

Running head: ASSESSING THE DANGER OF RADIOFREQUENCY RADIATION

Executive Development

Assessing the Danger of Radiofrequency Radiation to Firefighters Assigned to Fire
Stations with Cell Towers

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: _____

Abstract

The City of Austin is considering the placement of cell towers at four fire stations. The International Association of Fire Fighters (IAFF) opposes co-location of cell towers. The purpose of this research was to determine current standards for radiofrequency (RF) exposure, ascertain whether IAFF concerns were consistent with published research and survey other fire departments on their current practices. The research found the current maximum recommended levels of exposure are not approached by the typical cell tower installation. Furthermore many large fire departments do allow cell towers at their stations. Recommendations were made for the City of Austin to allow installation of cell towers but have the level of RF emissions monitored and made available to department members.

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Assessing the Danger of Radiofrequency Radiation to Firefighters Assigned to Fire Stations with Cell Towers

The cell phone has become a ubiquitous communications tool, whose numbers continue to multiply at an exponential rate. The research firm, Informa, stated that, on November 29, 2007, worldwide mobile telephone subscriptions reached 3.3 billion - equal to half the world's population - only 26 years after the first cellular network was launched (Reuters, 2007). Furthermore, cell phone users demand enhanced connectivity and wider coverage areas. Trying to meet this demand has required cell service providers to dramatically expand their infrastructure. A big part of the cellular system infrastructure is the cell site or cell tower. Numerous cell sites are required to increase both the capacity and coverage of a network (International Engineering Consortium, n.d.). Cell providers looking for locations to host cell sites have seized upon non-traditional locations to expand their service delivery. For example, many church bell towers in New England now perform double duty as cell towers (Bansal 2004). Another location that has increased in popularity as a cell site is the neighborhood fire station. Fire stations tend to be centrally located; and governmental entities, always on the look out for new revenue streams, are easily convinced to lease space at fire stations to host these cell towers. Opposing this trend is the International Association of Fire Fighters (IAFF). The IAFF has expressed concerns about potential deleterious effects to the health of the firefighters exposed long-term to radiofrequency (RF) radiation. In August 2004, the IAFF stated that it was opposed to cell towers being located at fire stations (International Association of Firefighters, 2005).

The problem is that the City of Austin has been approached by private cell phone providers who would like to place cell towers at four fire stations; however, Austin's IAFF affiliate, Local 975, has adopted the International's stance and opposes the cell tower installation. As the Chief of Communications, I was asked for my opinion on the proposed installation. The purpose of the research was to be able to present a constructive and informed opinion on the matter.

The research method used was descriptive with an extensive literature review. The research incorporated a survey of fire agencies across the country to determine current practices and policies regarding cell tower installations at fire stations.

This research paper will address the following questions:

What are the current standards for human exposure to RF radiation?

What are the documented health effects from RF exposure?

What, if any, studies have been done on humans regarding long term exposure to RF radiation?

What are current practices of fire agencies around the country with respect to cell tower installation at fire stations?

Background and Significance

The Austin Fire Department celebrated its 150th anniversary on September 25, 2007. The fire department has seen tremendous growth from the early days of Hook and Ladder 1 with their motto of "Always Ready" protecting a sleepy town to today's large metropolitan fire department protecting the 16th largest city in the nation (Austin Fire Museum, n.d.). The Austin Fire Department (AFD) serves a population of 709,000

citizens from 43 fire stations spread over the city's 256 square miles. During the fiscal year 2005 - 2006 AFD responded to 68,335 calls (Austin Fire Department 2007).

While the City of Austin has seen tremendous growth over the past 150 years, it pales in comparison the growth of the relatively new wireless industry. Cell phones were first introduced in 1981 when Nordic Mobile Telephony turned on networks in Saudi Arabia, Sweden and Norway (Reuters, 2007). Since that time, the cell phone has gone from being a luxury item affordable by only a few to being considered a necessity by many. And it's not just voice communication creating the demand. The BlackBerry™ and other hand-held communication devices that require wireless communication to access the internet have dramatically increased the demand for wireless service. This demand, not only for increased capacity but expanded coverage as well, has required cell service providers to continue to beef up their infrastructure. Technology has reduced the size of giant cell towers and antennas to a manageable size. Consequently, cell sites and their associated towers and/or antennas can now be placed in or around many different types of buildings and facilities. Fire stations, by their very nature, are strategically located throughout the community and often seem to be the perfect place to locate cell towers. Combine this with the fact that cities can receive significant compensation and the idea of locating cell towers at fire stations has become popular.

Recently AFD was approached by two private cell phone providers, each of whom wanted to place cell towers at two fire stations (G. Hager, personal communication, July 12, 2007). AFD already has one fire station hosting a cell site and this would bring the total to five. Local 975, the IAFF affiliate, communicated to the Fire Chief that they opposed the cell towers and forwarded the IAFF's position paper (S. Truesdell, personal

communication, July 16, 2007). The City of Austin (COA) stands to receive significant revenue by allowing the tower to be erected on the site. The IAFF's position is that its members should oppose the co-location of cell towers at fire stations "until a study with the highest scientific merit and integrity is conducted and it is proven that such sitings are not hazardous to the health of our members" (IAFF, 2005, ¶ 2).

Complicating this issue is the Federal regulation that states governmental entities cannot refuse the installation of cell towers based on health concerns (Federal Communications Commission, A Local Government Official's Guide, 2000). Specifically, Section 704 of the Telecommunications Act of 1996 states:

No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions(Federal Communications Commission, Wireless Telecommunications Bureau, 1996, p.12).

So even if the City of Austin and AFD agreed with the opinion of the IAFF, they could not refuse the placement of a cell site based solely on health concerns. This is a complex issue that requires careful deliberation.

The National Fire Academy's Executive Development course stressed information based decision making. Using applied research and information gathering to make decisions is at the core of the Executive Fire Officer Program. This research project also

satisfies the United States Fire Administration's Operational Objective to respond appropriately in a timely manner to emerging issues.

Literature Review

The literature review for this applied research project focused first on a basic understanding of radiofrequency (RF) radiation, including how and by what means it is created. Then it looked at the relationship between cell site configuration and operation and radiofrequency emissions.

Electromagnetic radiation consists of waves of electric and magnetic energy moving together at the speed of light (FCC Office of Engineering Technology RF Safety, n.d.) Radiofrequency or RF describes that portion of the electromagnetic energy spectrum containing radio waves and microwaves. Depending on the context, RF emissions can be viewed in terms of energy, radiation or fields. For the purposes of this paper the research focused primarily on radiofrequency energy and emissions in the form of radiation. The most common sources of RF radiation exposure that people receive in their daily lives come from radio and television broadcasts, radar, microwave ovens and cellular telephones (Ziskin et al. 2002). When a radio station or a cellular base station or tower broadcasts it generates electromagnetic waves of a particular size or "frequency" that radiate away from the transmitting device, usually an antenna. This RF radiation is then received by devices tuned to that frequency, such as a radio or cell phone (Cleveland & Ulcek, 1999).

Where do cell towers fit in? A cellular phone system uses a large number of wireless transmitters or "base stations" to create a seamless communication network (Institute of Electrical and Electronics Engineers Committee on Man and Radiation, 2000). Each

transmitter provides an area or “cell” of coverage. The base station or “cell” sites usually consist of a tower or other elevated structure for mounting antennas and one or more sets of transceivers and associated equipment to broadcast and receive wireless communication (International Engineering Consortium, n.d.). With respect to radiofrequency radiation, the transmitting antenna is the focus “Base station antennas are frequently located on tall tapered poles (called monopoles), much like lamp standards, or on towers of a metal strut lattice construction” (IEEE COMAR, 2000, p. 2). In the strictest definition a cell tower is a vertical structure to which the cell site antennas are affixed however the term “cell tower” has become a synonym for a cell site base station and the two terms are used interchangeably. Becoming more common are antenna affixed to existing structures including buildings, water tanks and high-voltage transmission-line towers. (IEEE COMAR, 2000).

Normally, base station antennas are located anywhere for 50 to 200 feet above ground. (Cleveland & Ulcek, 1999). The antennae must be high enough to provide coverage throughout the cell but low enough so as not to interfere with remote cell sites using the same frequency (IEEE COMAR, 2000). The energy levels transmitted by a base station are regulated by the FCC (FCC, A Local Government Official’s Guide, 2000). Base station antennas come in two primary types. The most common type is a sector arrangement in which groups of transmitting and receiving antennas are oriented 120 degrees apart and aimed at the horizon. The radiation pattern from this arrangement expands outward in a wedge shape (FCC OET RF Safety, n.d.). Omni directional antennas broadcast uniformly over 360 degrees. An Omni-directional antenna’s radiation pattern can be described as a “thin donut or pancake centered around the antenna. In both

types of the antennas the beam produced is very wide in the horizontal aspect but extremely narrow in the vertical aspect (IEEE COMAR, 2000). “Measurements made near a typical cellular installation, especially those with tower-mounted antenna, have shown ground-level power densities are thousands of times less than the FCC’s limits for safe exposure.” (FCC OET RF Safety, are cellular and pcs antennas safe? n.d. ¶ 5).

Both in the US and internationally several different organizations have established guidelines for exposure to RF energy. In the United States these include the Federal Communications Commission (FCC), the Institute of Electrical and Electronics Engineers (IEEE) and the National Council on Radiation Protection and Measurements (NCRP). Internationally the United Kingdom’s National Radiation Protection Board (NRPB) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) also have guidelines dealing with exposure to RF radiation (IEEE COMAR, 2000). While the guidelines differ in some details they are similar with respect to the frequency ranges used by cellular and personal communications systems (PCS). In fact in 1996, the FCC updated its guidelines for evaluating human exposure to radiofrequency (RF) fields from cellular radio and PCS base stations and these guidelines are identical to those recommended by the National Council on Radiation Protection and Measurements. These guidelines are also similar to the 1992 guidelines recommended by the American National Standards Institute and the Institute of Electrical and Electronic Engineers (FCC OET RF Safety, n.d.).

Most of the exposure guidelines are divided into two distinct sections. Controlled or occupational exposure guidelines are set for those people who are exposed as a consequence of their employment. Furthermore, these employees must be fully aware of

the potential for RF exposure and be able to exercise control over the amount of exposure (Cleveland, Sylvar & Ulcek, 1997). The second set of guidelines cover the general public or those employees who may not be fully aware of the risk for exposure or who have no control over their exposure. This second, more stringent, set of guidelines would be applicable to firefighters assigned to a station that has a cell tower co-located.

A commonly used unit for characterizing an RF electromagnetic field is “power density.” Power density is defined as power per unit area and is most accurately used when the point of measurement is located away from the antenna (FCC OET RF Safety, n.d.). RF energy emissions are typically expressed in W/cm^2 (Cleveland, Sylvar & Ulcek, 1997). Watts can be further divided into milliwatts (mW) and microwatts (μW). One milliwatt equals $1/1000^{\text{th}}$ of a Watt and one microwatt equals $1/1000^{\text{th}}$ of a milliwatt or $1/1,000,000^{\text{th}}$ of a Watt. In the FCC report, guidelines call for a maximum exposure in the frequencies used by cellular services - 800 to 900 megahertz - of 580 microwatts per square centimeter ($580\mu\text{W}/\text{cm}^2$) for the uncontrolled or public exposure (Cleveland, Sylvar & Ulcek, 1997). It is permissible in occupational exposures for the RF radiation to be above the guidelines for brief periods of time as long as the average exposure is below the maximum exposure limit. However RF radiation in an uncontrolled or public environment should never exceed the emission limit (Cleveland & Ulcek, 1999). The FCC’s information sheet on RF exposure states that numerous sources have consistently shown that “ ‘worst-case’ ground-level power densities near typical cell towers are on the order of $1\mu\text{W}$ or less” (FCC OET information on RF exposure, n.d. Cellular and PCS base stations, ¶ 6). The report goes on to state that calculations have shown that in order for a person to be exposed to levels near the FCC maximums all of

the transmitters would have to be in continuous operation at maximum power and that the individual must place themselves within the main transmitting beam, located at the height of the antenna, and within a few feet of the antenna. (FCC OET information on RF exposure, n.d.).

From a medical point of view, perhaps the most important aspect of RF radiation is that it is non-ionizing (Ziskin et al. 2002). The photon energies of RF electromagnetic waves are not great enough to cause ionization of atoms and molecules and are therefore characterized as non-ionizing radiation (Cleveland & Ulcek, 1999). Ionizing radiation, such as X-rays and gamma rays, has sufficient energy to dislodge orbiting electrons from atoms. Ionizing radiation can cause ionization, free radical production and subsequent chromosomal damage. Unlike X-rays and other ionizing radiation any damage that results for RF exposure is not cumulative (Ziskin et al.).

All established hazards of RF radiation don't occur until exposure levels that cause heating of the body tissues by the absorption of the incident energy. (IEEE COMAR, 2000). The eyes and testes are two areas of the body that are known to be vulnerable to RF energy because of the relative lack of blood flow to dissipate heat (Cleveland & Ulcek, 1999). Laboratory experiments on rabbits have shown that short term (30minutes to 1 hour) exposure to high levels of RF radiation ($100\text{-}200\text{ mW/cm}^2$) can cause cataracts. However, cataract production in humans would require such high RF radiation that it would be accompanied by extreme pain and potentially, burns to the skin (Ziskin et al. 2002). While the vast majority of RF radiation overexposures result in no symptoms, the most common non-psychological symptom of overexposure is a sensation of warmth in the part of the body that has been exposed (Ziskin et al.).

Thresholds for acute RF radiation-induced biological effects have been the focus of many scientific studies over the past few years. Government agencies and standard setting organizations have reviewed this data, including the NCRP in 1986 COMAR in 1995, and IEEE in 1999 (Ziskin et al. 2002). While the level of the RF field outside the body is best quantified by power density, the level of absorbed RF energy, or dose, is quantified in terms of specific absorption rate (Cohen et al. 2005). Specific absorption rate (SAR) is the measure at which the body absorbs RF energy. (FCC OET information on RF exposure, n.d.). SAR is the total power absorbed by a human (in watts) divided by the body mass and is expressed in W/kg. (Cohen et al, 2005). SAR is not a direct measure; rather, it is computed or measured experimentally using models whose electrical characteristics are similar to those of tissue (Cohen et al.). IEEE and NCRP's exposure guidelines are based on the studies that show potentially harmful biological effects can occur at 4 W/kg.

The reproducible biological effect judged to be adverse with the lowest threshold is a reduction in the rate of lever-pushing behavior in a number of laboratory-animal species, including two types on monkeys. This response was typically observed to occur in association with prolonged (tens of minutes) RF radiation exposures producing a whole-body rate of energy absorption of approximately 4 W/kg and a core temperature elevation of about 1 degree Celsius. (Ziskin et al. 2002 p.388).

Using these studies all of the aforementioned agencies set guidelines that limited the occupational maximum exposure to one tenth of this threshold. Whole body exposure

limits are set at 0.4 W/kg for controlled/occupation exposures and 0.08 W/kg for the uncontrolled or general public exposure (FCC OET RF Safety, n.d.).

Outlined as well are partial body exposure limits also known as localized SAR. An example of this type of exposure would be the RF exposure to the head of a cellular phone user. Current guidelines use 1.6 W/kg as the limit for an uncontrolled exposure or exposure to the public while partial body exposures of up to 8 W/kg are acceptable in an occupational or controlled exposure (FCC OET RF Safety, n.d.). As a point of interest, several cellular phone handsets emit RF radiation that exposes the user to levels near the maximum SAR 1.6 W/kg on an intermittent basis (FCC OET information on RF exposure, n.d.). Cell phone providers are now required to determine and provide the SAR rate of each phone (FCC OET RF Safety, n.d.).

Studies on the effects on humans of long term RF exposure have consisted mostly of epidemiological studies. In 2004, The International Commission for Non-Ionizing Radiation Protection (ICNIRP) Standing Committee on Epidemiology did a comprehensive review of the epidemiologic studies of the effect of RF fields on human health. They found that there is “no consistent or convincing evidence of a causal relationship between RF exposure and any adverse health effects” (Ahlbom, Green, Kheifets, Savitz, & Swerdlaw, 2004, p. 1741). The ICNIRP did, however, state that the studies had too many deficiencies to rule out an association (Ahlbom et al. 2004).

Specific to cell towers as a cause of cancer, the American Cancer Society reports that there have been no human studies that have focused specifically on cell phone towers; however, a number of animal studies generally showed no carcinogenic effect of radio waves (American Cancer Society, n.d.). Furthermore, scientific evidence indicates that

exposure to RF radiation is “not mutagenic and therefore unlikely to act as the initiator of carcinogenesis” (American Cancer Society, n.d. what does the animal evidence say?). To date, there have been no human studies that have focused specifically on cancer risks from cell towers (American Cancer Society, n.d.).

In 1996 the World Health Organization (WHO) established the International Electromagnetic Fields Project (EMF). The International EMF project has established a program to monitor the EMF scientific literature to evaluate the health effects from exposure to EMF in the range from 0 to 300 GHz, to provide advice about possible EMF hazards and to identify suitable mitigation measures. Following extensive international reviews the International EMF Project has promoted research to fill gaps in the knowledge (World Health Organization, Electromagnetic Fields and Public Health, 2001). While no health effects are expected from exposure to RF fields from base stations and wireless networks, research is still being promoted by WHO to determine whether there are any health consequences from the higher RF exposures from mobile phones. The International Agency for Research on Cancer, a WHO specialized agency is expected to conduct a review of the cancer risks from RF fields in 2006-2007 and the International EMF Project will then undertake an overall health risk assessment for RF fields in 2007-2008 (World Health Organization, Electromagnetic Fields and Public Health, 2006).

Procedures

Descriptive research methods were used to identify the current standards for human exposure to RF radiation, the documented health effects to exposure to RF radiation and whether there had been any studies done on long term exposures to RF radiation. In

addition, the research looked at the practices of other fire departments across the country to determine their practices with regards to hosting cell sites.

The procedures used to research radiofrequency radiation and its effects on humans consisted of reviewing existing research and literature on the subject as well as reviewing Federal standards and guidelines for RF exposure. The reviewed materials included news sources, periodicals, journals, government standards and publications as well as numerous internet sites.

Applied research was done to determine the practices of other fire departments across the country with respect to cell towers. The research consisted of a survey of the fire departments serving the 100 most populous cities in the United States (US) as determined by the United States Census Bureau (United States Census Bureau, Population Division. 2007).

The primary focus of the survey was to determine if a fire department did, in fact, have any cell towers co-located with their fire stations. If the answer was in the affirmative, the survey asked follow up questions to determine how many stations/locations had cell towers and if revenue was being generated, determine whether the fire department received that revenue directly or whether the money went to the government entity. Finally, the survey asked if the fire department had any written procedures that governed the location and operations of the cell tower at their stations

Using contact information gathered from each fire department's website, the author contacted each department by phone, explained the primary focus of the survey, and then specific to the individual department, spoke with the person best able to answer the questions. Responses were received from all 100 departments.

The survey focused on three major areas. The first four questions looked at the statistical background of the fire department. Specifically asked was the number of employees, the number of fire stations and whether the department was paid, volunteer or a combination.

The second section was the primary focus of the survey and asked one question - whether the fire department had any private cell towers located at fire stations. Along with an affirmative and negative choice, the survey also offered the choice of a third answer for those departments that had been contacted but had either declined or were still discussing it.

If the respondents answered yes in the second section, they went to the third section and were asked a total of three questions; how many fire stations had cell towers, did the department or the city get the money from the lease, and if the department had any written protocols on cell tower placement.

Results

The first research question asked what are the current standards for human exposure to radiofrequency radiation. Both the FCC and NCRP have set the maximum permissible exposure level (MPE) for RF radiation both in terms of power density, which measures the levels of RF radiation outside the body and specific absorption rate, which measures the RF radiation inside the body tissues. SAR can be more appropriately thought of as the dose, in terms of RF radiation (Cohen et al. 2005). In terms of power density the MPE is 580 microwatts/centimeter squared ($580\mu\text{W}/\text{cm}^2$) for the frequencies used by cellular towers (Cleveland and Uleck, 1997). The MPE for RF radiation in terms of SAR is 1.6 W/kg . (FCC OET RF Safety, n.d.).

The second question asked what are the documented health effects from exposure to RF radiation. All established hazards of RF radiation occur at levels that cause heating of the body tissue. The most common non-psychological symptom of overexposure is a sensation of warmth in the part of the body that has been exposed (Ziskin et al. 2002). High intensity exposures can cause heating that exceeds the body's ability to dissipate heat resulting in tissue damage or burns, not only externally but internally - think microwave oven (Ziskin et al.).

The third question asked what, if any, studies have been done on humans regarding long term exposure to RF radiation. The primary way that long term exposure to RF radiation has been evaluated is with epidemiological studies. In 2004, The International Commission for Non-Ionizing Radiation Protection (ICNIRP) Standing Committee on Epidemiology did a comprehensive review of the epidemiologic studies about the effect of RF fields on human health. They found that there is “no consistent or convincing evidence of a causal relationship between RF exposure and any adverse health effects” (Ahlbom, Green, Kheifets, Savitz, & Swerdlaw, 2004. p. 1741). WHO reports that there have been only few studies that have investigated the health effects in individuals exposed to RF radiation from base stations. The main reason for this is the difficulty in distinguishing potential health effects of the base station RF as opposed to the other higher strength RF sources (WHO, Electromagnetic Fields and Public Health, 2006). The WHO report concludes “considering the very low exposure levels and research results collected to date, there is no scientific evidence that the weak RF signals from base stations and wireless networks cause any health effects” (WHO Electromagnetic Fields and Public Health, 2006, Conclusions ¶ 1).

The fourth research question asked what are current practices of fire agencies around the country with respect to cell tower installation at fire stations. As previously stated, the survey sample was the fire departments that served the 100 most populous cities in the United States as determined by the US Census Bureau's July 1st, 2006 estimate. All of the departments surveyed were paid departments and all had at least 100 employees.

31 of the 100 fire departments surveyed had at least one fire station with a cell tower. 16 others had been contacted about placing cell towers but had not done so at the time of publication. 53 departments had no cell towers nor, to the best of their knowledge, had ever been contacted about cell tower placement.

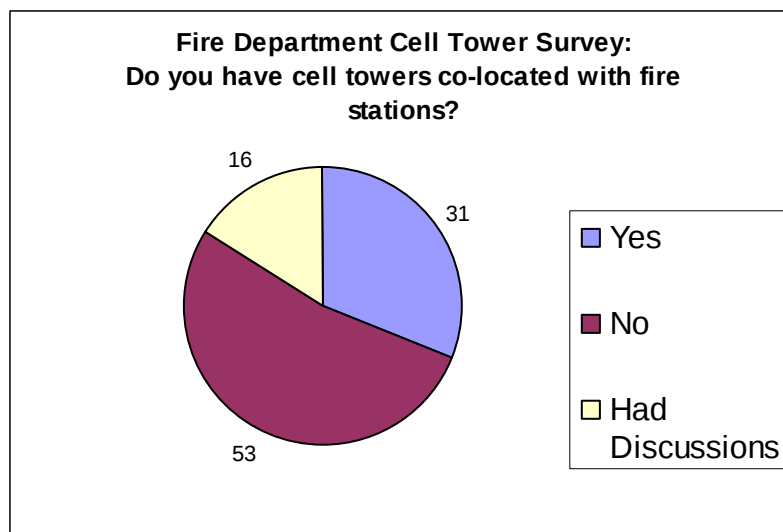


Figure 1

With respect to population, only one of the nine cities that had populations over 1 million had cell towers. 11 of the 23 departments who served a population between 500,001 and 1 million had cell towers and two others had been contacted. Of the 36 departments serving populations from 250,000 to 500,000 11 had cell towers at their stations and eight others had been contacted. Finally, 8 of the 31 departments in cities with populations under 250,000 population had cell towers and six others had been contacted.

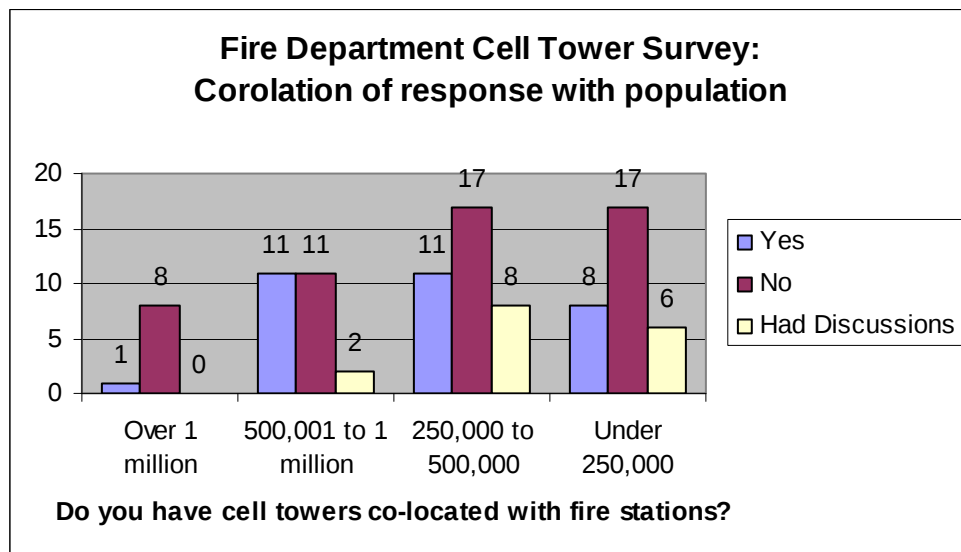


Figure 2

With the exception of the fact that no department that had over 50 stations had cell towers, there was nothing significant about the individual department's number of employees or number of fire stations with respect to cell towers.

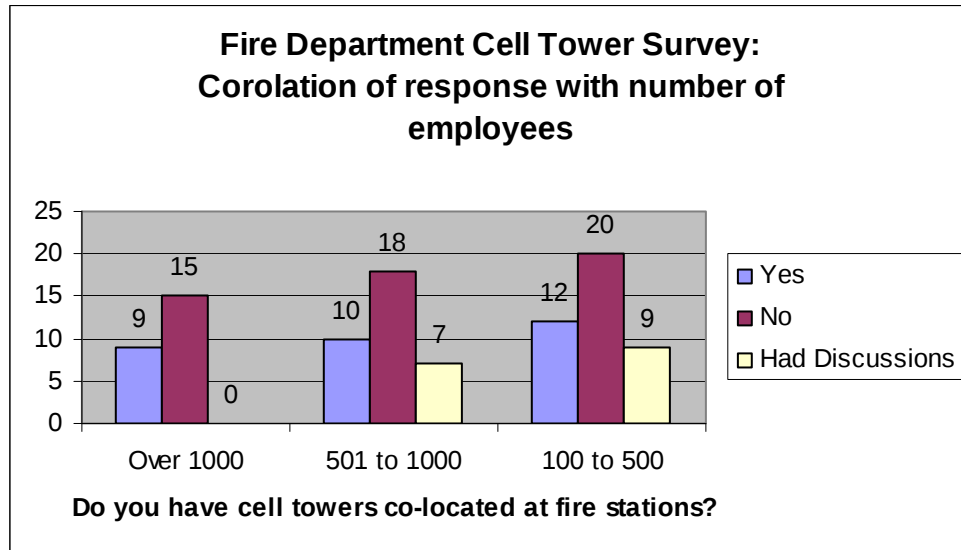


Figure 3

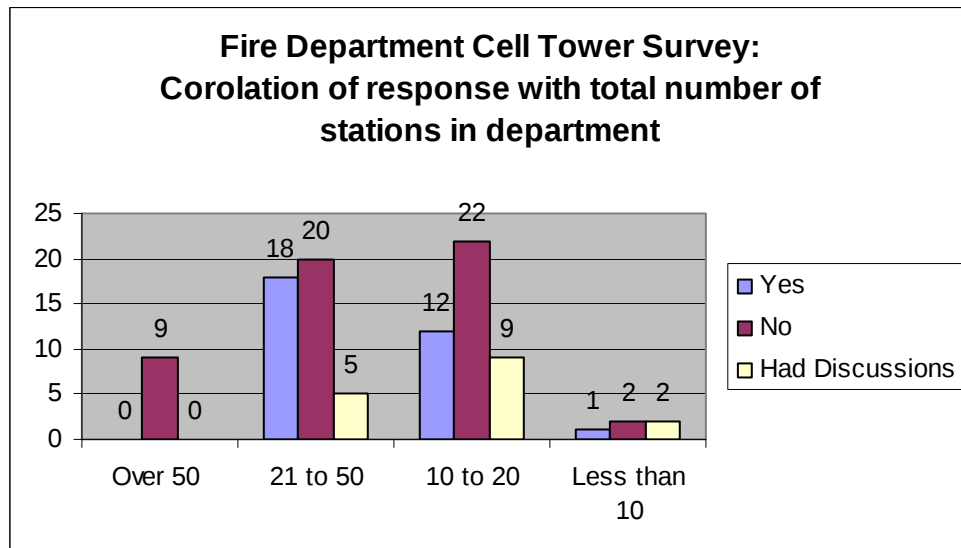


Figure 4

Of the 31 fire departments that had cell towers, 28 had cell tower at 1 to 5 stations while the other three had cell towers at 6 to 10 stations. No department surveyed had towers at more than 10 stations.

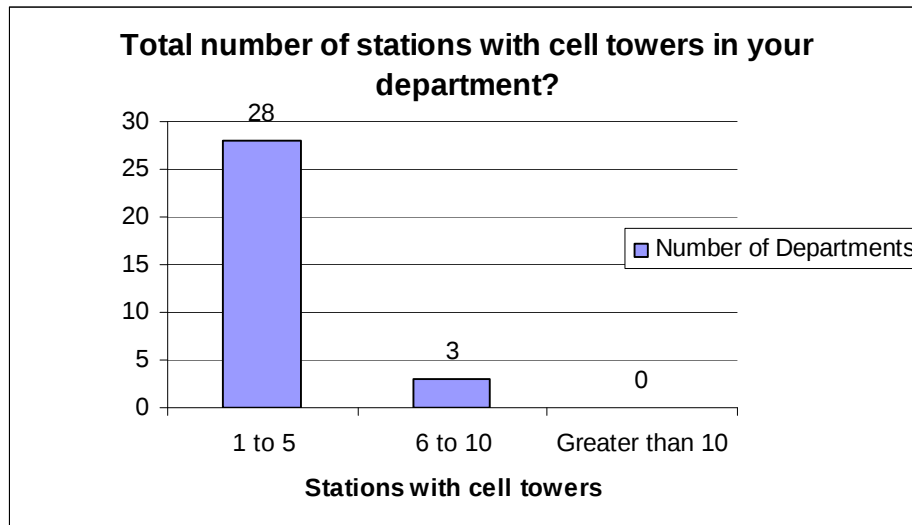


Figure 5

All 31 departments generated money from leasing space for the cell towers. However only 3 of the 31 departments had that money credited to them, all of the others saw the money sent to the city's general fund.

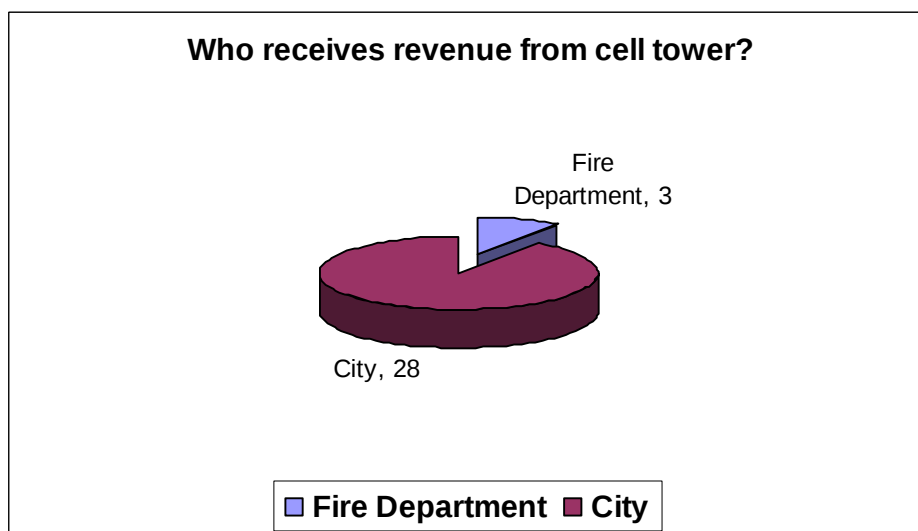


Figure 6

Finally, of the 31 departments with cell towers, only three had written protocols on placement of cell towers at fire stations.

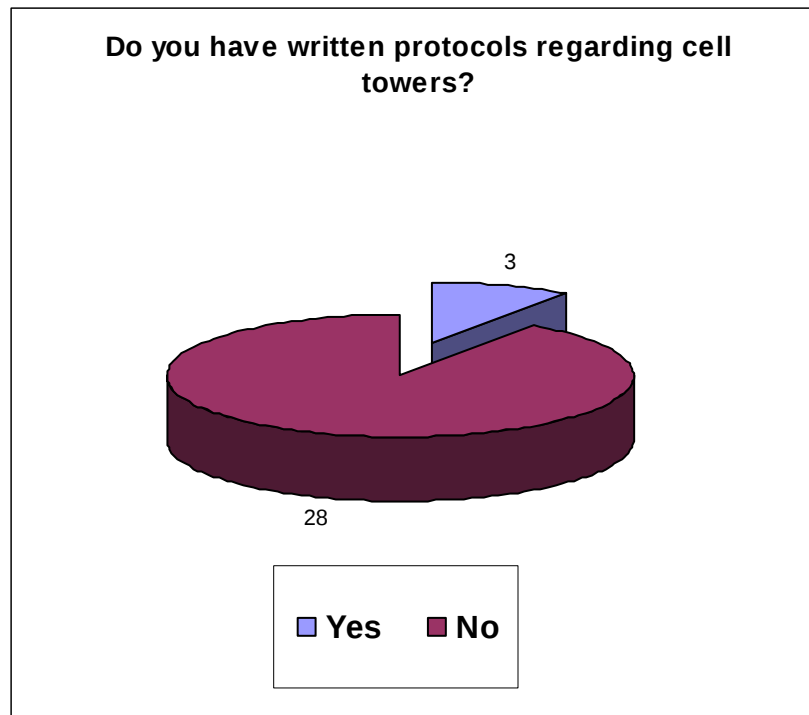


Figure 7

Discussion

In today's high tech world, we are bombarded by RF radiation. The air is full of RF energy coming in from all directions. Radio and television broadcasts, wireless computer networks, microwave ovens, radar, medical equipment, computers and cell phones. In the fire stations our alerting systems, pagers and radios often produce RF. This inundation of RF radiation is a relatively new phenomenon and we probably won't know all of the effects or potential problems from exposure to RF radiation for many years. However, in researching this topic and conducting the literature review, the author could find very little information to substantiate the IAFF concerns over long term exposure to RF

radiation. Specifically, a vast majority of the subject matter experts have stated that there is no evidence of health effects from low levels of RF radiation, including cellular base stations or cell towers. These entities include the World Health Organization, The Institute of Electrical and Electronics Engineers, the Federal Communications Commission, the National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines dealing with exposure to RF radiation (Ahlbom et al.2004; IEEE COMAR, 2000; WHO Electromagnetic Fields and Public Health, 2006)

In several different resources it was stated that the average RF radiation exposure from a cell site or cell tower was hundreds, if not a thousand, times below the FCC maximum exposure level of $580\mu\text{W}/\text{cm}^2$. (FCC, Office of Engineering Technology RF Safety, n.d.; FCC, A Local Government Official's Guide, 2000.; Cleveland & Ulcek, 1999). For a person to even approach the maximum permissible exposure limits, they would have to be at the level of the antenna (often 50 to 200 feet in the air) and stay within a few feet of the antenna for several minutes while it was broadcasting at full power with all transmitters (FCC, Office of Engineering Technology RF Safety).

As the survey of fire department across the county progressed, it became evident that a substantial number of departments had cell towers located at fire department facilities. Almost a full third of the 100 departments queried had at least one cell tower and three departments had 6 to 10 stations with cell towers. Of the remaining 69, 16 of them had been approached by private companies and several departments were in active negotiations. Several of the ones that had been contacted but had elected not to do so said that it was due to pressure from the IAFF local. The setup varied from city to city.

Most of the cell sites were stand-alone and self sufficient; however, some departments had at least part of the equipment inside their fire station which required that the company managing the tower to have some access to the station. Only three departments had developed written protocols on how to manage the cell sites. The other 28, for the most part, deferred to another part of the city government. Similarly, only 3 of 31 departments had any revenue go directly to them. The rest of the agencies saw the money disappear go into the general fund.

It appears evident from the research that most subject matter experts agree that there is no problem with a properly constructed cell tower operating at an occupied facility. Furthermore, many departments are already hosting cell towers at fire stations. While the concerns of the IAFF should not be dismissed out of hand, they should be put into perspective. There is no question that large amounts of RF radiation can be harmful but today's cell sites don't produce anywhere near that amount of radiation. In fact, as the cell providers strengthen their infrastructure, cell sites are increasing in number but actually decreasing in power (FCC, Office of Engineering Technology RF Safety).

Recommendations

Based upon the research conducted, I will be making the following recommendations to the Austin Fire Department.

First, AFD should meet with the Local IAFF Affiliate and try to reach a consensus on cell towers at fire stations. Both groups should have input on whether to move forward and also with how to manage the program. This should include explanations of the lease agreements and the plan of a reoccurring RF survey at the affected stations.

Second, AFD should develop a written procedure for allowing and managing private cell sites and towers at AFD facilities. These procedures should include a radiofrequency survey prior to the installation and after the tower goes operational and those results should be made available to those who are assigned to that facility, similar in concept to a Material Safety Data Sheet. These procedures should include provisions for things such as station access, maintenance schedules, and testing to make sure the tower does not interfere with the radio or dispatching system.

Third, AFD should aggressively pursue at least some of the revenue that will be generated from leasing of the space. Whether it is services in kind, such as station upkeep or remodeling, or a deposit into the training fund, the department should realize a gain from the lease agreement.

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Appendix A

Survey

Department Name_____

Contact_____

1) Number of Employees in your Fire Department:

Under 100 100 to 500 501 to 1000 Over 1000

2) Number of Fire Stations:

Less than 10 10 to 20 21 to 50 Over 50

3) Type of Department:

Paid Volunteer Combination

4) Population Served:

Under 250,000 250,000 to 500,000 500,001 to 1 million Over 1million

5) Do you have any privately-owned cell sites/towers/antennas co-located at fire stations?

Yes No Not currently but have been approached or have had discussions about the possibility of cell tower installation

If Yes to Question 5, please answer the following questions. If No, or Not currently you have completed the survey, thank you!

6) How many fire stations have cell sites/towers/antennas?

1 to 5 6 to 10 11 to 20 more than 20

7) Who receives the money generated by the leasing of the space for the cell site?

No money generated Your Department Governing Agency Don't Know

8) Does your department (or governing agency) have written protocols regarding when cell sites will be allowed to be co-located at fire stations?

Yes No Don't Know

Appendix B

Most populous cities in the United State 1 thru 50
Cell Tower Survey

City	YES	NO	NOT
New York			1
Los Angeles			1
Chicago			1
Houston			1
Phoenix			1
Philadelphia			1
San Antonio	1		
San Diego			1
Dallas			1
San Jose, Calif.	1		
Detroit	1		
Jacksonville			1
Indianapolis	1		
San Francisco	1		
Columbus, Ohio			1
Austin	1		
Memphis			1
Fort Worth			1
Baltimore	1		
Charlotte	1		
El Paso			1
Boston	1		
Seattle			1
Washington			1
Milwaukee	1		
Denver			1
Louisville			1
Las Vegas	1		
Nashville-Davidson			1
Oklahoma City	1		
Portland, OR			1
Tucson			1
Albuquerque			1
Atlanta	1		
Long Beach	1		
Fresno	1		
Sacramento			1
Mesa, Ariz.	1		
Kansas City			1
Cleveland			1
Virginia Beach			1
Omaha	1		
Miami			1
Oakland			1
Tulsa			1
Honolulu			1
Minneapolis			1
Colorado Springs			1
Arlington, Texas	1		
Wichita			1

Most populous cities in the United State 51 thru 100
Cell Tower Survey

	City	YES	NO	NOT
51	Raleigh		1	
52	St. Louis			1
53	Santa Ana, Ca	1		
54	Anaheim, CA			1
55	Tampa	1		
56	Cincinnati		1	
57	Pittsburgh		1	
58	Bakersfield, CA		1	
59	Aurora, CO	1		
60	Toledo	1		
61	Riverside, CA	1		
62	Stockton, CA		1	
63	Corpus Christi, Tex.			1
64	Newark		1	
65	Anchorage		1	
66	Buffalo			1
67	St. Paul		1	
68	Lexington, KY			1
69	Plano, TX		1	
70	Fort Wayne, IN		1	
71	St. Petersburg, FL	1		
72	Glendale, AZ			1
73	Jersey City		1	
74	Lincoln, NE	1		
75	Henderson, NV	1		
76	Chandler, AZ	1		
77	Greensboro, N.C.		1	
78	Scottsdale, AZ		1	
79	Baton Rouge		1	
80	Birmingham, AL	1		
81	Norfolk, VA		1	
82	Madison, WI			1
83	New Orleans		1	
84	Chesapeake, VA			1
85	Orlando			1
86	Garland, TX		1	
87	Hialeah, FL		1	
88	Laredo, TX	1		
89	Chula Vista, CA		1	
90	Lubbock, TX		1	
91	Reno			1
92	Akron, OH		1	
93	Durham, NC		1	
94	Rochester, NY		1	
95	Modesto, CA		1	
96	Montgomery, AL		1	
97	Fremont, CA	1		
98	Shreveport, LA	1		
99	Arlington, VA		1	
100	Glendale, CA			1