

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO 78-117-617

CONSOLIDATED EDISON OF NEW YORK
20TH AVENUE AND 21ST STREET
ASTORIA, QUEENS, NEW YORK 11105

SEPTEMBER 1979

I. TOXICITY DETERMINATION

A Health Hazard Evaluation was conducted by representatives of the National Institute for Occupational Safety and Health (NIOSH) on August 22, 1979 and April 26, 1979 at the Radio Communications Section (Building 136) of Consolidated Edison of New York in Astoria to determine potential employee exposure to radio frequency radiation.

Results of the survey indicate that exposure levels are less than the OSHA standard of 10 milliwatts per square centimeter (mW/cm²).

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22151. Information regarding this report's availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati address.

Copies of this report have been sent to:

1. The requestor of the Health Hazard Evaluation
2. Consolidated Edison Co. of New York
3. Utility Workers Union of America, Local 1 - 2
4. U.S. Department of Labor, OSHA, Region II
5. NIOSH, Region II

III. INTRODUCTION

Section 20 (a) (6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a) (6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

NIOSH received such a request from an employee authorized by several fellow employees to represent them for the purposes of this Health Hazard Evaluation.

IV. EVALUATION

A. Facility and Process Description

The facility in question is the repair shop of the radio communications section. Total employment is ten technicians, two clerks and two managers. The repair shop where the technicians work is approximately 10 ft. high by 40 ft. by 26 ft.

The operations of this shop are limited to the repair of radio communications equipment such as walkie-talkies and car two-way radios. The work load is 150 to 200 units per week. The work process generally consists of electronic testing of equipment, replacement or repair of mal-functioning parts. Repair consists of occasional soldering of loose connections. Because the work involves small parts, lighting is of major concern. The health hazard request also expressed concern over ventilation. Con-Edison disclosed plans to upgrade both the lighting and the air-conditioning system during the survey. This satisfied the concern about these two conditions. Interviews with employees disclosed concern about exposure to radio-frequency radiation. This concern was generated by warning cards issued by the manufacturer of the radio transmitters. The safety information flyers stated:

"The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic radiation safety standard which applies to any two-way mobile radio equipment. Normal use of this radio will result in exposures far below the OSHA limit. There are no reported incidents of physical damage resulting from the use of this type radio. However, the following precautions are recommended:

Do not operate the transmitter when someone outside the vehicle is within two feet of the mobile antenna.

Do not operate the transmitter near unshielded electrical blasting caps or in an explosive atmosphere."

Since the technicians frequently are within two feet of the transmitters, they were concerned about the possible health effects of their work.

B. Background Information

29 CFR 1910 (OSHA Safety and Health Standards for General Industry) establishes a "Radiation Protection Guide" for electromagnetic energy of frequencies from 10 megahertz to 100 gigahertz (Radio frequencies) to be 10 milliwatts per square centimeter, averaged over a 0.1 hour period. "Radiation Protection Guide" is defined as the radiation level which should not be exceeded without careful consideration of the reasons for doing so.¹

Information supplied by the radio manufacturers² state:

In the band 150-450 MHz, helical antennas deposit relatively little power in muscle tissue place at close distance. A 450 MHz quarter-wavelength whip in the same conditions very efficiently couples RF energy into the deep layers of biological tissue. The in-depth power deposition of helices increases very rapidly with frequency for distances less than one inch. Commercially available E-field probes placed near portable radiators can give a substantially distorted picture of the power density, because the instrument is sensitive to electric fields that are associated with relatively little power. It has been shown that, for a 150 MHz helix, there is nearly 20 dB difference between the levels of the power density indicated by the Narda E-field probe and the measured deposited power density. At 450 MHz, the indication of the probe is within an order of magnitude of the deposited power density. Even in this case, however, the indication of the instrument can be misleading in terms of determining an RF radiation hazard. It has been shown that, in the case of the whip, there is maximum power deposition in the locations where the instrument readings are the smallest.

The temperature increases in the head of an operator due to exposure to a portable radio are very small, if the radio is held in the position recommended for best performance. Temperature increments no larger than 0.1°C are caused in simulated human heads for one minute exposures and no larger than 0.4°C for six minute exposures. Temperature variations larger than these are caused in the human body by ambient thermal changes or emotional status. If the radio antenna is held extremely close to the face (less than 0.5"), parts of the surface of the face of the operator are subjected, for prolonged exposures (more than 2-3 minutes), to temperature increases that may be considered

hazardous. As the experimental data have shown, at close distances, the strong electric fields near the tip of the antennas can cause substantial temperature increases in the surface fatty layers of human tissue. This danger can be eliminated by having an adequate insulating cap on the tip of the antenna.

The eyes of the operator are protected by their naturally recessed location, so it is difficult for an operator to place the antenna extremely close to the eye while normally operating the transmitter. A hazard is present if the user accidentally places the antenna tip in the vicinity of practically touching, the eye and then operates the transmitter. An RF burn may then be caused to the cornea. Even in this case, the possibility of damage is eliminated by a suitable insulating cap at the tip of the antenna.

From this information, it appears that radio frequency radiation can deposit energy, measured by temperature increase, in body tissue or muscle, held very close (about $\frac{1}{2}$ inch) to a power source. Apparently, the safety information flyer's warning statement recommending that no one be within two feet of a transmitting antenna allows for a large safety factor, since power densities diminish rapidly with distance.

C. SURVEY METHODS

Measurements of power densities were taken with Narda [®] meter model # 8315 using probe # 8323, or 8321, depending on range scale necessary. Measurements were maximal approximately two inches from power sources in the repair shop. The measurements fell off rapidly with distance. Measurements were also made in the garage, at the perimeter of a mobile van with communication equipment in operations. See the table of Power Density Measurements for results of the survey.

D. INTERPRETATION OF MEASUREMENTS AND CONCLUSIONS

Measurements recorded in the table are maximum readings. In the repair shop, measurement were observed with the probe approximately two inches from the power source (antenna or amplifier). Power densities diminish rapidly to non-measurable within short distances. Considering the time spent on testing the equipment, the maximum power density measured and the improbability of any portion of the servicemen's anatomy in proximity to the power sources, it is doubted, in light of present knowledge, that any measurable risk occurs in normal operations.

In the garage, measurements were made at the perimeter of a mobile van, several feet from the antenna. These measurements also were below the OSHA standard and indicate little probability of risk to near-by personnel.

D. RECOMMENDATIONS

No recommendations are considered necessary.

V. REFERENCES

1. 29 CFR 1910.97, Occupational Safety and Health, General Industry Standards.
2. Energy Deposition in Biological Tissue Near Portable Radio Transmitters at VHF and UHF, Q. Balzano, O. Garay, R. F. Steel. Motorola, Inc., Communications Division, Fort Lauderdale, Florida.

VI. AUTHORSHIP

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Table 1

Maximum Power Density Measurements

Consolidated Edison of NY
Astoria, Queens, NY

April 26, 1979

Model #	Power Output (Watts)	Frequency	Power density/distance from source (mW/cm ²)
Motorola T34BBA-3200-AA	25	456	
Power Amplifier			2.0 / 2 inches ^A
Antenna dummy load- cable disconnected			1.9 / 2 inches ^B
Motorola T63-RTN-1190A	100	153	
Power Amplifier			0.15 / 2 inches ^A
Antenna dummy load- cable disconnect			1.2 / 2 inches ^A
Motorola CC4160 (mobile van antenna)	25	456	0.10 / front 84 inches ^A
			0.25 / right 33 inches ^A
			0.15 / rear 99 inches ^A
			0.20 / left 33 inches ^A
OSHA Standard (f=10 mH to 100 gH)			10 mW / cm ² (TWA for 0.1 hr.)

A. Measured with Narda [®] 8315, Probe # 8321

B. Measured with Narda [®] 8315, Probe # 8323