NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2004-0064-2933
ISCO International
Mt. Prospect, Illinois

March 2004

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

PREFACE

The Hazard Evaluation 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 employers 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 John Cardarelli and Chandran Achutan of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS). Desktop publishing was performed by Robin Smith. Review and preparation for printing were performed by Penny Arthur.

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For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Highlights of the NIOSH Health Hazard Evaluation

Evaluation of Radiofrequency Exposure at ISCO International

Because of a confidential employee request, NIOSH representatives conducted a health hazard evaluation at ISCO International in Mt. Prospect, Illinois, on February 2, 2004. They looked into concerns about exposures to radiofrequency (RF) fields from the minimum detectable signal (MDS) testing station.

What NIOSH Did

- We measured RF fields at the MDS test station.
- We met with management and employees to discuss measurement techniques and health effects from RF field exposures.

What NIOSH Found

- All RF field measurements were below the exposure limits applicable to the working and general populations.
- No RF exposure hazards exist from the MDS testing station.

What ISCO International Employees and Managers Can Do

- Learn more about the health effects of RF exposures by visiting the following websites:
  - ➜ htpp://www.cdc.gov/niosh/emfpg.html
  - ➜ http://www.fda.gov/cellphones
  - ➜ http://www.fcc.gov/oet/rfsafetv
  - ➜ http://www.ieeeusa.org/forum/tis/index.html
- Employees with concerns should see their health care provider. It may be useful to seek evaluation by a physician who is residency-trained or board certified in occupational medicine and is familiar with the types of exposures and health effects of concern to employees.

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 #2004-0064-2933

Health Hazard Evaluation Report 2004-0064-2933
ISCO International
Mt. Prospect, Illinois
March 2004

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SUMMARY

On November 26, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) at ISCO International in Mt. Prospect, Illinois. The requestor expressed concerns about possible excessive exposures to radiofrequency (RF) radiation while working near or at the minimum detectable signal (MDS) station. Reported symptoms included skin rashes, sunburn-like redness and swelling of face and back, burning feeling in the eyes, headaches, fatigue, elevated temperature, and diarrhea. The test transmitters were reportedly active throughout the day even when no products were being tested. On February 2, 2004, NIOSH investigators completed a source characterization of the RF fields emitted from the testing station at ISCO International. This evaluation assessed occupational exposure to RF fields in the frequency range from 0.3 to 3,000 megahertz (MHz) among workers during a typical daily work regimen.

All measurements taken with the Narda Shaped Frequency Response Probe 8742D, combined with the Narda Model 8718B Electromagnetic Radiation Survey Meter, were below the occupational exposure limits of 2.7 to 3.0 milliwatts per square centimeter (mW/cm^2) recommended by the U.S. Federal Communication Commission for frequencies between 800 to 900 MHz. Further, all of the measurements were below 1.5 percent of the limit, which indicates that the emissions from this testing station pose no threat to employees or the general population who visit or pass through the area.

No RF exposure hazards exist from the testing station located at the ISCO International manufacturing facility. This conclusion is based on the RF measurements taken on February 2, 2004, which were all below any RF exposure limits for the general population or occupational work environments.

Keywords: SIC 3663 (Radio and Television Broadcasting and Television Communications), Antenna, Non-Ionizing Radiation, Radiofrequency, RF, electric fields

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INTRODUCTION

On November 26, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) at ISCO International, Mt. Prospect, Illinois. The requestor expressed concerns about possible exposures to radiofrequency (RF) radiation while working near or at a minimum detectable signal (MDS) station. The test transmitters at the MDS station were reported to be active throughout the day, even when no products were being electronically tested. Reported health problems included skin rashes, sunburn-like redness and swelling of face and back, burning feeling in the eyes, headaches, fatigue, elevated temperature, and diarrhea.

On February 2, 2004, NIOSH investigators conducted a site visit at ISCO International and completed a source characterization of the RF fields emitted from the MDS testing station. This evaluation assessed occupational exposure to radiofrequency fields in the frequency range from 0.3 to 3000 megahertz (MHz) among workers during a typical daily work regimen. The MDS test station uses frequencies of 800 to 900 MHz which fall within the detection range of the instrument.

BACKGROUND

ISCO International, founded in 1989, is located in the Chicago suburb of Mount Prospect, Illinois. ISCO develops and manufactures front-end systems for wireless networks using adaptive notch filters and high-temperature superconductor filters. The MDS test station is part of the quality control process to evaluate the electronic sensitivity of the components (Figure 1).

METHODS

This evaluation assessed occupational exposure to a broadband of RF fields ranging from 0.3 to 3,000 megahertz (MHz) among workers during a typical daily work regimen. The number and types of measurements performed in the evaluation were intended to evaluate the potential for excessive exposure. They were not intended to represent an in-depth investigation of exposure to all RF fields present at the site, as that would require long-term monitoring.

A Narda Shaped Frequency Response Probe 8742D combined with the Narda Model 8718B Electromagnetic Radiation Survey Meter was used in this evaluation. The shaped frequency response probe technology mirrors a particular standard as closely as possible and provides a measurement in terms of a percent of the standard instead of a power density reading.

RF exposure potentials were measured at various locations in the facility, with emphasis in and around the MDS testing station. These measurements were obtained using two methods. The first method consisted of area measurements around the MDS testing station to seek out the higher potential RF exposure locations. Each measurement was obtained at heights approximately 3 to 6 feet above ground level (with the exception of a few spatial-average measurements; see evaluation criteria).

The second method consisted of spatial-average measurements at the MDS testing station to determine the RF exposures while working at this location. Spatial-average measurements were obtained in accordance with the Institute of Electrical and Electronics Engineers (IEEE) Standard[1] and the Narda Model 8718B User's Guide.[2] The Narda Model 8718B is capable of taking about 100 measurements during a 10-second scan over a distance equivalent to a standing adult (eg., about six feet). The results are presented as both an average value (spatial-average) and a peak value. This measurement technique is necessary because the field strengths vary substantially over a six-foot vertical span. It consists of a vertical, linear scan of the RF fields. Each scan lasts about 10 seconds incorporating about 100 RF measurements. Two spatial-average measurements were obtained at the MDS test station. The average of these spatial-average

measurements and the peak measurement is reported.

EVALUATION CRITERIA

Radio frequency (RF) Evaluation Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff use environmental evaluation criteria for the assessment of a number of chemical and physical agents. Guidelines for limiting RF exposure have been developed by several voluntary organizations and government agencies in the United States and elsewhere (Table 1).[1,3,4,5] The Federal Communications Commission (FCC) requires that all licensed telecommunications facilities comply with its exposure guidelines.[6] These guidelines were developed to protect workers and the general population from harmful exposure to RF radiation.

For workers, the occupational limits (sometimes referred to as controlled environment) apply to persons exposed as a consequence of their employment, provided they are fully aware of the potential for exposure and can exercise control over their exposure. For workers that do not satisfy this description, NIOSH applies the exposure limits as defined for the general population (sometimes referred to as the uncontrolled environment). These general population exposure limits apply to situations in which the general public may be exposed, or in which persons are exposed as a consequence of their employment but may not be fully aware of the potential for exposure or can not exercise control over their exposure. In this survey, ISCO employees would be placed in the occupational category. Regardless of which category is being used, the consensus of the scientific community is that exposure to RF radiation below recommended limits is safe.

There are three fundamental concepts that apply to either the occupational or general public limits. These are (1) understanding the difference between ***exposure*** and ***emission*** limits; (2) spatial averaging; and (3) time averaging. Each of these concepts is described below in greater detail.

Exposure vs. Emission Limits

Exposure limits, as described above, apply to workers and the general public and are designed to prevent harmful effects from exposure to electromagnetic radiation (such as RF). Emission limits are the maximum power output authorized by the FCC for companies or individuals who apply for a license to transmit signals (e.g., radio and television stations, amateur radio operators). However, these transmitting signals are often not emitted at the maximum power output. This is especially true for cell-phone base stations or towers, since the amount of power used is proportional to the number of calls handled. This is also true for the MDS test station used by ISCO International. For this reason, it is important to note that the emission limit (maximum power output) may not be directly related to specific exposure measurements in the field.

Unlike the emission limits, the FCC exposure guidelines apply to exposure limits, and they are relevant only to locations that are accessible to workers or members of the public. Exposures can often be controlled by limiting or restricting access to areas by appropriate means (such as using fences, warning signs, etc). For example, in the case of occupational exposure, procedures can be instituted for working in the vicinity of RF sources that will prevent exposures in excess of the guidelines (this is called a controlled environment). An example of such procedures would be restricting the time an individual could be near an RF source, or requiring that work on or near such sources be performed while the transmitter is turned off or while power is appropriately reduced.

Spatial Averaging

The exposure limits shown in Table 1 are based on the concept that the exposures are applied to a **whole-body** averaged specific absorption rate (SAR). The spatially-averaged RF field is

accepted as the most accurate estimate to compare to the FCC guidelines. This means that **spot measurements** exceeding the stated exposure limits do not imply non-compliance if the spatial average of RF fields over the body does not exceed the limits. Further discussion of spatial averaging as it relates to field measurements can be found in Section 3 of Bulletin 65[6] and in the reference documents of the American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) and the National Council on Radiation Protection and Measurements (NCRP).

Time Averaging

Another feature of the exposure guidelines is that exposures may be averaged over certain periods of time with the average not to exceed the limit for continuous exposure. The averaging time for occupational (controlled environment) exposures is **six minutes**, while the averaging time for general population (uncontrolled environment) exposures is **thirty minutes**. To properly apply field measurements to the exposure limits, one must consider the length of time the individual is exposed. For example, with the occupational exposure, during any given six-minute period, a worker could be exposed to twice the applicable limit for three minutes as long as they were not exposed at all for the preceding or following three minutes. Similarly, a worker could be exposed at three times the limit for two minutes as long as no exposure occurs during the preceding or subsequent four minutes.

RESULTS

Two spatial-average measurements indicated an average RF exposure of 0 percent of the occupational standard, with maximum readings below 1.5 percent of the occupational standard (Figure 1).

All other RF measurements taken with the Narda 8742D probe were below both the occupational exposure limits and the general population limits (the latter being the most conservative criteria which could be applied to ISCO International employees). These very low measurements indicate that the emissions from this MDS test station pose no threat to employees or the general public who visit or pass through the facility.

DISCUSSION

Exposure to RF fields near the MDS test station was far below recommended exposure limits, even though the RF source was within the building. The reported health problems have not been associated with RF exposures at the levels measured at the MDS test station. Further, with the type of testing equipment used by ISCO International, it is not possible for RF levels to be generated at levels which may cause these health problems or even exceed the occupational limits at this station.

Large amounts of RF energy can heat tissue. This can increase body temperatures and damage tissues especially the eyes and the testes, which are particularly vulnerable to RF heating because there is relatively little blood flow in them to carry away excess heat. The amount of RF radiation routinely encountered by the general public is too low to produce significant heating or increased body temperature. Still, some people have questions about the possible health effects of low levels of RF energy. It is generally agreed that further research is needed to determine what effects actually occur and whether they are dangerous to people. In the meantime, standards-setting organizations and government agencies are continuing to monitor the latest scientific findings to determine whether changes in safety limits are needed to protect human health.

More information regarding the health effects associated with exposure to RF radiation can be found at the NIOSH internet site at http://www.cdc.gov/niosh/emfpg.html and other internet sites, including the following:

http://www.fcc.gov/oet/rfsafety/;
http://www.fda.gov/cellphones/; and
http://www.ieeeusa.org/forum/tis/index.html.

These internet sites and their associated links should be used to learn more on this topic, as they are considered to be technically correct and scientifically credible.

CONCLUSIONS

No RF exposure hazard exists from the MDS testing station located in the ISCO International manufacturing facility. This conclusion is based on the measurements which were well below any RF exposure limits for the general population or occupational work environment.

RECOMMENDATIONS

There are no recommendations for protective actions. However, we recommend that the readers of this report visit the FCC Frequency Asked Questions website (http://www.fcc.gov/oet/rfsafety/rf-faqs.html) to increase their awareness and understanding of the health effects associated with electromagnetic radiation (and specifically RF radiation), how it is measured, what research is being conducted in this area, the basis for setting exposure guidelines, and many other issues.

Employees with concerns should see their health care provider. It may be useful to seek evaluation by a physician who is residency-trained or board certified in occupational medicine and is familiar with the types of exposures and health effects of concern to employees. Occupational medicine physicians can be located through a variety of sources, including universities, the Association of Occupational and Environmental Clinics at www.aeoc.org, and the American College of Occupational and Environmental Medicine at www.acoem.org . It may be useful to provide the physician with a copy of this report.

REFERENCES

1. IEEE [1999]. IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz. Institute of Electrical and Electronics Engineers, Inc. Std C95.1.

2. Narda Model 8718B Electromagnetic Radiation Survey Meter User's Guide. Narda Safety Test Solutions, 435 Moreland Road, Long Island, NY. (www.narda-sts.com). P/N 42983600 Rev A.

3. NCRP [1986]. Biological effects and exposure criteria for radio frequency electromagnetic fields, Report 86. Bethesda, MD: National Council on Radiation Protection and Measurements, pp.1-382.

4. ICNIRP [1998]. Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz), Health Physics, 74 (4): 494-522.

5. NRPB [1993]. Board Statement on Restrictions on Human Exposure to Static and Time-Varying Electromagnetic Fields and Radiation, Documents of the NRPB, Vol. 4, No. 5, Chilton, Didcot, Oxon, UK: National Radiological Protection Board.

6. OET [1997]. Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, Bulletin 65. U.S. Federal Communications Commission, Office of Engineering and Technology.

Table 1. Guidelines used for limiting RF exposures from 800 to 900 MHz cellular frequencies					
Cellular frequencies between 800 MHz and 900 MHz	Exposure Limit (Power Density) in milliwatts per square centimeter (mW/cm^2)				
	FCC[§] (1997)	IEEE[†] (1999)	ICNIRP[‡] (1998)	NRPB[#] (1993)	NCRP[&] (1986)
General Public*	0.53 - 0.60	0.53 - 0.60	0.40 - 0.45	3.1 - 3.3	0.53 - 0.60
Occupational**	2.67 - 3.00	2.67 - 3.00	2.00 - 2.25	3.1 - 3.3	2.67 - 3.03

Notes

* These exposure limits are applicable during any consecutive 30-minute exposure period, except for the National Radiological Protection Board (NRPB) limits which do not discriminate between public and occupational exposures.

** These exposure limits are applicable during any consecutive six-minute exposure period, except for NRPB limits which do not discriminate between public and occupational exposures.

§ U.S. Federal Communications Commission, Washington DC.

† Institute of Electrical and Electronics Engineers.

‡ International Commission on Non-Ionizing Radiation Protection.

National Radiological Protection Board (United Kingdom). This standard has the same limits for occupational and general public exposure at these frequencies.

& National Council on Radiation Protection and Measurements.

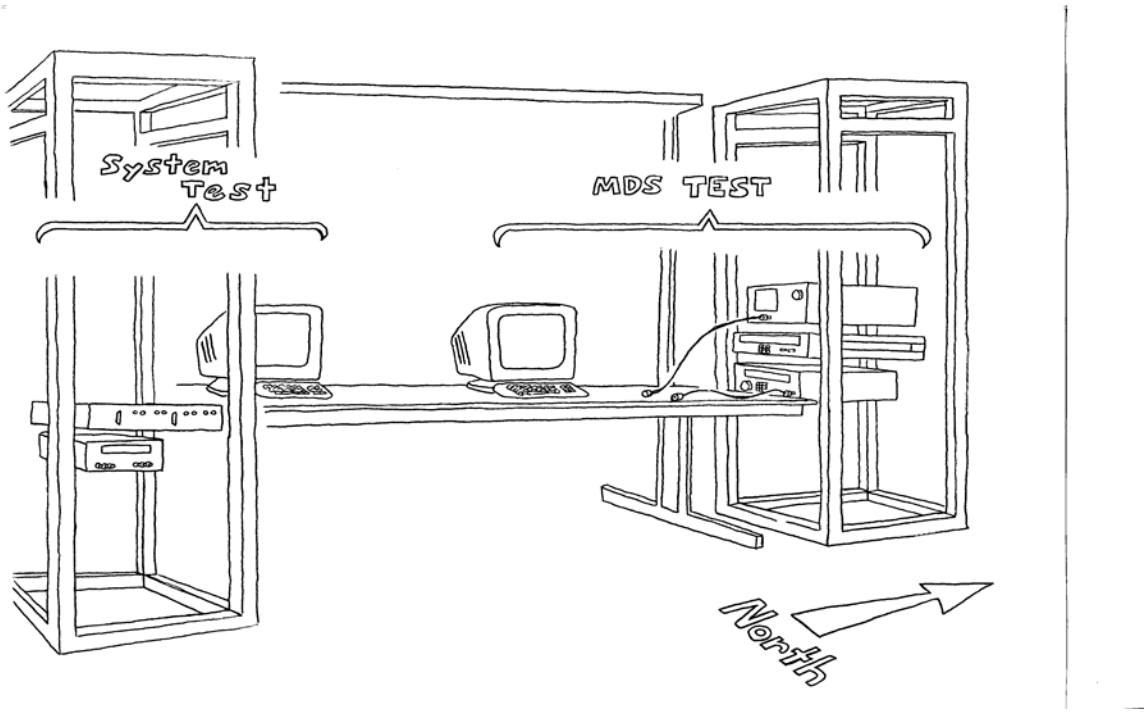

Figure 1: Minimum Detectable Signal (MDS) test area. Two spatial-average measurements indicated an average RF exposure of 0 percent of the occupational standard, with maximum readings below 1.5 percent of the occupational standard.

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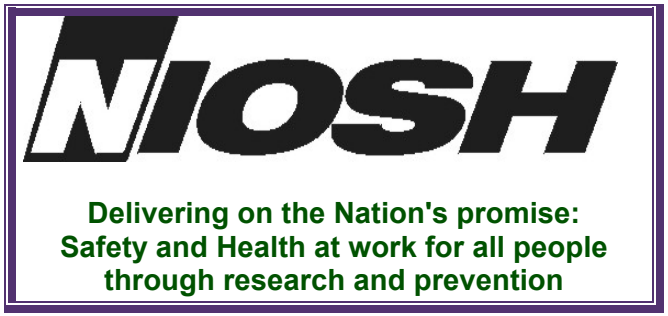

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