TECHNICAL EXHIBIT
APPLICATION FOR LICENSE
RADIO STATION WKYS(FM)
WASHINGTON, DC
CH 230B 24.5 KW 215 M

Technical Statement

This Technical Exhibit, of which this statement is part, was prepared on behalf of radio station WKYS(FM) on Channel 230B at Washington, DC. WKYS(FM) has replaced its non-directional transmitting antenna with a new non-directional antenna. There is no change in the antenna radiation center above ground level or the effective radiated power of 24.5 kilowatts. By this instant application, station licensure for the new facility is requested. Figure 1 is a tabulation of the RF Transmission System Specifications.

The replacement of the antenna system will not affect the groundlevel radiofrequency radiation exposure around the WKYS(FM) transmitter site. Enclosed within the Appendix is an *RF Safety Report, an Analysis of RF Field Levels at the Studio and Broadcast Facility of WRC Television, December 26, 2005.* WKYS(FM), which is co-located at the WRC transmitter site, is included in this analysis. As stated within the report, “The RF field levels on the ground at WRC’s broadcast facility were below the minimum measurement capability of the survey instrument in all areas.” Furthermore, the WKYS(FM) antenna replacement is predicted to contribute less than five percent of the

groundlevel power density of the Commission's guideline value for an uncontrolled environment for a FM radio station.

Charles A. Cooper

March 31, 2008

du Treil, Lundin & Rackley, Inc.
201 Fletcher Avenue
Sarasota, Florida 34237
941.329.6000

Figure 1

TECHNICAL EXHIBIT
APPLICATION FOR LICENSE
RADIO STATION WKYS(FM)
WASHINGTON, DC
CH 230B 24.5 KW 215 M

WKYS(FM) RF Transmission System Specifications

Description	System
Transmitter Power Output (18.8 kW):	12.7 dBk
Transmission Line Loss (3″ Air Dielectric) 180 feet:	0.2 dB
Transmission Line Loss (MI-561579 6-1/8″ Air Dielectric) 530 feet:	0.2 dB
Dielectric DCR-M3B1 Full-Wave Spaced Antenna Gain (1.45 Power Gain):	1.6 dB
Effective Radiated Power (24.5 kW):	13.9 dBk

APPENDIX

RF SAFETY REPORT, AN ANALYSIS OF RF FIELD LEVELS AT THE STUDIO AND BROADCAST FACILITY OF WRC TELEVISION, DECEMBER 26, 2005

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RF Safety Report

An Analysis of RF Field Levels at the Studio and Broadcast Facility of WRC Television

Prepared for
NBC Television Stations Division

and

WRC Television

Washington, District of Columbia

December 26, 2005

Executive Summary

Purpose

The Environmental Health and Safety Department of the National Broadcasting Company, Inc. (NBC) Television Stations Division commissioned this RF Safety Report. The primary objective of the analysis and report is to determine whether the RF field levels in the vicinity of the studio and transmitter facility of NBC television station WRC are in compliance with Federal Communications Commission (FCC) and Occupational Safety and Health Administration (OSHA) Regulations regarding RF radiation safety. WRC is part of NBC's Television Stations Division. The other objectives are to determine whether operating procedures represent industry-best practice regarding RF safety and whether any RF safety risks exist.

Description of WRC Facilities

The major market for WRC is metropolitan Washington, District of Columbia. WRC broadcasts from a small, two-tower facility located in the northwest corner of Washington, DC. The WRC studio, NBC network news, MSNBC, and CNBC all share space in the same building. The two towers are located very close to the building and to each other. The facility is owned and operated by WRC/NBC.

RF Safety Concerns at WRC Facilities

Because WRC owns and operates the facility and has other licensees as tenants, it must be concerned with regulatory compliance and liability issues in addition to personal safety.

The main tower has an elevator that can be stopped at four platforms. The elevator is in the main beam of a tenant's television antenna on the shorter tower when it is in the vicinity of the third platform. Although the elevator shields a large percentage of the energy, the RF field levels inside the elevator exceed the FCC's Maximum Permissible Exposure (MPE) limits at elevations roughly the same as the television antenna on the nearby tower. WRC personnel are well aware of this situation and have written procedures that must be followed whenever anyone ascends the main tower.

The auxiliary antenna for the FM station located on the same tower is just below the television antennas. It can be assumed that very strong RF fields will be present whenever it is in use. These fields are likely to be additive to the fields from the television antenna.

It is recommended that additional signs that warn of the RF field levels on both towers and especially on the third platform be installed. Specific recommendations are described in Section 3: Risks and Recommendations.

The RF field levels on the ground at WRC's broadcast facility were below the minimum measurement capability of the survey instrument in all areas. Based on the measurement range of the survey equipment, this means that the RF field levels on the ground are definitely less than 3 percent of the FCC's MPE limit for

General Population/Uncontrolled exposure and are most likely less than 1 percent of these limits.

The RF field levels at ground level are negligible. The only RF radiation safety concerns at ground level pertain to those individuals who

- Perform maintenance on the two satellite-uplink antennas. One of the two satellite antennas is operated by NBC Network.
- Perform maintenance on the satellite news-gathering (SNG) truck antenna.

There are no RF safety concerns at this facility except for those who ascend either of the two towers and/or perform maintenance on the satellite antennas or SNG truck antenna. The facility is fully compliant with the RF safety requirements of the FCC.

Goals

The goals of WRC and NBC are to:

- Minimize the risk to all employees, contractors, and visitors.
- Comply with all FCC Regulations.
- Comply with all OSHA Regulations.
- Comply with all state and local regulations.
- Minimize liability risk.

Statement of Richard R. Strickland, RF Safety Consultant

Richard R. Strickland of RF Safety Solutions LLC certifies that the statements in this report accurately describe, to the best of his knowledge, the conditions at the WRC television studio and transmitter facility in Washington, DC, when surveyed on December 1, 2005. The findings within this report are based on the observations from that survey and sound engineering practice. Changes in operating practices and/or hardware or property reconfigurations should be followed by another survey and report modification as appropriate.

Table of Contents

Executive Summary

Section 1: Overview of Findings

Results of Site Measurements and an Investigation of Operations

Section 2: Standards, Calculations, and Measurements

Measurements Compared to FCC Regulations

Section 3: Risks and Recommendations

The Main RF Safety Risks Are on the Towers

Appendices

Section
1

Overview of Findings

Results of Site Measurements and an Investigation of Operations

Overview

WRC's studio and broadcast transmission facility is located in Washington, District of Columbia. The site has no RF safety concerns except for personnel who ascend either of the two towers or perform maintenance on either the satellite-uplink antenna or the SNG truck antenna.

The findings are as follows:

- **RF Field Levels on the Ground.** The RF field levels on the grounds of the WRC broadcast transmission facility were below the minimum measurement capability of the survey instrument in all areas, which prompted additional checks to verify that the survey equipment was functioning properly. Based on the measurement range of the survey equipment, this means that the RF field levels on the ground are definitely less than 3 percent of the FCC's MPE limit for General Population/ Uncontrolled exposure and are most likely less than 1 percent of this limit. As anticipated, the only RF safety concern at this facility is for those individuals who ascend either of the towers.

- **Satellite-Uplink Antenna.** A 6.0-meter-diameter Ku-band satellite-uplink antenna is located on the grounds of the studio. This antenna is mounted in such a manner that if would be virtually impossible for anybody to get into the beam without the use of a ladder or other lifting device. The calculated maximum RF field level in the beam of this antenna under worst-case conditions is less than the FCC's MPE limit for General Population/Uncontrolled exposure. The only potential hazards are at the feed horn and, should one occur, near the site of a waveguide leak. A second satellite-uplink antenna is operated by NBC Network.

- **SNG Truck Antenna.** The calculated maximum RF field level in the beam of this antenna is about 800 percent of the FCC's MPE limit for Occupational/Controlled exposure when the system is operated at full power. Normally, the system is operated at a fraction of the maximum power. Under these conditions, the maximum RF field level in the main beam is about half of the MPE limit for Occupational/Controlled exposure.

- **Signs.** There is an RF CAUTION sign mounted on a door to a small room near the base of the main tower. There is a CAUTION sign and a site-specific instruction sign located on the inner door that leads to the main tower elevator. There are no other RF safety signs at other points where the towers may be accessed, such as the ladders for both towers and the cable platform.

Description of Facilities

Overview

WRC's studio and transmission facility is located at 4001 Nebraska Avenue NW, Washington, DC. This is an urban area close to private residences in the northwest corner of Washington. The WRC studio, NBC Network News, MSNBC, and CNBC all share space in the same building. There are two towers that are located very close to the building and to each other. The facility is owned and operated by WRC/NBC.

Towers

The two towers are tapered, 4-sided, self-supported structures. The bases of the towers are only about 30 feet apart. The main tower is 525 feet high with an elevator that goes to the 500-foot level, where there is a platform and a vertical ladder that is used to access the antennas mounted on the top of the tower.

There are three high-power broadcast antennas stacked on the top of the tower:

1. WRC-DT, Channel 48
2. WRC-TV, Channel 4
3. WKYS-FM, a tenant

The top of WRC-DT's antenna is at 657 feet Above Ground Level (AGL).

WRC-TV's auxiliary antenna is located at about 475 feet AGL. There are numerous two-way radio and cellular antennas located at lower elevations.

There are four platforms on the main tower that can be accessed by the elevator. They are located at approximately 125 feet, 250 feet, 375 feet, and 500 feet AGL. The tower also has a ladder that runs up one side.

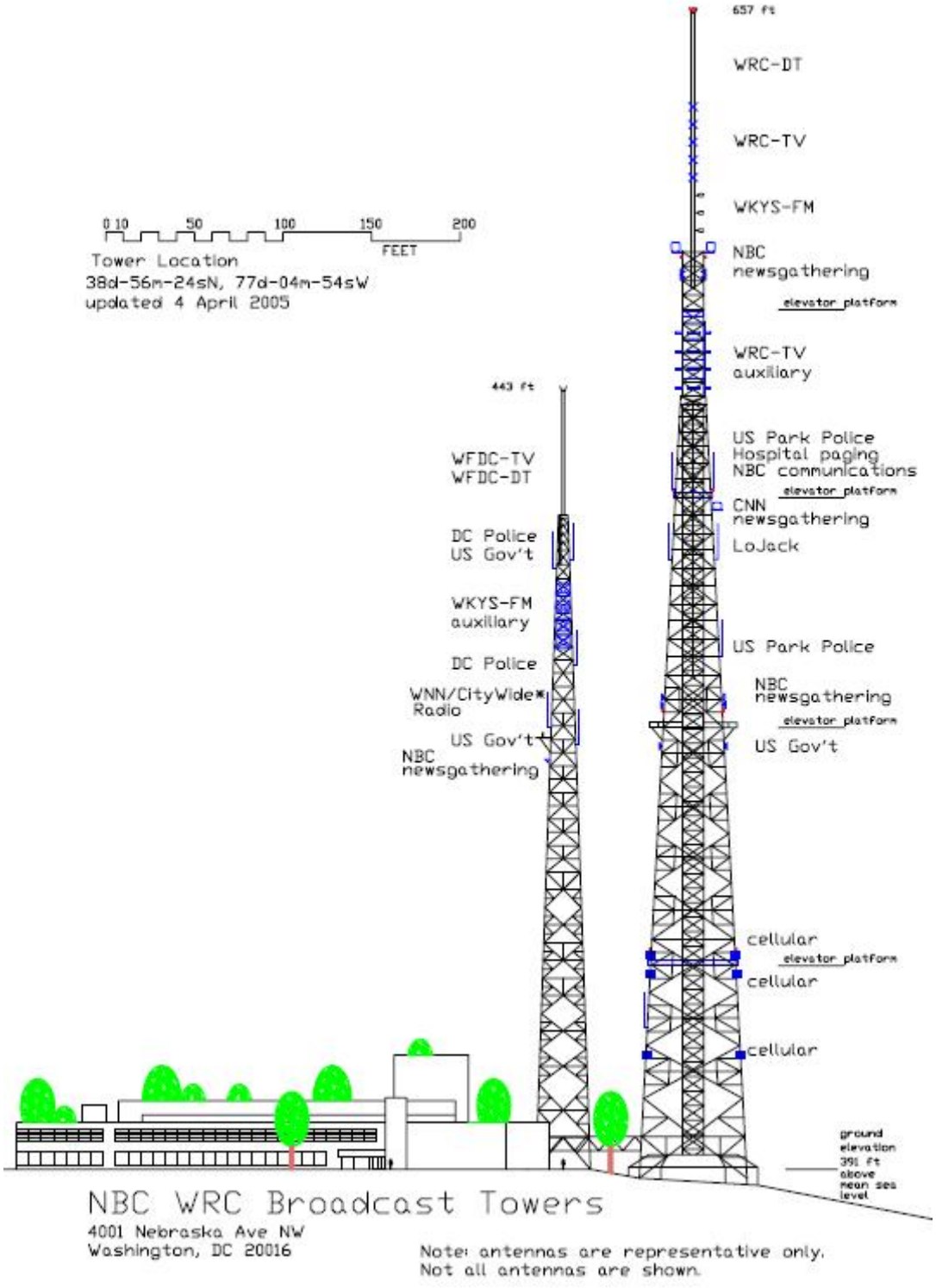
This is the base of the main tower. The cable bridge from the studio building can be seen on the right.

Although the elevator is normally used to ascend the tower, a ladder is also available.

The shorter tower and cable bridge are shown below.

The shorter tower is approximately 380 feet high with antennas for WFDC-TV and WFDC-DT located on the top. The top of upper antenna is 443 feet AGL. A ladder is used to ascend this tower. In addition to the WFDC television antennas, an auxiliary antenna for WKYS-FM and an assortment of two-way radio systems are located on the tower.

A diagram of the two towers and the studio building is shown on the following page.


657 ft
WRC-DT
WRC-TV
WKYS-FM
NBC
newsgathering
elevator platform
WRC-TV
auxiliary
US Park Police
Hospital paging
NBC communications
elevator platform
CNN
newsgathering
LoJack
US Park Police
NBC
newsgathering
elevator platform
US Gov't
cellular
elevator platform
cellular
cellular
443 ft
WFDC-TV
WFDC-DT
DC Police
US Gov't
WKYS-FM
auxiliary
DC Police
WNN/CityWide
Radio
US Gov't
NBC
newsgathering
0 10 50 100 150 200
FEET
Tower Location
38d-56m-24sN, 77d-04m-54sW
updated 4 April 2005
ground
elevation
391 ft
above
mean sea
level
NBC WRC Broadcast Towers
4001 Nebraska Ave NW
Washington, DC 20016
Note: antennas are representative only.
Not all antennas are shown.

Transmitters

The transmitters are located in separate rooms in the main building, not far from the towers.

WRC-TV, Channel 4, uses a 52.5-kW solid-state HPA. WRC-DT, Channel 48, uses two tube HPAs with a combined power output level of 38.7 kW. There is no auxiliary transmitter.

The solid state HPA used by WRC-TV, Channel 4, has an output power level of 52.5 kW.

The two tube HPAs used by WRC-DT, Channel 48, have a combined output power level of 38.7 kW.

Satellite Antennas

Satellite-Uplink Antennas

NBC Network operates a 4.5-meter Ku-band satellite-uplink antenna that is located near the entrance to the facility. A 100 Watt high-power digital amplifier (HPAs) is mounted on the antenna support structure. Thus, the only waveguide transmission line is located several feet above the ground between the HPAs and the hub of the antenna.

This antenna is only rarely used to transmit energy.

This is the 4.5-meter Ku-band satellite uplink operated by NBC Network.

WRC operates a 6-meter Ascent Ku-band satellite uplink antenna that is located near the main tower. Three small solid-state HPAs are located in a trailer behind the antenna. The total output power of the three HPAs is 95 Watts. There is waveguide located in an overhead tray that carries the RF energy from the HPAs inside the trailer and the back of the antenna.

This is the Ascent 6-meter Ku-band satellite uplink.

Section 2: Standards, Calculations, and Measurements contains calculations of the RF field levels from these antennas.

Satellite Truck

The satellite news-gathering (SNG) truck has a 2.4-meter-diameter, Ku-band antenna mounted on it. A pair of 300-Watt HPAs is located inside the truck. Although as much as 600 Watts can be used for transmission, the system is typically operated with no more than 40 Watts of power.

RF Field Measurements

Studio Equipment

Grounds

Measurements were made throughout the grounds. As expected, the RF field levels were below the minimum measurement threshold of the RF survey instrument. The actual field levels are almost certainly a fraction of 1 percent of the FCC's MPE limit for General Population/Uncontrolled exposure.

Satellite Uplink

This system is only used occasionally and was not active on the day of the survey. Therefore, the system was not checked for leaks. Calculations of the RF field strength in the beam of the antenna are shown in Section 2: Standards, Calculations, and Measurements.

SNG Truck

The SNG truck was not available on the day of the survey. Calculations of the RF field strength in the beam of the antenna are shown in Section 2: Standards, Calculations, and Measurements.

Broadcast Transmission Equipment

Grounds

Several areas of the grounds were checked to determine the magnitude of the RF field levels on the ground throughout the studio. As previously stated, the RF field levels were below the minimum measurement threshold of the survey equipment. There are no RF field level measurements to report for the grounds.

HPAs

Both the exteriors of the solid-state high-power amplifier modules used to power WRC-TV and the two tube cabinets in the HPA used to power WRC-DT were checked for leaks. No significant leaks were found. Although no significant leaks were found, the small, localized RF fields were useful in confirming that the RF survey equipment was functioning properly, since no measurable fields were found anywhere on the grounds.

Tower

Measurements were made at various locations on Platforms 1, 2, and 4 (the highest). In each case, the highest spatially averaged measurements were on the side of the tower that faces the shorter tower. This is invariably due to the signals from WFDC-TV and WFDC-DT that are radiating from the antennas located at the top of the tower.

Measurements at Platform 3 were made only i\on the platform immediately in front of the elevator door due to the very high field levels. Although several

spatially averaged measurements were made, the indicated average is incorrect since the levels exceeded full scale of the instrument at some elevations above the deck of the platform. Therefore, the indicated average field level of about 350 to 390 percent underestimates the actual field level. Since the field level was below 350 percent for about half of a person's height and more than 600 percent for the other half, it is estimated that the true average is roughly 500 percent of the MPE limit. Since the levels exceeded the full-scale measurement range of the instrument (600 percent of the MPE), a more accurate measurement could not be made without reducing the output power of WFDC television.

The spatially averaged measurements, in terms of percentage of the FCC's MPE limit for Occupational/Controlled exposure, were:

Platform	Elevation	RF Field Level
1	125 ft.	~2% of occupational MPE limit
2	250 ft.	~3% of occupational MPE limit
3	375 ft.	Roughly 500% of occupational MPE limit
4	500 ft.	~ 7% of occupational MPE limit

NOTE

The auxiliary antenna for WKYS-FM station is located on the shorter tower, well below WFDC Television's antennas. It can be assumed that very strong RF fields will be present whenever it is in use. These fields will be additive to the fields from the WFDC television antennas that exist on Platform 3. This auxiliary antenna may generate very significant RF field levels on Platform 2 of the main tower.

Section
2

Standards, Calculations, and Measurements

Measurements Compared to FCC Regulations

Standards and Regulations

Federal Communications Commission (FCC) Regulations

The FCC updated its RF safety regulations in 1997. Initially, certain sites were "grandfathered" in and not immediately constrained by these new regulations. However, the regulations require that all transmitting sites in the United States must meet all aspects of these regulations as of September 1, 2000.

The FCC Regulations are based on setting limits for human exposure. The FCC limits are similar to, but not identical to, the limits of several other major standards. There are two sets of exposure limits:

- Occupational/Controlled
- General Population/Uncontrolled

These are Maximum Permissible Exposure (MPE) limits averaged over the body and averaged over time. The Occupational/Controlled limits are five times higher than the General Population/Uncontrolled limits at all frequencies above 3 MHz. The averaging period for Occupational/Controlled Environments is six minutes for exposure to frequencies below 15 GHz. The averaging time decreases as the frequency increases from 15 GHz to 300 GHz. The FCC does not allow time averaging for General Population/Uncontrolled exposure. The MPE limits are the same for both the electric field and the magnetic field.

The FCC provides definitions for the two types of exposure and attempts to define when they apply. A simplified view, endorsed by the Occupational Safety and Health Administration (OSHA), is that the more restrictive General Population/Uncontrolled limits apply unless:

- The organization is operating under a written RF safety program.
- The individuals who may be exposed to levels above the General Population/Uncontrolled limits have received RF safety training.

A current Notice of Proposed Rulemaking is aimed at further defining when an organization is allowed to use the higher MPE limits for Occupational/Controlled exposure. The terms *fully aware* and *exercise control* are referred to in the current FCC Regulations when defining the requirements for establishing an Occupational/Controlled environment. The Notice further defines these two important terms.

The term *fully aware* refers to workers who:

- Have received both written and verbal information regarding RF radiation.
- Have received training that includes how to control or mitigate RF radiation exposure.

The term *exercise control* refers to workers who:

- Understand how to use administrative controls to reduce their exposure level. Administrative controls include time averaging.
- Understand how to use engineering controls to reduce their exposure level. Engineering controls include Personal Protective Equipment (PPE), specifically RF personal monitors and RF protective clothing.

The FCC's MPE limits for the two environments are shown in the tables below. Limits are spatially averaged over the whole body. The Occupational/Controlled limits are time averaged.

Table 1. FCC Maximum Permissible Exposure Limits

Table 1A. Occupational/Controlled Exposure

Frequency (MHz)	Power Density (S) (mW/cm^2)
0.03–3	100
3–30	$900/f^2$
30–300	1.0
300–1,500	f/300
1,500–100,000	5.0

Table 1B. General Population/Uncontrolled Exposure

Frequency (MHz)	Power Density (S) (mW/cm^2)
0.03–1.34	100
1.34–30	$180/f^2$
30–300	0.2
300–1,500	f/1,500
1,500–100,000	1.0

Occupational Safety and Health Administration (OSHA) Regulations

OSHA still has an outdated standard on its books that is based on the first American National Standards Institute (ANSI) standard developed in the 1960s. This is a single-tier standard that suggests limiting exposure to 10.0 mW/cm^2 at all frequencies. The FCC limits are far more restrictive. Under the "General Duty" clause of its regulations, OSHA has been using modern, "consensus" standards, such as the FCC's, as a model for enforcement. OSHA defined its position relative to the FCC Regulations in a reply to an official request from the Personal Communications Industry Association (PCIA) in October 1998. In essence, OSHA went on record stating that while it was not relinquishing its role as the agency responsible for worker health, organizations that satisfy FCC requirements would also satisfy OSHA requirements. Refer to *Appendix B: OSHA/PCIA Correspondence.*

This may be the official position of OSHA, but the evaluator could not identify the corresponding compliance directive. Therefore, local OSHA offices may not be aware of it. For this reason, only FCC MPE limits are considered in this RF Safety Report.

MPE Limits for WRC Television

The facility that was surveyed does not qualify to use the FCC's higher MPE limit for Occupational/Controlled exposure. This is because the facility does not currently operate under an RF safety program. This situation is changing with the introduction of the new NBC RF Radiation Safety and Health Program. The facility should become a controlled environment once the Site Requirements section that is specific to WRC has been written, and its requirements have been implemented by WRC.

However, the requirement to comply with the more restrictive MPE limit for General Population/Uncontrolled exposure in all areas has little impact on WRC because the only significant RF field levels are on the towers or are associated with maintenance operations near the satellite antennas (fixed and truck) at the studio.

The exposure limits vary with frequency as shown in Table 1B on the previous page. These exposure limits are one fifth of the limits for Occupational/Controlled exposure (shown in Table 1A) above 3 MHz. There are no identified emitters that operate below 3 MHz in the vicinity of WRC's broadcast transmission facility or the studio. The survey instrument that was used automatically compensates for these variable exposure limits and yields results in "Percentage of Standard." These values are in terms of the limits for Occupational/Controlled exposure. Meter readings are converted to General Population/Uncontrolled exposure values by multiplying the indicated results by a factor of five.

Personnel

A member of WRC Television's Engineering Department accompanied the consultant during all of the measurements and the review of the facilities and hardware. The representative was:

Name	Title
Chuck Lindner	Chief Engineer

Antenna Calculations

Characteristics of Reflector Antennas

The radiated power from reflector antennas such as the two Ku-band satellite-uplink antennas and the microwave point-to-point systems is well understood and relatively simple to calculate. Calculations of RF field levels from reflector antennas are in many ways more accurate, albeit more conservative, than measurements. There are three regions with distinct characteristics:

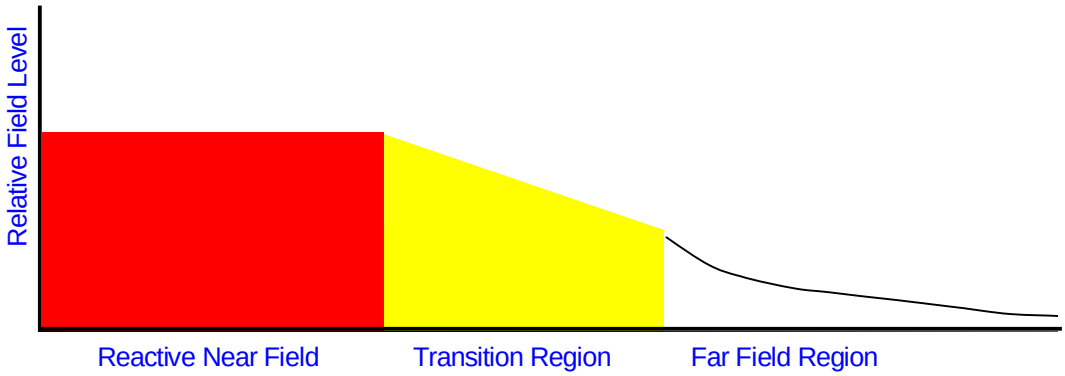
1. **Reactive Near Field.** The radiated energy in the reactive near field region takes the approximate shape of a cylinder with a diameter equal to that of the antenna. For the purpose of analyzing RF radiation hazards, it is assumed that the on-axis energy is at its maximum in this region and does not begin to diminish in intensity until the beginning of the transition region. The energy level throughout this region is highly variable and can be as high as 6 dB, or four times higher than the calculated average at any point. The amount of transmitted energy is proportionate to the efficiency of the antenna reflector. Reflector efficiency is typically 50 to 80 percent.

   The reactive near field is the area in which the potential exists for maintenance personnel, due to unforeseen or deliberate action, to be exposed to excessive RF fields.

2. **Radiating Near Field or Transition Region.** The radiating near field, or transition region, is located between the reactive near field and the far field regions. The energy level in this region drops off linearly with distance.

3. **Far Field.** The far field region begins once the beam is fully formed. The electric and magnetic fields are uniform and 90 degrees out of phase in this region. Field intensity in the far field drops off inversely in proportion to the square of the distance from the antenna as the energy spreads out. This is often referred to as the inverse square law.

Relative RF Field Strength through Three Regions



The assumed power density anywhere in the reactive near field (S_{RNF}) is calculated by dividing the power into the antenna (P) by the area[1] (A) and multiplying by both the reflector efficiency (E_{Ref}) and a factor of four.

$$S_{RNF} = P/A \times 4 E_{Ref}$$

This is the formula approved by the FCC for use in calculating RF field levels in the reactive near field of reflector antennas.

The distance that the reactive near field extends from the antenna (L_{NF}) increases in direct proportion both to the square of the antenna diameter and the frequency.

$$L_{NF} = D^2/4\lambda$$

The distance to the far field region (L_{FF}) is proportionate to the square of the antenna diameter and the frequency.

$$L_{FF} = 0.6D^2/\lambda$$

The RF field strength in the far field region drops off inversely with the square of the distance (R) from the antenna and increases proportionately with the gain (G) of the antenna.

$$S_{FF} = GP/4\lambda R^2$$

The first two formulas are used in the calculations for the satellite-uplink and radar antennas. They predict the maximum RF field strength in the reactive near field and the extents of the reactive near field.

These calculations are conservative because:

- The reactive near field calculation calculates the maximum field density, which is four times higher than the average since it is impossible to predict where the peak field areas may occur. However, for relatively large apertures, the spatially averaged RF field levels are normally closer to the calculated average field strength.
- It is very difficult to get into the beam of either of the two satellite-uplink antennas.

[1] Area (A) is calculated based on the two-dimensional area of a circle equal in diameter to the antenna.

Ku-Band Satellite-Uplink Antenna Calculations

Specifications and Assumptions

System	Fixed Uplinks		SNG Truck (older truck)
Antenna Diameter	6.0 meters	4.5 meters	2.4 meters
Frequency	14.0 to 14.5 GHz		
Power Level, maximum	95 Watts	100 Watts	600 Watts
Power Level, typical			40 Watts
Reflector Efficiency	75% (assumed)		
Area (πR^2)	28.3 m²	15.9 meters	4.52 m²
Wavelength (λ)	2.07 cm		
MPE limit[2]	1.0 mW/cm²		

Calculated Values

S_{RNF} @ maximum power	1.0 mW/cm²	1.89 mW/cm²	39.8 mW/cm²
S_{RNF} @ typical power			2.65 mW/cm²
Percent of MPE limit[2] @ maximum power	100%	189%	3,982%
Percent of MPE limit[2] @ typical power			265%
L_{NF}	435 m/1,426 ft	245 m/803 ft	69.6 m/228 ft

S_{RNF} This is the calculated *maximum* field level within the reactive near field.

L_{NF} The reactive near field extends out this far from the antenna.

[2] FCC MPE limit for General Population/Uncontrolled exposure

RF Survey Equipment and Measurement Techniques

RF Survey Equipment

The RF survey equipment used to make the measurements in this report was manufactured by Narda Safety Test Solutions, an L-3 Communications Corporation company located in Hauppauge, New York. The equipment was in excellent operating condition. Both the meter and the probe were last calibrated in March 2005. The manufacturer recommends annual calibration. The consultant is very familiar with this equipment and its operation. The equipment is comprised of a probe (the sensor), a meter, a cable, and a shielded bag used as a "zero field" reference.

DESCRIPTION	MODEL	SERIAL NO.
Electric Field Probe, 300 kHz to 3 GHz, 600% full scale	A8742D	02807
RF Survey Meter	8715	12009

The Narda Safety Test Solutions Model 8715 Survey Meter is used with all 8700 series probes. It has spatial-averaging capability.

These are two Narda Safety Test Solutions 8700 series probes. The larger probe is the Model A8742D that was used to survey the facility described in this report. It operates over a frequency range of 300 kHz to 3 GHz. The full-scale rating is 600 percent of the FCC's MPE limits for Occupational/Controlled exposure.

Model A8742D Probe

Measurements

Measurement Range

The shaped-frequency response Model A8742D probe has frequency-dependent sensitivity that closely conforms to the FCC's MPE limits for Occupational/ Controlled exposure. Thus, it is not important to know the operating frequencies of the equipment being measured providing that they operate within the broad frequency limits of the probe—300 kHz to 3 GHz. All significant emitters at the facility described in this report operate within this frequency range except for the satellite antennas. The measurements that were made on the grounds, the main tower, and in the transmitter rooms are located far outside the beams of these antennas. Therefore, they are not a consideration that could cause measurement errors.

At frequencies between 3 MHz and 3 GHz, the ratio between the FCC's two sets of exposure limits is exactly five to one. This includes all identified sources located at the facility that were surveyed and described in this report. Therefore, a meter indication of 20 percent is equivalent to 100 percent of the limits for General Population/Uncontrolled exposure, excluding measurement uncertainty. The minimum RF field level that can be measured accurately is about 0.6 percent of the MPE limits for Occupational/Controlled exposure, which is equal to 3.0 percent of the MPE limits for General Population/Uncontrolled exposure. The minimum field level that can be *detected* is 0.5 percent of the FCC's MPE limits for General Population/Uncontrolled exposure.

Measurement Technique

The arm holding the probe was constantly moved to cover the largest possible volume while walking through the grounds and when on the tower platforms. More careful measurements were made whenever significant field levels were found. Spatial averaging was not used on the grounds because no areas of significant RF field levels were found.

Measurement Uncertainty

The major component of measurement uncertainty for a probe is normally its frequency deviation. The Model A8742D probe is calibrated at 14 different frequencies to guarantee that the frequency deviation—error versus frequency—is a maximum of ±2 dB. The other factors that contribute to measurement uncertainty are less significant. A good rule of thumb when making measurements in multi-signal environments with this type of equipment is to assume an uncertainty of ±3 dB.

An uncertainty of 3 dB is assumed for WRC's broadcast facility. Thus, all meter indications of 10 percent or less are considered to be fully compliant with the FCC's MPE limit for General Population/Uncontrolled exposure. The 10 percent figure of merit is based on the five-to-one difference between the indications from the survey instrument that reads out for the Occupational exposure limits and the General Population exposure limits and the addition of a 3 dB (2:1) uncertainty factor. Measurement uncertainty is irrelevant in this case since the RF field levels on the grounds were below the minimum measurement threshold of the survey instrument.

Section
3

Risks and Recommendations

The Main RF Safety Risks Are on the Towers

Risks

Overview

The RF safety risks for WRC are insignificant for personnel who remain at ground level. The major concerns are for personnel who ascend either of the two towers at the facility in Washington. The other area of concern is for personnel who perform maintenance on the satellite-uplink antenna and/or the SNG truck antenna.

Broadcast Transmission Systems

WRC must be concerned with three types of risks. The most important is personnel safety. The other concerns are compliance with FCC Regulations and liability. Fortunately, the RF field levels on the ground near WRC's transmission towers are negligible. They are far below the FCC's MPE limit for General Population/Uncontrolled exposure, and thus FCC compliance is not a concern. Liability concerns primarily relate to tower climbing.

There are always risks associated with high-power RF transmission equipment. The goal is always to understand and manage operations so that risks are minimized. The risks are dramatically higher whenever tower climbing is involved. Written procedures limit WRC personnel to ascending the main tower via elevator to no higher than the second of four platforms. The RF field levels at the first and second platforms are normally far below the FCC's MPE limits for General Population/Uncontrolled exposure. However, the magnitude of the RF field levels on the second platform is most likely much higher whenever the auxiliary antenna for WKYS-FM is in use. Since these levels have not been quantified, it must be assumed that a potential RF safety hazard exists under these conditions.

WRC contractors and tenants and their contractors may ascend to all levels on both the main tower and the shorter tower. Personnel who ascend either of the two towers may be exposed to significant levels of RF energy from an antenna on the other tower. Therefore, great care must be exercised whenever anyone ascends either tower.

Transmitter Rooms

There is always a small risk of a large leak in a tube-type HPA. The doors to the HPA cabinets function as reasonably good RF shields; even if a large leak were to occur, the risk of exposure would only occur if the doors were open and a person was standing immediately in front of the cabinet. WRC-DT is powered by a pair of IOT tube-type HPAs. WRC-TV is powered by a solid-state HPA, which is less likely to develop significant RF leaks.

Therefore the risks from the HPAs are very low.

Satellite Antennas

The only RF safety concerns at ground level are for those individuals who maintain either of the three satellite transmission systems—the two fixed uplinks and the SNG truck. When the SNG truck is operated at a typical power level of about 40 Watts, the maximum RF field level in the main beam of the antenna is approximately half the MPE limit for Occupational/Controlled exposure and about 270 percent of the MPE limit for General Population/Uncontrolled exposure. Under these conditions, this is not a significant RF safety hazard. However, the system is capable of transmitting up to 600 Watts. This system is a significant RF safety hazard when operating at higher power levels.

Although the RF field levels in the beams of either of the fixed uplink antennas cannot be considered a hazard, there is sufficient energy to cause serious eye damage should it be concentrated. There are two places in each antenna where the RF energy is concentrated:

1. **Feed Horn**. When 100 Watts is distributed over an area equal to about 4.5 meters in diameter, the energy level is not intense enough to be a concern. But the energy level at the feed, which is only a few centimeters in diameter, is extremely high and has the potential to cause serious eye energy in minutes. The same concern exists with the SNG truck antenna even when operated at the typical power level of 40 Watts. It is an extreme eye hazard at higher operating power levels.

2. **Waveguide Leaks**. If only a fraction of the power from the HPA of these antennas were to leak out of a connection while a person had his or her face a few inches from the site of the leak, there would be a possibility of eye damage.

Recommendations

Broadcast Systems

Overview

Because there are insignificant RF field levels on the ground, the major recommendation for WRC's broadcast transmission operation is to ensure that safety practices are followed whenever anyone ascends either of the two towers at the site. In addition, some new signs are recommended.

General Procedures

It requires a great deal of discipline and planning to ensure safety when ascending a broadcast tower. Coordination with all licensees on both towers is required to ensure that power has been reduced adequately for the climbers. RF protective garments can be used to allow the climbers to work in areas where the RF field levels are up to a maximum of 1,000 percent of the MPE limit for Occupational/Controlled exposure. But it is critical that the garments be worn properly to be effective in reducing the RF energy to which the wearer will be exposed.

There are two approaches that are appropriate whenever RF protective garments are used:

1. Sophisticated computer modeling can be used to determine the RF field levels on the tower. Climbers wearing protective suits can enter any area that has RF fields less than 1,000 percent of the MPE limit.

2. Climbers can wear RF protective suits with special high-power RF personal monitors worn outside the suit. This approach allows climbers to enter areas where the field levels are not known and to be warned should the field levels exceed the protection afforded by the suit.

Nardalert XT RF Personal Monitor

RF personal monitors should always be used when climbing towers *without* RF protective suits. RF personal monitors should *never* be worn under an RF protective suit because they will not function properly.

The Nardalert XT series RF personal monitors are recommended for tower climbing and are the only monitors approved by NBC's RF Radiation Safety and Health Program.

Procedures for Ascending the Main Tower

Personnel who ascend above the first platform level may be exposed to significant and potentially harmful levels of RF energy.

Second Platform

Although the RF field levels on the second platform level are normally quite low, they are likely to be high whenever WKYS-FM is broadcasting via its auxiliary antenna on the shorter tower. Therefore, it recommended that the existing tower procedures be modified to emphasize that nobody is to go to the second platform while this auxiliary antenna is in use without carefully verifying that the RF field levels are within acceptable limits. This can be accomplished through the use of an NBC-approved RF personal monitor. The NBC RF Radiation Safety & Health Program requires that RF personal monitors be worn by all personnel ascending towers.

Ascending Above the Second Platform

The elevator must never be stopped anywhere between the second and fourth platforms unless it is intended to work on Platform 3, which requires special procedures.

Working on Platform 3

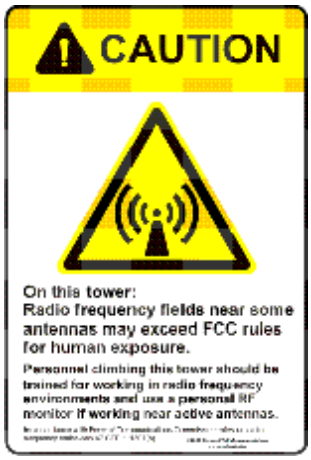
The output power level of WFDC-TV must be reduced a minimum of 80 percent (maximum of 20 percent of normal operating power) before anyone is allowed to stop at this level of the main tower. The RF personal monitors should be used to verify that the field levels are consistently below 50 percent of the MPE limit for Occupational/Controlled exposure. The recommended monitors are set to alarm at this level whenever the average exposure over a 1-second interval exceeds 50 percent.

Working above Platform 4

WRC's existing procedures for power reduction and use of auxiliary antennas should be followed whenever anyone climbs any higher than the level of the fourth platform.

RF Safety Signs

The RF field levels on the grounds of the facility are insignificant and far below the FCC's MPE limit for General Population/Uncontrolled exposure. The most appropriate sign warns people who ascend the towers of the high RF fields near the broadcast antennas. It is recommended that a Tower CAUTION sign be installed at all the access points to both towers.



This Tower CAUTION sign should be installed at all access points to the two towers so that one is visible to anyone who begins to climb the tower or enter the elevator.

The Tower CAUTION sign described on the previous page should be installed in the following locations:

- On the inner entrance door to the main tower elevator to replace the existing sign.
- At the base of the shorter tower near the ladder. Two signs should be mounted so that they can be seen regardless of the direction from which a person approaches the ladder.
- At the base of the main tower near the ladder. Two signs should be mounted so that they can be seen regardless of the direction from which a person approaches the ladder.
- At each of the two levels of the cable support structure, near the point where the structure joins the main tower.

In addition to the Tower CAUTION signs, two WARNING signs should be installed.

- On the railing of the third platform directly opposite the door to the elevator so that it will be seen by anyone who opens the elevator door.
- Next to or behind the ladder that extends to the top of the main tower from the fourth platform.

This WARNING sign should be installed on the third railing opposite the elevator door and on the fourth platform near the ladder that leads to the top of the tower and the broadcast antennas.

In addition, the existing CAUTION sign that leads to a small room near the base of the main tower can be removed since there are no RF safety hazards in this room.

Remove this sign near the base of the main tower. There are no RF hazards inside the room.

Satellite Antennas

It is important that appropriate lockout, tagout (LOTO) procedures always be followed whenever anyone works on either of the satellite-uplink systems or the SNG truck.

It is also recommended that personnel keep their eyes a minimum of 2 feet from any waveguide connection or section of flexible waveguide, since this type of hardware is prone to acute failure.

Appendices

Appendix A: Consultant Qualifications

Richard Strickland founded RF Safety Solutions in 2001 after ten years as Director of Business Development for Narda Safety Test Solutions, the world's leading supplier of RF safety measurement and monitoring products. As director of the RF safety business at Narda, Mr. Strickland determined which products were developed and their performance characteristics. He frequently functioned as program manager, as he did with the Nardalert XT RF personal monitor. He initiated the development of RF radiation training courses at Narda and has conducted courses ranging from basic employee awareness seminars to in-depth application specific courses. Audiences have included environmental health and safety professionals, engineers, technicians, attorneys, communications industry professional consulting engineers (PEs), and senior managers of major corporations, government organizations, and professional groups. Mr. Strickland has taught more than one hundred public and private seminars on RF radiation safety. In-house course clients include the National Association of Broadcasters, National Public Radio, Sony, Motorola, NYNEX Mobile, ABC, CapRock, the U.S. Army, Bell Atlantic Mobile, Ameritech, Primeco, NORTEL, Texas Instruments, and Northrup-Grumman. He has been both a featured speaker and a member of the radio frequency radiation panel at the National Association of Broadcasters, the Radio Club of America, and the International Wireless Conference and Exposition. He is a member of IEEE SC 28 P1466. The project scope of this group is "Preparation of a guidance document for the development of RF safety programs." Mr. Strickland is the author of numerous articles on RF safety practices and measurement issues.

Recent Customers

Richard Strickland provides advice regarding RF radiation safety to several major companies. Services include RF surveys and RF safety reports, development of RF safety programs, and RF safety training.

Current clients include:

- ABC Radio
- ABC Television
- British Aerospace
- Cornell University
- ESPN
- Lockheed Martin Corporation
- NBC Television
- Raytheon Corporation
- Trinity Broadcasting
- U. S. Coast Guard

Education

- MBA, University of District of Columbia, 1980
- BA Physics, Bridgewater College, 1972
- Advanced (radar & IFF) and basic electronics courses, U.S. Coast Guard

Presentations & Publications

- More than 35 articles published in technical publications on RF safety, high-power amplifiers, and radomes
- Organized and conducted more than 100 public and in-house training courses
- Featured speaker for numerous professional organizations including NATO, National Public Radio, National Association of Broadcasters, and Radio Club of America

Professional Memberships

- Member of the International Electrotechnical Commission (IEC) Technical Advisory Group (TAG) 106: Methods for the Assessment of Electromagnetic Fields Associated with Human Exposure
- Member of the IEEE CS 28 P1466, guidance document for the development of RF safety programs
- Member of the Association of Federal Communications Consulting Engineers (AFCCE)
- Member of the IEEE and IEEE Antennas and Propagation Society

Awards

- Winner of the R & D 100 Award for the Nardalert XT RF Personal Monitor. Mr. Strickland was the originator of this product. He functioned as project manager and decided on all of its features and design details. The R & D 100 Awards are given annually to the top 100 scientific and technological achievements in the world. They are frequently referred to as “the Nobel Prizes of Applied Research.”

Appendix B: OSHA/PCIA Correspondence

Letter from Personal Communications Industry Association (PCIA) to Department of Labor Occupational Safety and Health Administration (OSHA), September 3, 1998

The Personal Communications Industry Association (PCIA) wrote this letter to obtain written confirmation from OSHA concerning that organization's position relative to the FCC's 1997 RF Safety Regulations. The FCC, OSHA, and PCIA met a few days prior to the writing of this letter to try to get a definitive position statement from OSHA. Up until this point, OSHA had been giving out often confusing and conflicting information on what it required for compliance with RF safety regulations, especially within the communications industry.

Letter from Occupational Safety and Health Administration (OSHA) to Personal Communications Industry Association, October 5, 1998

This is OSHA's official response to the PCIA letter dated September 3, 1998. While maintaining its legal rights, the letter in essence clearly states that it will accept full compliance with the FCC's 1997 RF Safety Regulations as fully satisfying OSHA in this area. The letter states "For purposes of construction or maintenance activities, OSHA will consider employers who are in compliance with the FCC standards as they relate to employee RF exposure to be in compliance with OSHA requirements."

Personal
Communications
Industry
Association

September 3, 1998

Mr. Charles N. Jeffress
Assistant Secretary of Labor
Occupational Safety and Health Administration
Room S2315
200 Constitution Avenue
Washington, D.C. 20210

Dear Mr. Jeffress:

I write on behalf of the Personal Communications Industry Association ("PCIA") to request confirmation of the position recently conveyed verbally to certain PCIA members in a recent meeting with staff of the Occupational Safety and Health Administration ("OSHA") regarding compliance with radiofrequency ("RF") radiation criteria.

As you know, each of OSHA and the Federal Communications Commission ("FCC") has certain responsibility for assuring compliance with federal RF regulations. The FCC has already promulgated regulations pursuant to ET Docket 93-62. Recently, certain of our members were advised that, while OSHA has not yet developed regulations of its own regarding RF criteria, and while it may promulgate regulations in the future, it has no current criteria to apply. In view of this vacuum, query was made as to whether OSHA would view compliance with FCC regulations as being sufficient to constitute effective compliance with OSHA requirements.

As I understand it, non-binding response was provided by OSHA staff to the effect that, at least in so far as compliance with OSHA regulations governing RF exposure involving construction of telecommunication facilities is concerned, compliance with FCC RF regulations would currently be viewed as constituting compliance with OSHA requirements. The staff was careful to make clear that OSHA still may promulgate alternative criteria in the future, that this position involves only construction (i.e., construction of new sites and modification including painting of existing sites) and

• 500 Montgomery Street • Suite 700 • Alexandria, VA 22314-1561 •
• Tel: 703-739-0300 • Fax: 703-836-1608 • Web Address: http://www.pcia.com •

that compliance with RF criteria would not in and of itself obviate the need for compliance with non-RF regulation governing other matters. Needless to say, the staff's informal comment was very useful and very well received by PCIA members.

PCIA will be hosting its annual convention during the week of September 21, 1998. At that time, we will have the attention of a considerable portion of the wireless telecommunication industry. We very much want to be able to advise them of OSHA's position as discussed above, but believe that it would be much more meaningful if conveyed via letter to me under your signature. We also believe that, by setting forth your views on compliance in this matter, you would further compliance by the telecommunication industry with both FCC established criteria and with the requirements that are effectively being applied by OSHA. Accordingly, we respectfully ask that you write to confirm our understanding as set forth above.

In the event that you should have any questions with respect to this matter, please feel free to contact me directly. Permit me to also thank you in advance for your efforts on this very important matter.

Very truly yours,

Jay Kitchen/m.m.

Jay Kitchen
Executive Director
Personal Communications Industry Association

cc: D. Morgan ✓

U.S. Department of Labor

Occupational Safety and Health Administration
Washington, D.C. 20210

Reply to the Attention of:

OCT - 5 1998

Mr. Jay Kitchen
Executive Director
Personal Communications Industry Association
500 Montgomery Street
Suite 700
Alexandria, VA 22314-1561

Dear Mr. Kitchen:

This is in response to your letter of September 3, 1998, from Personal Communications Industry Association (PCIA) members regarding compliance with radiofrequency ("RF") radiation criteria. I understand that your representatives, as well as a representative from the Federal Communications Commission (FCC) recently met to discuss the subject with staff members from OSHA's Directorates of Compliance and Construction and were telephonically connected with Bob Curtis of our Technical Support Directorate in Salt Lake City. You ask in your letter for written verification that compliance with FCC regulations regarding RF be viewed as constituting compliance with OSHA requirements.

OSHA understands that FCC does not dispute OSHA's exercise of jurisdiction over employers with employees who may be exposed to RF. OSHA does have limited standards which apply both to general industry and to construction, covering employee exposure to non-ionizing radiation (see 29 CFR 1910 97 and 1910.268(p) for general industry and 29 CFR 1926.54 for construction). However, these standards are over thirty years old and neither reflect current technology in the communications industry nor provide the level of employee protection from exposure to RF currently promulgated by the FCC. It has been and continues to be OSHA's policy to recognize state and federal standards which are more protective than current OSHA regulations as constituting compliance with our requirements. For purposes of construction or maintenance activities, OSHA will consider employers who are in compliance with the FCC standards as they relate to employee RF exposure to be in compliance with OSHA requirements. If an employer is not in compliance with the FCC standards, OSHA will enforce current OSHA standards but may also enforce Section 5 (a)(1) of the OSH Act to the extent that the FCC standards address serious, recognized hazards not covered under OSHA's requirements.

As discussed in the meeting with PCIA representatives and reiterated in your letter, although not on our current regulatory agenda, OSHA may promulgate alternative criteria in the future In the meantime, the enforcement policy stated in the preceding paragraph covers construction activities (i.e., tower/site construction, major equipment installation and/or replacement, painting operations, and other such construction activities) as well as routine tower maintenance activities. Finally, employers will continue to be responsible for complying with all other OSHA standards on their worksites.

We have accepted the invitation from your representatives to participate in a panel discussing RF compliance at your annual convention during the week of September 21, 1998. Bob Curtis from our Salt Lake City Technical Laboratory represented OSHA on that panel and was available for questions from the attendees. We trust that this letter of confirmation of our position on RF compliance and Bob's expertise on the subject addressed your concerns and those of your constituents and members. If you have questions regarding this letter, please contact Berrien Zettler of the Directorate of Construction on 202-219-8644.

Sincerely,

Russell B. Swanson, Director
Directorate of Construction