: Universal Licensing System** <http://wireless2.fcc.gov/ULsApp/ULsSearch/searchLicense.jsp>

Step 1: Search. You can search for a license with the name of the licensee, the call sign, or the FCC Registration Number (FRC). If you do not have this information, you might find the call sign and licensee name using AntennaSearch.com (see below), or you can search a number of different ways, including geographically – in a radius around a specific address or coordinates.

The screenshot shows the FCC Universal Licensing System search interface. A red box highlights the 'License Search' form, which includes a dropdown menu set to 'By Call Sign', an input field, and a 'SEARCH' button. Below the form are three main search categories: 'Advanced Search' (with a link to 'Advanced License Search'), 'Service Specific Search' (with links for Aircraft, Amateur, Commercial/Restricted Permits, GMRS, and Ship), and 'Specialized Search' (with links for Market Based, Site Based, Facility ID, Geographic, Buildout Deadline, Lease Specific, and 800 MHz Reconfiguration Search).

Step 2: See Results – Click on the call sign/lease ID to go to the details.

The screenshot shows the search results for 'WQCU741'. The page title is 'Search Results' and it includes navigation links like 'New Search', 'Refine Search', 'Printable Page', 'Query Download', and 'Map Licenses'. A legend indicates that 'PA' stands for Pending Application(s), 'TD' for Termination Pending, and 'L' for Lease. The results are displayed in a table with the following data:

Call Sign/Lease ID	Name	FRN	Radio Service	Status	Expiration Date
1 WQCU741	International Brotherhood of Electrical Workers	0013410576	IG	Active	05/31/2025

A red arrow points to the first row of the table, specifically to the call sign 'WQCU741'.

Step 3a: Details: Main Page – This page contains: license expiration date, licensee name and contact, point of contact for the license itself, eligibility (“*applicant provides building and engineering services and will use radios to coordinate employees*”), radio service type, and regulatory status. The tabs at the top of the page provide more information. The Admin tab contains application information, the license itself, and other correspondence.

U.S. License
Industrial/Business Pool, Conventional License - WQCU741 - International Brotherhood of Electrical Workers HELP

[New Search](#) [Refine Search](#) [Return to Results](#) [Printable Page](#) [Reference Copy](#) [Map License](#)

MAIN ADMIN LOCATIONS FREQUENCIES

Call Sign	WQCU741	Radio Service	IG - Industrial/Business Pool, Conventional
Status	Active	Auth Type	Regular

Dates

Grant	03/31/2015	Expiration	05/31/2025
Effective	03/31/2015	Cancellation	

Control Points

1	900 7th Street NW, Washington, DC P: (202)207-3916
---	---

Licensee

FRN	0013410576 <small>(Main Ownership Office)</small>	Type	Corporation
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Licensee

International Brotherhood of Electrical Workers 900 7th Street NW Washington, DC 20001 ATTN: Jason Reidenbach - Chief Engineer	P:(202)430-9495 F:(202)289-5871 E:none
---	--

Contact

Federal License Management Eric Z Wolfe 1784 E. 3rd Street Suite 269 Williamsport, PA 17701-3862	P:(570)505-3894 F:(570)651-9032 E:support@federal-license.com
---	---

Land Mobile Data

Extended Implementation (Slow Growth)	Assoc.Call Signs
---------------------------------------	------------------

Eligibility

90.35A1 - Applicant provides building and engineering services and will use radios to coordinate employees.

Ownership and Qualifications

Radio Service Type	Mobile
Regulatory Status	Private Comm Interconnected No

Alien Ownership

Is the applicant a foreign government or the representative of any foreign government? No

Is the applicant an alien or the representative of an alien?

Is the applicant a corporation organized under the laws of any foreign government?

Is the applicant a corporation of which more than one-fifth of the capital stock is owned or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?

Is the applicant directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned or voted by aliens, their representatives, or by a foreign government or representative thereof, or by any corporation organized under the laws of a foreign country?

The Alien Ruling question is not answered.

Basic Qualifications

The Applicant answered "No" to each of the [Basic Qualification](#) questions.

Step 3b: Details: Locations Page. The location tab shows the address of the antenna or the range of operation. You can click each location for information on the height of the building, the height to the tip of the antenna, and more.

Industrial/Business Pool, Conventional License - WQCU741 - International Brotherhood of Electrical Workers
Locations Summary

[New Search](#) [Refine Search](#) [Return to Results](#) [Printable Page](#) [Reference Copy](#) [Map License](#)

MAIN ADMIN **LOCATIONS** FREQUENCIES

Call Sign	WQCU741	Radio Service	IG - Industrial/Business Pool, Conventional
2 Total Locations			Locations Displayed: All Fixed Mobile Itinerant Temp Fixed 8.1m
10 Locations per Summary Page			

(C) = Special Condition (P) = Termination Pending

Location	Transmitter Address / Area of Operation	Latitude, Longitude	Status
1 - Fixed	900 7th Street NW Washington, DC	38-54-05.2 N, 077-01-33.5 W	
2 - Mobile	14.0 km radius around centerpoint	38-54-05.2 N, 077-01-33.5 W	

2 Total Locations
 10 Locations per Summary Page
 Locations Displayed: All | Fixed | Mobile | Itinerant | Temp Fixed | 8.1m

Step 3c: Details: Frequencies Page. This page shows the type of device/station class, the number of units of each device, the Output Power and Maximum ERP (effective radiated power) for each frequency (in MHz). This example shows a Mobile Relay (FB2) at location 1, and 25 Mobile (MO) units at the other three frequencies.

Industrial/Business Pool, Conventional License - WQCU741 - International Brotherhood of Electrical Workers

Frequencies Summary

[New Search](#) [Refine Search](#) [Return to Results](#) [Printable Page](#) [Reference Copy](#) [Map License](#)

MAIN **ADMIN** **LOCATIONS** **FREQUENCIES**

Call Sign: WQCU741 Radio Service: IG - Industrial/Business Pool, Conventional

4 Frequencies for all locations Filter Frequencies By Location: All Locations

20 Frequencies per Summary Page

Special Condition Termination Pending Define View: [General](#) | [Buildout](#) | [COSER](#) | [Emission](#) | [IRAC](#)

Frequency	Loc#	Ant#	Freq ID	Station Class	Units	Paging Rec.	Output Power	Maximum ERP
000461.52500000	2	1	3	MO	25		4,000	4,000
000461.60000000	2	1	2	MO	25		4,000	4,000
000463.60000000	1	1	1	FB2	1		25,000	40,000
000466.60000000	2	1	1	MO	25		4,000	4,000

4 Frequencies for all locations Filter Frequencies By Location: All Locations

20 Frequencies per Summary Page

Federal databases also allow us to search for more information on antenna structures/towers. A tower may have multiple transmitting antennas on it, each of which may have different licenses and different owners. However, it may provide additional contact information, and details on location. The Federal Aviation Administration (FAA) *may* also provide information on the frequencies and power levels of devices on the structure.

- **FCC: Antenna Structure Registration**
<http://wireless2.fcc.gov/UlsApp/AsrSearch/asrRegistrationSearch.jsp>

The FCC defines an antenna structure as “a structure that is constructed or used to transmit radio energy, or that is constructed or used for the primary purpose of supporting antennas to transmit and/or receive radio energy, and any antennas and other appurtenances mounted thereon.” The owner must register the structure if the structure requires notice of proposed construction to the FAA. Owners may also voluntarily register the structures. Antenna Structure Registration numbers are assigned and must be displayed near the base or perimeter fence, unless it is a historic landmark. The FCC provides a database of antenna structure registrations.

Step 1: Search. You can search with the registration number, the FAA study number, coordinates, or location.

The ASR Registration Search enables you to search for a wide range of licenses in the Antenna Structure Registration system. The Search for a Registration enables you to search on basic elements of a registration, including registration number, FAA study number, FRN, and licensee name. The Search by Location enables you to look up a registration based on the location and height of a structure. You can also use the advanced search to perform more sophisticated searches based on numerous criteria.

Step 2: Results. The results are displayed on one page. You can find information on the location, the structure (e.g. Building with Tower), height of structure, and contact information. The page also contains actions taken (e.g. Administrative Action Received) and automated letters, such as the Authorization letter.

ASR Registration Search
Registration 1206471
[New Search](#) [Return to Results](#) [Printable Page](#) [Reference Copy](#) [Map Registration](#)

Registration Detail			
Reg Number	1206471	Status	Granted
File Number	A0366530	Constructed	
EMI	No	Dismantled	
NEPA	No		
Antenna Structure			
Structure Type	BTWR - Building with Tower		
Location (in NAD83 Coordinates - Convert to NAD27)			
Lat/Long	38-53-39.4 N 077-01-00.9 W	Address	300 Indiana Aven, N. W.
City, State	Washington, DC	County	Washington
Zip	20001	Position of Tower in Array	
Center of AM Array			
Heights (meters)			
Elevation of Site Above Mean Sea Level	12.2	Overall Height Above Ground (AGL)	51.2
Overall Height Above Mean Sea Level	63.4	Overall Height Above Ground w/o Appurtenances	45.7
Painting and Lighting Specifications			
None			
FAA Notification			
FAA Study	89-AEA-1303-OE	FAA Issue Date	08/22/1989
Owner & Contact Information			
FRN	0002088631	Owner Entity Type	
Owner			
District of Columbia, Metropolitan Police Department 310 McMillan Drive, N.W. Washington, DC 20001-1032		P: (202)671-2872 F: E: sherwin.bigelow@dc.gov	
Contact			
Bigelow, Sherwin D 310 McMillan Drive, NW Washington, DC 20001-1032		P: (202)671-2872 F: E: sherwin.bigelow@dc.gov	

Federal Aviation Administration

Any construction or alteration exceeding 200 ft. above ground level needs to be filed with the Federal Aviation Administration for an Obstruction Evaluation/Airport Airspace Analysis (OE/AAA). The study determines if the structure will interfere with flight paths and if it requires particular painting/lighting.

➤ **OE/AAA** <https://oeaaa.faa.gov/oeaaa/external/searchAction.jsp?action=showSearchArchivesForm>

Step 1: Search. You can search the archived cases by study number (found on the FCC ASR details or antennasearch.com), or by city and state, which then can be sorted by latitude & longitude.

Obstruction Evaluation Version 2015.4.2

Federal Aviation Administration

Search Archived Cases

Home | Search - Desk Reference Guide V_2014.2.0

faa.gov Tools: Print this page

• Search the entire archive of OE/AAA cases.
• Enter/select any combination of fields to construct a desired query.
• Note: the system returns a maximum of 2000 records.

Search For: Off Airport Cases or On Airport Cases

Year: ASN: - OE

FAA Region: FCC Number:

City: Status:

State: 7460-2 Filed:

View Circularized Cases

Search Archives

Step 2: Results. The one-page results page has the determination letter, sponsor information, latitude/longitude/location, structure height, as well as the frequencies/power levels that may be present on the tower. Frequencies are given by range (low to high) and the power level listed is the effective radiated power (ERP). Not all the information will always be provided. There may be additional information in the “Description of proposal” in the bottom left section of the results.

Overview

Study (ASN): 2003-ACE-1209-OE
Prior Study: 2002-ACE-1380-OE
Status: Determined
Letters: Determination
Supplemental Form 7460-2: Please login to add a Supplemental Form 7460-2.

Received Date: 06/03/2003
Entered Date: 06/03/2003
Completion Date: 06/16/2003
Expiration Date:

Sponsor Information

Sponsor: AMERICAN TOWER (#93068)
Attention Of: LOTTIE THOMPSON
Address: 1101 PERIMETER DRIVE, SUITE 225
Address2:
City: SCHUMBERG
State: IL
Postal Code: 60173
Country: US
Phone: (847)240-1508
Fax:

Sponsor's Representative Information

Representative:
Attention Of:
Address:
Address2:
City:
State:
Postal Code:
Country:
Phone:
Fax:

Construction Info

Notice Of: ALTER
Duration: PERM (Months: 0 Days: 0)
Work Schedule:
Date Built:

Structure Summary

Structure Type: Antenna Tower
Structure Name:
FCC Number: 1218883
FCC ASR Registration

Structure Details

Latitude (NAD 83): 38° 43' 14.58" N
Longitude (NAD 83): 90° 14' 28.68" W
Horizontal Datum: NAD 83
Survey Accuracy: 2C
Marking/Lighting: None
Other Description:

Height and Elevation

	Proposed	DNE	DET
Site Elevation:	479		
Structure Height:	122	0	122
Total Height (AMSL):	601	479	601

Frequencies

Low Freq	High Freq	Unit	ERP	Unit
806	824	MHz	500	W
824	849	MHz	500	W
851	866	MHz	500	W
869	894	MHz	500	W
896	901	MHz	500	W
1850	1910	MHz	1640	W
1920	1990	MHz	1640	W
2305	2310	MHz	2000	W
2345	2360	MHz	2000	W

Name:
City: JENNINGS
State: MO
Nearest County: St. Louis
Nearest Airport: 74MO
Distance to Structure: 12732.39 feet
On Airport: No
Direction to Structure: 39.29°
Description of Location:
Description of Proposal:

Previous | Back to Search

The databases provide useful information such as contact information, but are not all-encompassing. For example, the ULS does not capture the exact locations of many cellular towers because the licensees (Verizon, etc.) get their licenses for geographic areas and are not required to notify the FCC of the specific locations. Additionally, devices on federal buildings are outside of the FCC jurisdiction and the FAA only contains information on structures over 200 feet or higher (from the ground level to the top of the device). Some are devices may be designed to be 199.9 feet instead.

C. Local Resources to Access Antenna Locations

Location (city/county, state)	Where to find information	Information Available	Link
Atlanta, GA	<p>Department of Planning & Community Development</p> <ul style="list-style-type: none"> • Acela Citizen Access • Online Permits • Office of Buildings 	<p>Building Permit Information:</p> <p>Nov 2009-present:</p> <ul style="list-style-type: none"> • On the main page, under “Building,” click “Search Permits/Complaints.” • On the “Search for Records” page: <ol style="list-style-type: none"> 1) Select the Permit Type – “Commercial Miscellaneous Non-Structural.” 2) Enter the address (street name and number). <i>Everything else can be left blank.</i> 3) Click on search to retrieve permit information • Record Results include all “Commercial Miscellaneous Non-Structural” permits issued. Antennas may be identified by permit name (e.g. T-MOBILE 9AT0315D) <p>Each record includes the status (terminated, complete, etc.), the applicant and contact information, and the project description). <i>For example: 10 Park Place SE – project description “Add equipment to existing rooftop co-location, (9) Antennas, (1).</i></p> <p>2000-2009:</p> <ul style="list-style-type: none"> • Permits are organized by year and street name. Each permit includes: permit number, address, inspector, contractor, owner, cost, issue date, and scope (e.g. ADD/ALTER COMMUNICATIONS TOWER) <ul style="list-style-type: none"> ○ <i>For example: 2009 A-G – 159 Armour Dr NE</i> • For more information or questions about permits 	<p>https://aca.accela.com/Atlanta_Ga/Default.aspx</p> <p>http://www.atlantaga.gov/index.aspx?page=327</p> <p>http://www.atlantaga.gov/index.aspx?page=324</p>

<p>Boston, MA</p>	<p>Inspectional Services Department (ISD)</p> <ul style="list-style-type: none"> • Data Boston • Simple Search <p>Inspectional Services Department</p>	<p>Building Permit Information:</p> <p>2009 to present:</p> <ol style="list-style-type: none"> 1) Search for a specific address in the top right search box of the table and press enter. 2) Sort the results by WORKTYPE by pressing the menu icon and click ascending. Antennas/Towers can be found under WORKTYPE: CELL, or ELECTRICAL. <p>Each Record includes: description of the project (e.g. Cellular Tower – modify existing wireless facility...), applicant, latitude and longitude, and address. <i>For example: 1135 Tremont St. – description: cellular tower, comments: Modification of an existing wireless communications facility all as depicted on the plans.</i></p> <p>Pre-2009:</p> <ol style="list-style-type: none"> 1. Enter the street number under Primary Street Number and street name under Street Name. 2. Under Document Type, select “Long Form Permit.” 3. Click Search to retrieve results. <p>Results include the scanned permits, identified by number and date. Each needs to be opened by checking the box next to it and clicking view in order to see additional details or descriptions. <i>For example: 1135 Tremont St (see 01/27/2012)</i></p> <ul style="list-style-type: none"> • For more information or questions about permits 	<p>https://data.cityofboston.gov/Permitting/Approved-Building-Permits/msk6-43c6</p> <p>http://sceris.cityofboston.gov/scerisweb/client/SimpleSearch.aspx</p> <p>http://www.cityofboston.gov/isd</p>
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<p>Chicago, IL</p>	<p>Buildings Department</p> <ul style="list-style-type: none"> City of Chicago Data Portal Building Department 	<p>Building Permit information:</p> <p>2006-present:</p> <ul style="list-style-type: none"> Enter the address in the top right of the table and press enter to search. Antennas/Towers may be included under PERMIT-TYPE: Renovation/Alteration or Easy Permit Process. <p>Each result includes: permit number, issue date, type of permit, the work description, costs, contractor information (type, name, address), and location.</p> <p><i>For example: 700 S Desplains St – Work description: REMOVE AND REPLACE 6 OF 9 EXISTING ANTENNAS WITH NEW TECHNOLOGY AND ADD 3 NEW ANTENNAS WITH RELATED ELECTRICAL EQUIPMENT TO AN EXISTING ROOFTOP WIRELESS COMMUNICATIONS FACILITY AS PER PLANS)</i></p> <ul style="list-style-type: none"> For more information or questions about permits 	<p>https://data.cityofchicago.org/Buildings/Building-Permits/ydr8-5enu</p> <p>http://www.cityofchicago.org/city/en/depts/bldgs.html</p>
<p>Cook County, IL</p>	<ul style="list-style-type: none"> Department of Building and Zoning 	<ul style="list-style-type: none"> No information available online All wireless facilities require permits issued by the Department of Building & Zoning. Contact the Department for questions and to see what information is available. 	<ul style="list-style-type: none"> https://www.cookcountyil.gov/agency/building-and-zoning-0
<p>Dallas, TX</p>	<p>Develop Dallas</p>	<p>Building Permit Information:</p> <ol style="list-style-type: none"> On the left of the screen, click on “Addresses” under Searches. You do not need to register or log in. Enter the house number and street name and press search. The results page lists the property or specific parts (Suite A, garage, etc.). Click View to see the details for a property. On the details page, permits are listed under the Applications tab. Each application is listed by type, project number, status, description, and date. <p>Antennas/Towers are listed under Type: Master Permit. The descriptions begin with “Building (BU).” Each permit includes the</p>	<p>https://developdallas.dallascityhall.com/Home.aspx</p>

	<p>Building Inspection Office</p> <ul style="list-style-type: none"> • Records Library • Building Inspection Office 	<p>applicant name, contractor, date, and costs. <i>For example: 1600 Commerce St – Description: Building (BU) INSTALL ROOFTOP CELL ANTENA</i></p> <ul style="list-style-type: none"> • The Building Inspection Office’s Library of Records contains information on permit history, but is not available online. • For more information, contact the Building Inspection Office. 	<p>http://dallascityhall.com/departments/sustainabledevelopment/buildinginspection/Pages/central_files.aspx</p> <p>http://dallascityhall.com/departments/sustainabledevelopment/buildinginspection/Pages/index.aspx</p>
<p>Fort Worth, TX</p>	<p>Planning & Development Department</p> <ul style="list-style-type: none"> • Online Permitting System 	<p>Building Permit information:</p> <ol style="list-style-type: none"> 1) Under Development, select “Search Applications/Permits.” 2) In the gray “General Search” bar, select “Search by Address” in the drop down menu. 3) Enter the street name and number and press search. Select the correct address from the results. 4) Results are listed by date, permit number, record type, and project name (if available). Antennas/Towers may be included under Remodel/New “Commercial Accessory Structure,” “Electrical Standalone Permit,” or “Electrical Umbrella Permit.” <p>Click the permit number for more information</p> <p>Permit results include any conditions, licensed professional, inspections, fees, attachments, and project description. <i>For example: 2901 Stanley Ave – PE06-13963 project description: MOUNT ANTENNAS ON EXISTING TOWER.</i></p>	<p>https://accela.fortworthtexas.gov/citizenaccess/</p>

	Planning & Development Department	Contact for more information or questions.	http://fortworthtexas.gov/planninganddevelopment/
Denver, CO	Development Services <ul style="list-style-type: none"> Records Counter 	Permit Records (2013 – present): <ul style="list-style-type: none"> Monthly records are available as pdf files on the lower part of the menu on the right of the screen. Commercial Building permits are grouped as Permit Type 1C. Each permit includes: address, permit number, address, owner’s name, and contractor’s name. <p>Older records and more information are available in person at the Records Counter in person. Contact Development Services for more information.</p>	https://www.denvergov.org/content/denvergov/en/denver-development-services/help-me-find/building-permits.html
Houston, TX	Houston Permitting Center	The “Open Records” tab explains how to obtain permit information. Contact for questions or more information about permits.	http://www.houstonpermittingcenter.org/
Los Angeles, CA	Department of Building and Safety <ul style="list-style-type: none"> Online Building Records 	Building permits information: <ol style="list-style-type: none"> At the bottom of the page, click “Online Building Records System.” A new window pops up. Click “By Address,” type the address, and press Search. The results show the document type, subtype, date, document number, and a digital image (if available). Antennas/towers require Building Permits and may be listed under Alter/Repair. <ul style="list-style-type: none"> Clicking the Document type, sub type, date, or doc number all open the same Document report, which includes comments/description (e.g. REPLACE SIX ANTENNAS & ADD THREE MORE ANTENNAS WITH VARIOUS ANCILLARY EQUIPMENT AND NEW SCREEN WALL). The digital image (if available) opens the application for the 	http://ladbs.org/LADBSWeb/online-building-records.jsf

	<ul style="list-style-type: none"> DataLA – Open Data Portal <p>Department of Building and Safety</p> <p>Bureau of Engineering</p>	<p>building permit. The application includes information on the owner, description of work, fees, and the plot plan.</p> <p><i>For example: 1020 W Downey Way</i></p> <ol style="list-style-type: none"> 1) Enter the address in the top right of the map. You can also enter “antenna” to narrow results down to those that mention antennas. Press enter to search. 2) Click on the blue dot that marks the results for the address. You may need to zoom in in order to find the dot. 3) Click the dot and click “View details for this row” in the callout that appears. 4) Each row is a different result for the address. Press the arrow keys at the bottom of the results. <p>Results include: information on the contractor, applicant, latitude and longitude, address, and description.</p> <p><i>For example: 1020 W Downey Way – description: INSTALLATION OF 6 NEW ANTENNAS AND RADIO EQUIPMENT CABINETS ON ROOFTOP</i></p> <p>For more information or questions about permits</p> <p>The Bureau of Engineering also handles permits for above ground telecommunication facilities. Contact the bureau for more information.</p>	<p>https://data.lacity.org/A-Prosperous-City/Building-and-Safety-Permit-Information/fyce-aa46</p> <p>http://ladbs.org/LADBSWeb/locations.jsf</p> <p>http://eng.lacity.org/index.cfm</p>
<p>Madison, WI</p>	<p>Planning Division</p>	<ul style="list-style-type: none"> No information is available online For more information or questions, contact the Planning Division, which handles applications for telecommunications facilities & antennas. 	<p>http://www.cityofmadison.com/planning/plan.html</p>

<p>New York, NY</p>	<p>Department of Buildings</p> <ul style="list-style-type: none"> • Open Data • Cellular Antenna Statistical Report • Department of Buildings 	<p>Cellular Antenna Filings:</p> <p>April 2013 – present:</p> <ul style="list-style-type: none"> • Enter the address in the top right corner of the table and press enter. • Scroll across to see all details for each filing. <p>Results include: contact information for the applicant and property owner, and job description</p> <p><i>For example: 174 Avenue B. Job Description: INSTALL NEW TELECOMMUNICATIONS ANTENNAS AND RELATED SMALL CELL UNITS ON ROOF IN CONFORMANCE WITH TPPN # 5/98. NO CHANGE IN USE, EGRESS OR OCCUPANCY.</i></p> <p>July 2005-present:</p> <ul style="list-style-type: none"> • The weekly antenna statistical reports are compiled into one that can be found at the bottom of the page. • Sort the excel spreadsheet by street name by clicking the arrow next to “Street Name” and select Sort. • Scroll across to see all details for each filing. <p>Results include: information on the applicant and owner, the location, dates, number of related permits at the same location, and a description.</p> <p><i>For Example: 275 Avenue 1 -- description: INSTALLING TELECOMMUNICATIONS ANTENNAS WITH RELATED DUNNAGE ON ROOF.</i></p> <p>For more information or questions about permits.</p>	<p>https://data.cityofnewyork.us/Housing-Development/DOB-Cellular-Antenna-Filings/iz2g-9x8d</p> <p>http://www1.nyc.gov/site/buildings/about/other-statistical-reports.page</p> <p>http://www.nyc.gov/html/dob/html/home/home.shtml</p>
<p>Newark, NJ</p>	<p>Planning Office</p>	<ul style="list-style-type: none"> • No information is available online • For more information on antennas in Newark or questions, contact the Planning Office. 	<p>http://planning.ci.newark.nj.us/</p>

Jersey City, NJ	Building Department: Office of Construction Code	<ul style="list-style-type: none"> No information is available online. For more information or questions, contact the Building Department Construction Code Office, which handles permits in Jersey City. 	http://www.cityofjerseycity.com/hedc.aspx?id=1178
Yonkers, NY	Bureau of Planning	<ul style="list-style-type: none"> No information is available online. For more information or questions, contact the Bureau of Planning. 	http://www.cityofyonkers.com/work/departement-of-planning-development/planning
Philadelphia, PA	Department of Licenses & Inspections	<p>Property Information Search:</p> <ul style="list-style-type: none"> On the left toolbar under “Property Search,” enter the address. Permits are listed by type. Antennas/Towers are under Zoning/Use permits. Click on ones that are under Z/U. The resulting permit includes: contact information, permit number, contractor name (if available), and work description. <p><i>For example: 1500 Market St. Description: FOR THE ERECTION OF EIGHT (8) PANEL ANTENNAS ON THE ROOF AND FOR THE INSTALLATION OF PECO CABINET ON THE 43RD FLOOR. SIZE AND LOCATION AS SHOWN IN THE APPLICATION.</i></p> <ul style="list-style-type: none"> For more information, contact the Department of Licenses & Inspections. 	http://www.phila.gov/li/Pages/default.aspx

<p>Phoenix, AZ</p>	<p>Planning & Development Department</p> <ul style="list-style-type: none"> • Permit Information Search • Planning & Development Department 	<p>Building Permit Information:</p> <ol style="list-style-type: none"> 1) Enter the Address. By default, the system only searches for permits in the past year, but you can change the date to look further back. Everything else can be left blank. Press search. 2) You cannot search for both an address and a type of permit, but you can sort the permits by type by clicking on the first column, "Type Number." Antennas/Towers may be included under permits that begin with OSE, SE, or S. 3) The results page lists the permits by type, date, status, professional, and project. 4) Click the permit numbers to open the issued permit, which includes more information, such as a description of the work. <p><i>For example: 132 S Central Ave – permit OSE-98013650 description: AN UNMANNED TELECOMMUNICATIONS SITE CONSISTING OF 3 NEW ANTENNA ARRAYS ON TOP OF AN EXISTING BUILDING WITH TRANCIEVER EQUIPMENT</i></p> <p>Contact the Planning & Development Department for more information.</p>	<p>https://apps-secure.phoenix.gov/PDD/Search/Permits</p> <p>https://www.phoenix.gov/pdd</p>
<p>Pittsburgh, PA</p>	<p>Department of Permits, Licenses, and Inspections</p>	<p>Issued Building Permits (January 2012-present):</p> <ol style="list-style-type: none"> 1) Click "Public Data Resources & Reports" in the menu on the right of the screen. Building permit information is available for each month. 2) You can search each excel sheet by address. Information includes: permit number, the owner and contractor names, and a description. <p><i>For example: January 2012, 122 Bluebelle St – work description: REPLACEMENT OF THREE ANTENNAS ON EXISTING TELECOMMUNICATIONS</i></p> <p>Contact for more information or questions about permits.</p>	<p>http://pittsburghpa.gov/pli/</p>

<p>Portland, OR</p>	<ul style="list-style-type: none"> • Development Services 	<ul style="list-style-type: none"> • No information is available online • The Resource/Records Counter provides access to a variety of building records, including permits, and contains a self-service center. The Counter is located in the Development Services Center. 	<p>Development Services: https://www.portlandoregon.gov/bds/35883</p>
<p>Sacramento, CA</p>	<p>Community Development Department</p> <ul style="list-style-type: none"> • Tracker Map • Citizen Portal • Community Development Department 	<p>Building Permit information:</p> <p>1982-present:</p> <ol style="list-style-type: none"> 1) Enter the address and press search. Click the dot to select the property. 2) Click the “More information” button to view all permit activity for that address. <p>Each result includes: permit type and number, activities and dates, project description, and a contact person. <i>For example: 770 L St – project description: Remove and replace 6 antennas, add 6 RRUS and associated cabling.</i></p> <ol style="list-style-type: none"> 1) At the bottom of the page, select “Search Permits or Submittals / Pay Fees” under Building 2) Enter the street number and name. By default, it searches only the past two years, but you can change the date range to be longer. Antennas/towers fall under commercial permits. In Permit Number, enter “COM”. Everything else can be left blank. Press search. 3) Results are listed by date and include permit number, record type, description, and status (e.g. complete). Clicking the permit number may provide more information. <i>For example: 770 L St – description: EXPEDITED - Request to remove six (6) existing panels.</i> <p>Contact for more information or questions about permits.</p>	<p>http://sacramento.civicsight.com/</p> <p>https://aca.accela.com/sacramento/</p> <p>http://portal.cityofsacramento.org/Community-Development</p>

<p>St. Louis, MO</p>	<p>Building Division</p> <ul style="list-style-type: none"> • Address Search • Building Division 	<p>Building Permit Information:</p> <ol style="list-style-type: none"> 1) Enter the address and press search. Select the desired address from the results. If the address is not an option, select the closest one and then click the desired parcel in the first map under the Boundaries & Geography section. 2) The address search contains basic information, images, assessment information, citizens' services requests, building permits and more. Scroll down to Building Permits. <p>Each building permit includes the owner, permit type, date, and a brief description;</p> <p><i>Example: 777 Olive St – description: REPLACE ANTENNA & EQUIPMENT PER PLANS</i></p> <p>Contact the Building Division for more information.</p>	<p>https://www.stlouis-mo.gov/data/address-search/index.cfm</p> <p> </p> <p>https://www.stlouis-mo.gov/government/departments/public-safety/building/</p>
<p>Salt Lake City, UT</p>	<p>Planning Division</p> <ul style="list-style-type: none"> • Citizen Access Portal • Planning Division 	<p>Building permit information:</p> <ol style="list-style-type: none"> 1) Under Building, click Check/Research Permits. 2) Under Permit Type, select “Commercial Building Permit.” Enter the street number and street name. Everything else can be left blank. Press search. 3) Results include the date, project name and description, and status. <p>Each record has information on the applicant, owner, licensed professional, and project description. There may also be related records or attachments.</p> <p><i>For example: 215 W. South Temple – project description: VERIZON ROOF TOP CELL SITE. CONSTRUCT WIRELESS COMMUNICATIONS SITE ON ROOF OF EXISTING BLDG T.B. INSTALL 8 NEW ROOF MOUNT ANTENNAS AND 4 NEW WALL MOUNT ANTENNAS AND EQUIPMENT PAINTED TO MATCH EXISTING BUILDING A.M</i></p> <p>Contact the Planning Division for more information.</p>	<p>https://aca.slcgov.com/citizen/</p> <p> </p> <p>http://www.slcgov.com/planning</p>

<p>San Francisco, CA</p>	<p>Planning Department</p> <ul style="list-style-type: none"> • Existing Wireless Telecommunication Service Facilities map • Permit/Complaint Tracking System • Planning Department 	<p>The map offers 3 ways to search: map of addresses, cards, or rows.</p> <ul style="list-style-type: none"> • In the top left of the map, press the blue “Filter” button and select address. Enter the address and select Find. • A blue marker indicates the results for the address. Clicking the result pulls up a box that includes the carrier, ID number, address, type of building, and number of antennas. • More information is available in the card or row view. Click either tab, press the blue “Filter” button, and select address. Enter the address and press Find. • The results include the same information from the map view, but also includes more on the type of service offered, the location (e.g. Roof), the frequency range (in MHz), power output, and the name and number of the community liaison. <p><i>For example: 1072 Market Street – 6 cellular/pcs antennas located on the roof with the frequencies 700, 850, 1900.</i></p> <p>Permit Tracking:</p> <ol style="list-style-type: none"> 1) Select “Search for documents by site address” 2) Enter the street number and name and press search. 3) Select “Building Permits” to find permits that may include antennas/towers. 4) The building permits are only identified by the number, status, and date. For specific information, click the permit number and then press “Show Site Permit Details” <p>Each permit includes: contact information, a brief description, and dates. <i>For example: 1072 Market Street – description: MODIFICATION TO AN (E) ATT FACILITY CONSISTING OF INSTALLTION OF 3 NEW RRUS NEAR (E) ATT ANTENNAS ON ROOF.</i></p> <p>For more information or questions about the permits, contact the Planning Department.</p>	<p>https://www.google.com/fusiontables/DataSource?docid=1jgD0NwaO_dLNhIkjaANj_2fzV9WFwLDGgb8uM57x#map:id=3</p> <p>http://dbiweb.sfgov.org/dbipts/</p> <p>http://www.sf-planning.org/index.aspx</p>
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<p>Washington, DC</p>	<p>Open Data Department of Consumer and Regulatory Affairs</p>	<p>Antenna Structure Registration (map):</p> <ul style="list-style-type: none"> • Map contains 3,552 antenna structures in Virginia, Maryland, and the District <ol style="list-style-type: none"> 1) Search for an address by entering the full address in the box next to the magnifying glass in the lower left of the map. 2) Results appear as blue dots. Clicking each opens a box of information. You can click “Full Details” for the information to appear in a table below. <p>The results include: FCC registration number, FCC file number, issue date of FCC license, latitude and longitude, structure height, structure address, FAA Study number, and contact name and address.</p> <p>Contact for questions and more information on permits & zoning</p>	<p>http://opendata.dc.gov/datasets/82f81285fabd4f1c94a3a1d4339a01e9_1</p> <p>http://dcra.dc.gov/</p>
<p>Montgomery County, MD</p>	<p>Transmission Facilities Coordinating Group (TFGC)</p>	<p>TFGC offers an Antenna/Tower database:</p> <ol style="list-style-type: none"> 1) Open the “Tower Locations” database on the lower left of the site. 2) Sort the Tower Locations by street name to find the address. Each tower application includes: the carrier name, type of structure (e.g. existing building, monopole), site name and address, property owner, latitude and longitude, and application actions. <ul style="list-style-type: none"> • The dates of approval in the Tower Locations database can be used to find the committee meeting minutes & action items for those dates, which may include more details on the structures. <p>TFGC also provides images of antennas. For more information on permits or questions, contact the TFGC.</p>	<p>http://www.montgomerycountymd.gov/cable/Towers/home.html</p>

<p>Prince George's County, MD</p>	<p>Telecommunications Transmission Facility Coordinating Committee (TTFCC)</p>	<ul style="list-style-type: none"> • Meeting Minutes & Agendas for the past year include the committee's actions on antenna applications, but applications are not available to review online. • Reports, master plans, and countywide maps are available online. • Contact the TTFCC for more information. 	<ul style="list-style-type: none"> • http://www.princegeorgescountymd.gov/693/Telecommunications-Transmission-Facility
<p>Fairfax County, MD</p>	<p>Department of Planning & Zoning</p> <ul style="list-style-type: none"> • Research applications 	<p>Applications cannot be reviewed online. Requests can be submitted by phone or email. Once completed, files can be reviewed in person or shipped for a fee.</p> <p>For more information, contact the Department of Planning & Zoning.</p>	<p>http://www.fairfaxcounty.gov/dpz/2232/research.htm</p> <p>http://www.fairfaxcounty.gov/dpz/2232/telecommunications.htm</p>
<p>Arlington County, VA</p>	<p>Building Arlington Permit Inquiry</p>	<p>Building Permits Information:</p> <p>Enter the Street Name & Number to search for building permits for the address. Results include permit number, type, permit holder, owner, and description.</p> <p><i>For example: 5301 22nd St N – description: ADDING 2 ANTENNA TO EXISTING CELL TOWER</i></p> <ul style="list-style-type: none"> • For more information, contact Building Arlington. 	<p>https://permits.arlingtonva.us/</p> <p>http://building.arlingtonva.us/</p>

D. Additional Resources

For more information, visit the following websites:

- Federal Communications Commission: Radio Frequency Safety
<https://www.fcc.gov/general/radio-frequency-safety-0>
- Occupational Safety & Health Administration: Radiofrequency & Microwave Radiation
<https://www.osha.gov/SLTC/radiofrequencyradiation/standards.html>
- Food & Drug Administration: Radiofrequency Background
<http://www.fda.gov/radiation-emittingproducts/radiationemittingproductsandprocedures/homebusinessandentertainment/cellphones/ucm116338.htm>
- Environmental Protection Agency: Radiation Basics
<https://www.epa.gov/radiation/radiation-basics>
- Microwave News <http://microwavenews.com/>

Key Documents & Sources:

Federal Communications Commission Office of Engineering & Technology (1997). OET Bulletin 65: Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.

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

Federal Communications Commission Office of Engineering & Technology (1999). OET Bulletin 56: Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields.

https://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf

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>

FCC Proceeding 13-84. "Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies." <http://apps.fcc.gov/ecfs/proceeding/view?name=13-84>

FCC Proceeding 03-137. "FCC Proposes Changes in the Commission's Rules and Procedures Regarding Human Exposure to RadioFrequency Electromagnetic Energy."

<http://apps.fcc.gov/ecfs/proceeding/view?name=03-137>

Federal Communications Commission. "Radio Frequency Safety."

<https://www.fcc.gov/general/radio-frequency-safety-0>

Federal Communications Commission. "RF Safety FAQs." <https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety>

Docket OSHA-2014-0018. Request for Information: Communication Towers Safety.

<https://www.regulations.gov/#!docketDetail;rpp=100;so=DESC;sb=docId;po=0;D=OSHA-2014-0018>

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https://www.osha.gov/dte/library/radiation/nir_stds_20021011/

Federal Communications Commission (2000). A Local Government Official's Guide to Transmitting Antenna RF Emission Safety: Rules, Procedures, and Practical Guidance.

http://wireless.fcc.gov/siting/FCC_LSGAC_RF_Guide.pdf

Federal Communications Commission. Last revised 2015. Consumer Guide - Human Exposure to Radio Frequency Fields: Guidelines for Cellular and PCS Sites.

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

Enforcement:

AT&T v. Orchitt. Supreme Court of Alaska No. S-12058, No. 6139. (2007).

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Federal Communications Commission. (2005). Notice of Apparent Liability for Forfeiture – In the Matter of Cumulus Licensing LLC ,File No. EB-03-DV-264. https://apps.fcc.gov/edocs_public/attachmatch/DOC-255968A1.pdf

Federal Communications Commission (2014). "Verizon to Pay \$50K to Resolve Radiofrequency Exposure Investigation." <https://www.fcc.gov/document/verizon-pay-50k-resolve-radiofrequency-exposure-investigation>

Federal Communications Commission (2007). Forfeiture Order – In the Matter of Entravision Holdings, LLC., File No.: EB-04-TP-161. https://apps.fcc.gov/edocs_public/attachmatch/DA-07-549A1.pdf

Federal Communications Commission, Spectrum Enforcement Division. "Enforcement Actions."

<https://transition.fcc.gov/eb/sed/rfse.html>

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World Health Organization: International Agency for Research on Cancer (2011). Press Release No. 208. "IARC Classifies Radiofrequency Electromagnetic Fields as Possibly Carcinogenic to Humans."

http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

Bowman J. (2010). Reflections on the INTERPHONE Study of Cell Phones and Brain Cancer. NIOSH Science Blog. <http://blogs.cdc.gov/niosh-science-blog/2010/07/26/cancer/>

U.S. Food and Drug Administration. "Interference with Pacemakers and Other Medical Devices."

<http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/ucm116311.htm>

Institute of Electrical and Electronics Engineers.(1998). Radiofrequency Interference with Medical Devices. <http://ewh.ieee.org/soc/embs/comar/interfer.htm>

Centers for Disease Control. Frequently Asked Questions about Cell Phones and Your Health.

http://www.cdc.gov/nceh/radiation/factsheets/224613_faq_cell-phones-and-your-health.pdf

PPE: RF Clothing & Monitors

OSHA (1993, updated 2006). Letter of Interpretation – RF PPE.

https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=21095

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

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

Other:

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CTIA – The Wireless Association. Annual Wireless Industry Survey. <http://ctia.org/your-wireless-life/how-wireless-works/annual-wireless-industry-survey>

Health Physics Society. “Radiofrequency (RF) Radiation.” <http://hps.org/hpspublications/articles/rfradiation.html>

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Mobile Manufacturers Forum & the GSM Association (2008). RF Safety at Base Site Stations. <http://www.gsma.com/publicpolicy/wp-content/uploads/2012/03/gsma2008rfworkerssafetymmf-1.pdf>

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Barry J. “Cell phone towers raise new concerns about safety.” CBS5 Arizona. Updated Nov. 25, 2014. <http://www.cbs5az.com/story/27348721/cell-towers-raise-concerns-about-safety>

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