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

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

*Last updated 06/17/2015
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](image)

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

Sources: RF Compliance Studies, accessed April 28, 2016. http://wirelessestimator.com/content/industryinfo/64
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.
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.
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:

  https://www.osha.gov/OshStd_gif/10gfq_11.gif
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.
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.
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.
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).

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](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.dejerocom/assets/files/documents/D-PB114-004_EnGo.pdf](http://www.dejerocom/assets/files/documents/D-PB114-004_EnGo.pdf)

Sources:
- IEEE Std. 802.1 [http://standards.ieee.org/about/get/802/802.1.html](http://standards.ieee.org/about/get/802/802.1.html). (available for free)
- FCC. Specific Absorption Rate (SAR) for Cellular Telephones. [https://www.fcc.gov/general/specific-absorption-rate-sar-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, their 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**

![AntennaSearch Map Screenshot](image)
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](image)

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](image)
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]](image)

- **Ownership Info**
  - Licensee: Company: Federal License Management
    - Address: 1754 E. 3rd Street Suite 109
    - Williamsport, PA. 17701-1882
    - License Contact: [email protected]
  - Licensee: Company: International Brotherhood of Electrical Workers
    - Address: 900 7th Street NW
    - Washington, DC, 20001
    - Licensee Contact: Jason Reidenbach - Chief Engineer

- **Transmitter Characteristics**
  - Service Type: Mobile/Private
  - Call Sign: WQGUT41
  - Latitude: 35.9018
  - Longitude: -77.9200
  - Structure Type: NA
  - Height of Structure: 229.6 feet
  - Ground Elevation: 183.5 feet
  - Overall Height: 669.1 feet
  - Structure Address: 900 7th Street NW
  - Washington, DC

- **Transmitter Frequencies**
  - Emitter Type: FM
  - Frequency (MHz): 462.5
  - Power (Output): 25W
  - Power (Radiated): 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.

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.


The FCC Universal Licensing System (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.
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.

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**

![Image of search results](https://oeaaa.faa.gov/oeaaa/external/searchAction.jsp?action=showSearchArchivesForm)

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.


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](http://www.montgomerycountymd.gov/cable/Towers/home.html) 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.

![Figure 6-P](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

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.
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](https://aca.accela.com/Atlanta_Ga/Default.aspx). 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.
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](image)

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.
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

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.