CDC Workplace Safety and Health™

NIOSH HEALTH HAZARD EVALUATION REPORT:

HETA #2003-0111-2909
Ethicon Endo-Surgery
Cincinnati, Ohio

August 2003

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

NIOSH

PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (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 (OSHA) 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.

HETAB also provides, upon request, technical and consultative assistance 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. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Mark M. Methner, Ph.D., CIH, of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS) and W. Gregory Lotz, Ph.D., of the Division of Applied Research and Technology (DART). Desktop publishing was performed by Robin Smith. Review and preparation for printing were performed by Penny Arthur.

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Highlights of the NIOSH Health Hazard Evaluation

Evaluation of Radio-frequency Exposure

In December 2002, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation (HHE) request from the management of Ethicon Endo-Surgery (EES) to evaluate worker exposure to radio-frequency electromagnetic radiation emanating from a radar antenna located across the street. An initial walkthrough survey was conducted on March 7, 2003, followed by a measurement survey on March 21, 2003.

What NIOSH Did

- We performed a walkthrough survey to familiarize ourselves with the different facilities.
- We talked to management and employees about the effects of exposure to radio-frequency electromagnetic radiation .
- We took measurements of the intensity of the radar. These are called radio-frequency (RF) measurements.

What NIOSH Found

- All measured RF levels were well below the exposure limits.
- Even though RF levels were extremely low, the sensitive electronics in some radios and cathode ray tube (CRT) monitors may be affected.

What EES Endo-Surgery Managers Can Do

- If CRT monitor "flicker" causes employee eye strain and/or headaches, these monitors should be replaced with a monitor that is not affected by radio-frequency electromagnetic radiation.

What the EES Endo-Surgery Employees Can Do

- No action is necessary.

What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2003-0111-2909

Health Hazard Evaluation Report 2003-0111-2909
Ethicon Endo-Surgery
Cincinnati, Ohio
August 2003

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SUMMARY

On December 20, 2002, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from management at Ethicon Endo-Surgery (EES) in Cincinnati, Ohio, to evaluate occupational exposure to radio-frequency (RF) radar emissions from an adjacent Ohio Air National Guard (OANG) facility.

RF was measured in the 2.9 - 3.1 GigaHertz [GHz] range at the source of the radar (approximately 5 feet from the rotating radar transmitter) and at various points along the beam path (which is in direct alignment with the EES facility). All equipment used to document exposure was calibrated by the manufacturer approximately one month prior to the survey.

The only power density measurement above the detection limit of the instrument was recorded 5 feet away from the hilltop rotating radar transmitter, at 0.33 milliwatts/square centimeter (mW/cm^2). This location is approximately 2500 ft from EES. The remaining levels were all below the limit of detection of the instrument (0.02 mW/cm^2), which is approximately 100 times below the Institute for Electrical and Electronic Engineers (IEEE) exposure limit for the general population.

The NIOSH investigators determined that no health hazard existed from exposure to RF. Computer monitors and radio reception interference in the EES office is due to RF levels far below all applicable criteria.

Keywords: SIC Code 3841 (Surgical and Medical Instruments and Apparatus) Radar, GigaHertz, frequency, off-site exposure, rotating antenna, electronic interference, microwaves.

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INTRODUCTION

On December 20, 2002, the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation (HHE) request from management at Ethicon Endo-Surgery (EES) in Cincinnati, Ohio, to evaluate occupational exposure to radio-frequency radar emissions from an adjacent Ohio Air National Guard (OANG) facility. Workers located on the second floor of the research and development office area expressed concern over the potential health effects related to radar operations which were reported to cause computer monitor "flicker" and radio/telephone interference (static). On March 7, 2003, investigators from NIOSH met with a concerned employee, a management representative from EES and the base commander of the OANG. A walkthrough inspection survey was conducted to familiarize NIOSH investigators with the operation of the radar site located across the street from the EES facility. A subsequent site visit was conducted on March 21, 2003, to measure the intensity of the radar emissions both at the source (OANG) and within the working environment of EES.

BACKGROUND

EES develops and markets a broad portfolio of advanced surgical instruments and medical devices for minimally invasive and traditional surgery, as well as a line of safety catheters for vascular access. EES world headquarters is located in Cincinnati, Ohio. Approximately 1,200 associates work at this location, which is also home to the Endo-Surgery Institute, a medical education and surgical training center where health care workers learn the latest technology in minimally invasive surgical procedures. The company designs procedure-enabling medical devices for interventional diagnosis and treatment of various diseases and conditions in the areas of general and thoracic surgery, breast disease, gynecology, oncology, and urology.

The OANG has operated a radar antenna at this site for more than 40 years. The purpose of the radar system is military air traffic surveillance and control. The operational configuration and specifications of the radar unit are presented in Table 1. In 1998 EES built an addition to house research and development activities. The addition occupies a space that is in direct alignment with the RF beam path at a distance of approximately 2500 feet east of the OANG radar facility.

METHODS

Worker exposure to radar was measured in the radio-frequency range of 2.9 - 3.1 GigaHertz [GHz] at a variety of locations within and outside the EES facility. The NIOSH investigators took measurements at the source of the radar (approximately 5 feet from the rotating radar transmitter) and at various points along the beam path (which is in direct alignment with the EES facility). The actual locations and concomitant power density measurements are presented in Table 2. Power density was measured with a NARDA Microwave Corporation Model 8716 meter with a Model 8721 probe. The power density probe operates in the frequency range from 0.3 to 40 GHz and measures in units of milliwatts per square centimeter (mW/cm^2). The limit of detection (LOD) for this probe-meter combination is 0.02 mW/cm^2. All equipment used to document exposure was calibrated by the manufacturer approximately one month prior to the survey.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though

their exposures are maintained below these levels. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace evaluated here are (1) Institute for Electrical and Electronics Engineers (IEEE),[1] (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),[2] and (3) the Federal Communications Commission (FCC).[3]

Many of the observed biological effects of RF exposure are accompanied by a rise in body temperature. The heating effect depends on the rate of RF energy absorbed by the body. The rate of energy absorption, denoted by the specific absorption rate (SAR), is measured in watts per kilogram (W/kg) for the whole body or parts of the body. The SAR depends on many factors, such as the frequency and field strength of the radiation, size and shape of the exposed worker, and the worker's orientation in the radiation field. The adult human body has a maximum absorption rate in the frequency range of 30 to 100 megahertz. Outside of this range, the energy absorption rate in the body is much less. Since the operating frequency of the OANG radar is 2.9 GHz to 3.1 GHz, and the magnitude of exposure at EES was not detectable, employing a SAR value would not be meaningful. Hence, if the measured power density does not exceed the applicable exposure limit, the SAR will not be exceeded.[1] Finally, much of what is known about RF biological effects has been developed from acute (short-term) exposure. Much less is known about long-term RF exposure at low levels.

Human and animal studies indicate that exposure to RF fields above occupational exposure guidelines (10 mW/cm^2) may cause heating of internal tissues which may be accompanied by harmful biological effects.[1-3] The effects include changes in the eye, nervous, endocrine (hormone), and immune systems, or changes in behavior, cell biochemistry, reproduction, and growth. According to the ACGIH TLV occupational exposure guidelines, acceptable power density levels at the operating frequency of 2.9 to 3.1 GHz could range from 9.7 mW/cm^2 to 10 mW/cm^2. Human exposure below occupational RF exposure guidelines has not been conclusively associated with any adverse health outcomes.[1-3]

RESULTS AND DISCUSSION

The only power density measurement above the detection limit of the instrument was recorded 5 feet away from the hilltop rotating radar transmitter. A value of 0.33 mW/cm^2 was measured at this location, which is approximately 2500 ft from the EES office area being evaluated. The remaining measurements were all below the limit of detection of the instrument (0.02 mW/cm^2), which is 500 times below the ACGIH maximum permissible exposure.

While no computer monitor flicker occurred during the NIOSH survey, static was heard from a small radio located on an employee desk. The static was cyclical and appeared to be synchronized with the rotation of the radar antenna. A possible explanation of the electronic interference for CRT monitors and radios where measurements were below the LOD is that the electronics are far more sensitive than the survey meter, even though the meter could detect levels about 1/500th of the maximum permissible exposure (TLV = 10 mW/cm^2). Interference may be due to "spurious emissions", a type of electromagnetic interference, that results from the transmission of a radar pulse. This phenomenon commonly affects electronic devices such as CRTs and radios, but not Liquid Crystal Display type monitors (LCDs). This finding was confirmed by employees who stated that workstations equipped with LCDs were not affected. At any rate, it is plausible that there could be electronic interference with the CRTs at a level NIOSH investigators could not detect with the survey meter.

CONCLUSIONS AND RECOMMENDATIONS

Based on the observations and measurements made during this survey, exposure was extremely low, and workers were not in danger of overexposure while performing their duties during the work day. However, if employees report eye strain and/or headaches as a result of viewing a monitor that flickers, that particular CRT should be replaced with an LCD monitor.

REFERENCES

1. IEEE [1999]. C95.1-1999, standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 KHz to 300 GHz. New York, NY. Institute for Electrical and Electronics Engineers IEEE Standards Coordinating Committee 28.

2. ACGIH [2003]. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, Radio-frequency and Microwave Radiation. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.

3. FCC [1996]. Limits for Maximum Permissible RF Exposure. Washington, DC: Federal Communication Commission. 96-326.

Table 1: OANG Radar Operational Configuration: Cincinnati, Ohio
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Equipment Description	**Specification**
Antenna	11 ft by 18.4 ft Planar array
Scan rate	6.5
Tilt angle	Adjustable from +3 to -1.5 degrees
Horizontal beam width	1.1 Degrees
Vertical beam width	20 Degrees
Transmitting frequency	16 Frequencies in the 2.9 to 3.1 GHz range
Pulse repetition	235, 250, 275 Pulses per second
Pulse width	6.8 microseconds
Peak power	2.8 megawatts
Average power	4.7 kilowatts
Bandwidth	>200 megahertz

Table 2: Location and magnitude of RF measurements: EES, Cincinnati, Ohio
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Location of Measurement	Power Density (mW/cm^2)
5 feet from base of rotating transmitter, 8 feet above ground	0.33 maximum (on antenna rotation); range = 0.25 - 0.33 over several measurements
At base of antenna hill	BDL
200 feet from antenna (Ground Level), on OANG base	BDL
EES parking lot at McKinley Rd	BDL
EES 2nd floor R&D office area (at window)	BDL
EES 2nd floor R&D office area (actual workstation of HHE co-requestor)	BDL
Rooftop above office space (near roof edge)	BDL
EES President Office/Conference Room	BDL

Note: BDL = Below Detectable Limit. For the instrument used, this value is 0.02 mW/cm^2.

Abbreviations: mW/cm^2 = milliWatts per square centimeter.
RF = radiofrequency.

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