U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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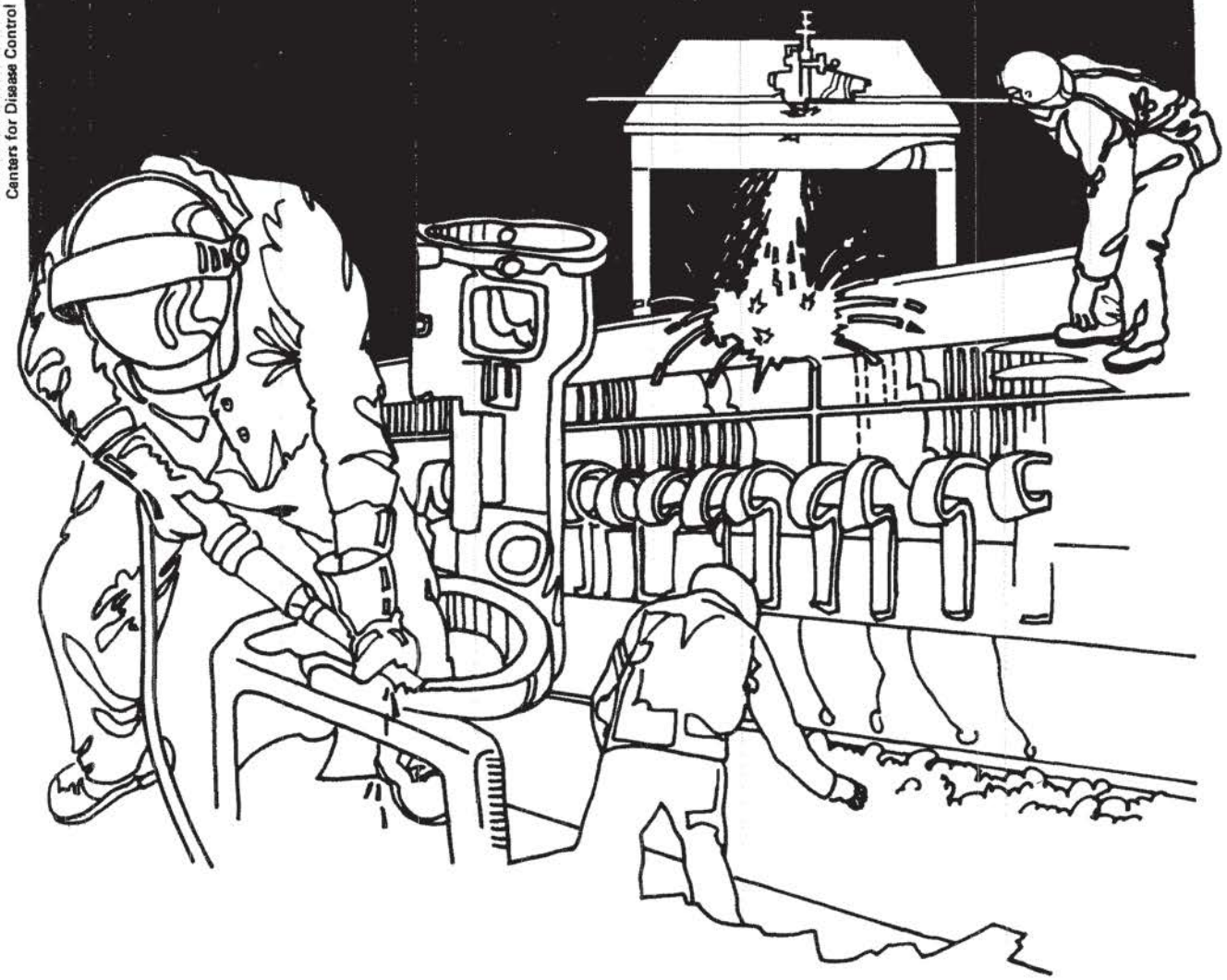
NIOSH



Health Hazard Evaluation Report

HETA 81-073-976
NARRAGANSETT ELECTRIC COMPANY
PROVIDENCE, RHODE ISLAND

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from 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.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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NARRAGANSETT ELECTRIC COMPANY
PROVIDENCE, RHODE ISLAND

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I. SUMMARY

On October 29, 1980, the Brotherhood of Utility Workers of New England Local No. 310, requested that the National Institute for Occupational Safety and Health (NIOSH) evaluate the potential radiation hazards associated with working on or near video display terminals (VDTs) at the Narragansett Electric Company, Providence, RI. Their primary concern was for pregnant women whose physicians had recommended that they be reassigned to other job duties because of possible radiation exposures from cathode ray tubes.

Approximately 53 terminals are used by the company. Both ionizing and nonionizing radiations were evaluated during the survey on January 15, 1981. The levels of ionizing (X-ray) radiation were not distinguishable from the background and all nonionizing (ultraviolet and radiofrequency) radiations were below the detection capability of the instrumentation. Therefore, all exposures were well below the current OSHA occupational standard and NIOSH recommended criteria.

From these measurements, NIOSH concluded that there is no radiation hazard to employees working at or near the terminals. Since the radations are very low and in most cases not detectable, there is no radiation hazard from the VDT to the women and developing embryos or fetuses.

KEYWORDS: SIC 2711 VDTs, ionizing (X-ray) radiation, nonionizing (ultraviolet, radiofrequency) radiation.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request, October 29, 1980, from the Brotherhood of Utility Workers of New England, Local No. 310, to evaluate the potential radiological health hazard for workers using video display terminals (VDTs) at the Narragansett Electric Company, Providence, Rhode Island. Representatives of Local 310 indicated that they were primarily concerned about pregnant women. In two cases, the woman's obstetrician recommended that they be transferred to another position because of the potential risk to the fetus of radiation exposure from cathode ray tubes. The NIOSH survey was conducted on January 15, 1981.

III. BACKGROUND

The Narragansett Electric Company has 53 IBM Model 3278-2 VDTs in use at three locations. At the main office in Providence, 27 terminals are used in the customer service office. At two branch customer service offices, the Coventry branch in West Warwick and the Warren branch in Providence, an additional 26 terminals are in use.

The VDT may produce several types of electromagnetic radiation depending upon the operating characteristics. Low energy X-rays may be generated by the cathode ray tube and electronic damper circuits. Ultraviolet (UV), visible, and infrared (IR) radiation may be emitted from the screen face depending on the phosphor used. Certain electronic components and circuits may produce radiofrequency (RF) radiation.

On December 23, 1980, a private consulting radiation physicist, contacted by the company, examined the terminals for x-radiation. His conclusion, based on his measurements, was that the VDTs may be operated without any hazard from ionizing radiation to the operators, or to the fetus of a pregnant operator.

IV. METHODS

NIOSH evaluated the workplaces by surveying the terminals in 2 of the 3 office locations. Measurements were recorded for RF electric field (E) and magnetic field (H) strengths and ultraviolet radiation for 5 of the 27 units in the Providence customer service office, and for 7 of the 10 units in the Coventry office. In addition, the remaining units in both offices were scanned for X-rays with the Stoms meter, and in Coventry office the remaining three units were examined for RF radiation. To perform a complete radiation survey, several instruments are required to measure the radiation types which may be emitted by the VDT.

An International Light Model IL730A Actinic Radiometer with probe PT171C (filter and diffuser attached) was used to measure the

irradiance in the near UV wavelength range of 320 to 400 nanometers (nm). The instrument reads out in watts per centimeter squared (W/cm^2). The minimum detectable level is $5x10^{-8}$ W/cm^2 and the accuracy is about ±20 percent. All measurements with this instrument were made at contact with the VDT screen face.

Electric field measurements were taken with Holaday instruments, the Model HI-3001 meter (S/N 26004) and two probes, the green probe (S/N 014) and the red probe (S/N 015). The probes were calibrated on September 14, 1980, and were used to measure the electric field strength in volts squared/meter squared (V^2/m^2). The minimum detectable limit for the green probe was 5 V^2/m^2 and for the red probe it was $5x10^3$ V^2/m^2. For the green probe, the maximum detectable field strength was 10^4 V^2/m^2 and for the red probe it was 10^7 V^2/m^2. The overall accuracy of both probes was ±2.0 dB, corresponding to +59 and -37 percent in the frequency range of 0.5 MHz to 1,000 MHz.

Magnetic field measurements were taken with Narda instruments, the Model 25540 meter (S/N 04022) and the Model 8635 probe (S/N 01008). The probe was calibrated May 30, 1980 and was used to measure the magnetic field strength in amperes squared/meter squared (A^2/m^2). The minimum detectable limit was 0.1 A^2/m^2 with an overall accuracy of ±3.0 dB, corresponding to +100 and -50 percent, in the frequency range of 10 to 300 MHz.

To identify the frequency of any detectable RF radiation found emanating from the VDTs, a Hewlett-Packard Model 53038/5300B, S/N 1520A02460/1452A0228 Frequency Counter/Measuring System mainframe and a Singer Model 90700-2 antenna loop with an upper limit of 525 MHz were available.

Two instruments were used in the x-ray survey. A Stoms meter[1] was employed first to detect any x-ray beams generated by the terminal. Every accessible surface of the VDT was slowly scanned as close to the surface as possible. This instrument is very sensitive and specifically designed to locate small diameter, low-energy (down to 12-13 kiloelectron volts keV) x-ray beams which may be emitted from the terminal. It was designed by the Food and Drug Administration's Bureau of Radiological Health (BRH) for use in enforcing the television receiver performance standard. This meter is very energy dependent, but is used only to detect, and not to measure, Xrays. The device uses four Victoreen Model 1B85 Geiger-Mueller tubes as the detectors and is calibrated electronically with a Tektronix Model 7603 oscilloscope and a pulse generator. A Victoreen Model 440 RF/C was available to accurately measure x-ray emissions in case any had been detected with the Stoms meter. The 440 RF/C is specifically designed to measure x-ray emissions from TV receivers and is shielded against electromagnetic interference. It responds adequately to photon energies from 6 to 42 keV. The maxiumum x-ray energy from these terminals is approximately 15-20 keV, depending on the operating voltage of the cathode ray tube. Exposure rates as low as 0.05 mR/hr can be measured and the overall accuracy is about ±15 percent.

V. EVALUATION CRITERIA

The Occupational Safety and Health Administration (OSHA) radiation protection standard (Table 1) for occupational exposure to RF and microwave radiation (29CFR 1910.97) applies to the frequencies from 10 to 100,000 MHz. It establishes as a limit for occupational exposures a maximum power density of 10 milliwatts per centimeter squared (mW/cm^2), as averaged over any possible six-minute period. Since power density cannot be measured at distances close to the VDT, separate measurements (as mentioned in Section IV) must be made for the electric and magnetic fields. In the far fields, equivalent values corresponding to a power density of 10 mW/cm^2 are a mean squared electric field strength of 40,000 V^2/m^2 and a mean squared magnetic field strength of 0.25 A^2/m^2. There is presently no standard for frequencies below 10 MHz. The OSHA standard for ionizing radiation is 2.5 milliroentgens per hour when averaged over a 40-hour work week (29CFR 1910.96). For near ultraviolet radiation (320-400 nm), the NIOSH Criteria Document[2] recommends an exposure limit of 1 mW/cm^2.

VI. RESULTS

At least four background readings for Xrays were taken with the Stoms meter in each area or room where VDTs were located and the typical readings were in the 40-80 counts per minute (cpm) range. A reading of 3000-4000 cpm is roughly equivalent to an exposure rate of 0.5 milliroentgens per hours (mR/hr) which is the federal (Food and Drug Administration) emission standard for television receivers (21CFR 1020.10).

Radiation measurements for X-rays, UV and RF were made and identified for 12 of 53 terminals used by the Narragansett Electric Company. The data are shown in Table 2. The nonionizing (RF and UV) radiations were below the detection capability of the instruments, and x-ray measurements around the terminal and in front of the screen were not distinguishable from background levels.

In the Coventry office, 3 additional terminals were monitored for X-rays and radiofrequency radiation. However, since no radiation was detected, the serial numbers of the terminals were not recorded, and the data is not included in Table 2.

Since the greatest concern was exposure to X-rays, the screens of all 27 units in the Providence office were scanned for X-rays with the Stoms meter. Again, as recorded for the other terminals, only background levels of radiation were detected.

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VII. DISCUSSION

Since the purpose of this evaluation was to charaterize radiation levels, ergonomic features of the VDTs were not examined. In contrast to some other facilities where such factors have been shown to be related to employee health complaints [3, 4] there were no such complaints received by the investigator. Perhaps the lack of complaints was due to what appeared to a very relaxed working atmosphere, e.g., good communications between employees and supervisors.

VIII. CONCLUSIONS

The maximum measured radiation levels are compared with the current occupational exposure guidelines in Table 1. As shown the levels are well below the guideline values and often below the detection capability of the instrumentation. Based on the survey data and present guidelines, NIOSH has concluded that Narragansett Electric Company employees working at or near the VDTs, in the customer service offices are not exposed to a radiation hazard. This conclusion applies to all workers, including pregnant women with developing embryos and fetuses.

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Technical Information Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After ninety (90) days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161. Information regarding its availablility through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati, Ohio address.

Copies of this report have been sent to:

1. Rhode Island Department of Health
2. Narragansett Electric Company
3. Brotherhood of Electrical Workers, Local 310 and 312
4. NIOSH Region I

XI. REFERENCES

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2. National Institute for Occupational Safety and Health (NIOSH) Criteria for a Recommended Standard...Occupational Exposure to Ultravilet Radiation. Cincinnati, Ohio: NIOSH Publication No. HSM73-11009 (NTIS: PB214268), 1972.

3. Smith, J.J., Stammerjohn, B., Cohen, B., Lalich, N., Video display operator stress In: E. Grandjean, Ed. Ergonomic Aspects of Visual Display Terminals. London, England. Taylor and Travies Ltd, 1980, pp 201-210.

4 National Institute for Occupational Safety and Health. NIOSH Research Report. Potential Health Hazards of Video Display Terminals, DHHS (NIOSH) Publication No. 81-189, 1981, 75 pp.

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TABLE I

COMPARISON OF MAXIMUM MEASURED RADIATION
WITH CURRENT OCCUPATIONAL EXPOSURE LIMITS
HETA 81-073

RADIATION TYPE	UNITS	MAXIMUM LEVEL	EXPOSURE LIMIT	REFERENCE
Electric Field	V^2/m^2	ND	$4x10^4$*	OSHA
Magnetic Field	A^2/m^2	ND	0.25*	OSHA
Ionizing	mR/hr	BG	2.5+	OSHA
Ultraviolet	mW/cm^2	ND	1.0	NIOSH

ND No radiation was detected
BG Background radiation
* Far field equivalent of the power density limit of 10 mW/cm^2
\+ Averaged over a 40-hour workweek

TABLE 2

RADIATION MEASUREMENTS ON IBM Model 32782 VDTs
JANUARY 15, 1981
HETA 81-073

Serial No.	X-rays mR/hr	Radiofrequency E-Field V^2/m^2	Radiofrequency H-Field A^2/m^2	Ultraviolet mW/cm^2
		Providence Customer Service Office		
J-9516	BG	ND	ND	ND
J-9520	BG	ND	ND	ND
J-9523	BG	ND	ND	ND
J-9525	BG	ND	ND	ND
J-1986	BG	ND	ND	ND
		Coventry Customer Service Office		
J-9537	BG	ND	ND	ND
J-9538	BG	ND	ND	ND
J-9539	BG	ND	ND	ND
J-9540	BG	ND	ND	ND
K-9541	BG	ND	ND	ND
J-1985	BG	ND	ND	ND
D-6617	BG	ND	ND	ND

BG Background radiation (40-80 cpm)
ND Not detectable