MICRO WAVE NEWS

Vol.IV No.10 **A Monthly Report on Non-Ionizing Radiation** **December 1984**

INSIDE...

Microwave News invites contributions to *From the Field*, our occasional column featuring news and opinions from the non-ionizing radiation community. Letters from readers are also welcome.

WHO-IRPA ELF Health Report

The World Health Organization's (WHO) and International Radiation Protection Association's (IRPA) criteria document on extremely low frequency (ELF) radiation recommends limiting long-term exposures to "levels as low as can be reasonably achieved," especially for the general population, until more is known about ELF biological effects.

The newly released report concludes that, "It is not possible from present knowledge to make a definitive statement about the safety or hazard associated with long-term exposure to sinusoidal electric fields in the range of 1-10 kV/m," although there is no need to limit access to areas which will result in "intermittent exposure" to electric fields below 10 kV/m.

The 131-page document, prepared by a joint WHO-IRPA committee, provides an overview of bioeffects research for 0-300 Hz radiation and offers tentative conclusions about the significance of reported findings. For example, the authors state that cellular, physiological and behavioral effects observed in *in vitro* and animal studies cannot be extrapolated to humans, although these studies "serve as a warning that unnecessary exposure" to these fields should be avoided.

The committee stresses that current knowledge of the mechanism of ELF biological interaction is very limited and that as yet there is no theory

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Hopkins Lab Sets 100 uW/cm² RF/MW Safety Standard

The Johns Hopkins University Applied Physics Laboratory (APL) has adopted a "flat" 100 uW/cm² safety standard for exposures to 30 MHz-100 GHz radiation. The standard applies to all lab employees, whether or not they work with radiation emitting devices.

The new APL standard differs from other radiofrequency and microwave (RF/MW) radiation limits in two key ways. First, it is much stricter than other occupational standards. Indeed, it is in line with the limit the Environmental Protection Agency was about to propose for the general public last summer. (EPA has now indefinitely delayed its radiation guidance, see *MWN*, October 1984.) The APL limits are ten times lower than the 1982 American National Standards Institute (ANSI) guidelines for the 30-300 MHz band, and *fifty* times more stringent than ANSI for frequencies above 1500 MHz. It is a hundred times stricter than the current, though older, Occupational Safety and Health Administration (OSHA) and Department of Defense RF/MW standards.

The APL standard also differs by being frequency-independent or "flat" above 30 MHz, as opposed to the increasingly common "well-shaped" limits which are most restrictive at whole-body resonant frequencies (approximately 30-300 MHz).

Below 30 MHz, the standard increases to 10 mW/cm² at 3 MHz and remains at that level down to 300 kHz.

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Delgado Group Corrects Pulse Rise Times

Due to an engineering error, Dr. Jose Delgado's research group misreported the rise times of pulsed magnetic fields in a key paper published last year. While the disclosure does not affect the group's finding that pulsed magnetic fields can have profound effects on the development of chick embryos, it will force a reassessment of which pulse shapes induce teratogenic effects (see *MWN*, March and November 1983).

Dr. Jocelyne Leal disclosed the error at a seminar at the Center for Devices and Radiological Health (CDRH) in Rockville, MD, on November 14. She explained that an inappropriate filter had been used to measure the rise times. Leal is a senior researcher in Delgado's lab and has led the group's chick embryo studies.

In a telephone interview with *Microwave News* from Madrid, Spain, Leal dictated the corrected rise times — each is the mean value of ten measurements. She said that the measurements were made with a Tektronix 7854 oscilloscope, equipped with a 7A15A vertical amplifier.

The table compares the revised rise times with those which were originally published in A. Ubeda *et al.*, "Pulse Shape of Magnetic Fields Influences Chick Embryogenesis," (*Journal of Anatomy, 137*, 513, 1983).

According to the original paper, pulse A had a teratogenic effect at certain intensities, pulse B and D upset the development of the embryos, while pulse C had no effect. (The pulse repetition rate was 100 Hz with a pulse duration of 500 microseconds (usec)).

Pulse Type	Reported Rise Time (usec)	Actual Rise Time (usec)	Field Intensity (uT)[1]
A	100	85-100	0.4-104
B	2	~2	0.4
C	42	6.9	1.0
D	42	1.7*	1.0

* maximum value: 3.5 usec
[1] microtesla

The authors have sent a correction to the *Journal of Anatomy*.

Interestingly, although it now turns out that Delgado and Leal did not use a 42 usec rise time, Dr. Kjell Hansson Mild of the National Board of Occupational Safety and Health in Umea, Sweden, has shown that magnetic field pulses with a 40 usec rise time cause harmful effects in developing chick embryos (see *MWN*, June 1984).

On November 15, several researchers who are working on replicating the chick embryo studies met with Leal in an effort to ensure that all the experimental parameters used by the various groups are as similar as possible. Among those present at the Rockville, MD, meeting were Richard Tell and Dr. Ezra Berman of the Environmental Protection Agency (see *MWN*, January/February 1984), Dr. Mays Swicord of CDRH, Dr. Michael Marron of the Office of Naval Research, and Mild and his associate Dr. Monica Sandstrom.

ISM Rules Simplified

The Federal Communications Commission (FCC) is moving ahead with plans to simplify its rules for industrial, scientific and medical (ISM) equipment. The changes proposed on November 21 include publishing emission measurement methods in a separate bulletin and eliminating the three-year recertification requirement for RF lighting devices and other ISM equipment.

The commission opened Docket 20718 six years ago in order to overhaul the decades-old Part 18 Rules which have become complicated and in some cases confusing. While authorization and measurement requirements will be clarified to accommodate the wide range of current ISM equipment, including microwave ovens, the FCC's emission limits will remain unchanged pending further study. An FCC spokeswoman said that it will be at least a year or two before any action is taken on the limits.

Under the proposed rules, emission measurement methods will be consolidated and published in Bulletin MP-5, *Methods of Measurements for Industrial, Scientific, and Medical Equipment*, which will incorporate the procedures for microwave ovens now published in OCE Bulletin 20.

A new authorization program will simplify the old rules, which provided inconsistent definitions and in some cases multiple programs for the same equipment. Now, only notification procedures will be necessary for most devices, with the exception of the following: consumer ISM equipment will require certification, except for microwave ovens which must meet the more stringent "type approval" requirements; and ultrasonic equipment generating less than 500 watts and operating below 90 kHz and one-of-a-kind equipment will require verification. The commission will start a sampling program to assure compliance.

RF lighting devices marketed under the new rules must continue to meet the technical standards established for computing devices in Part 15 Subpart J pending further action, (see *MWN*, September 1983 and October 1984).

Comments on the commission's third notice of proposed rule making (49*FR*47628, December 6, 1984) (which includes an appendix with the revised measurement methods) are due by January 7 and reply comments by January 22. The first two notices appeared in the *Federal Register* on October 6, 1978 (43*FR*46326) and February 15, 1979 (44*FR*9771). For further information, contact Liliane Volcy, Office of Science and Technology, FCC, Washington, DC 20554, (202) 653-8247.

Clear Radar Accident: One Year Later

The Occupational Safety and Health Administration's (OSHA) reenactment of the radar accident at Clear Air Force Station in Alaska indicates that worker exposures could have been significantly different from those previously estimated by the U.S. Air Force.

In an October 25 report released by Alaska Congressman Don Young, Robert Curtis of OSHA's Health Response Team states that the highest exposure may have reached approximately 390 mW/cm^2. The Air Force survey, conducted shortly after the September 14, 1983 incident, concluded that the maximum exposure was 105 mW/cm^2. Some of OSHA's figures for the field intensities are lower than those released by the Air Force and some are higher, indicating the presence of complex fields.

Six welders and technicians were exposed to 420 MHz radiation when a high-power tracking radar (AN/FPS-92) was accidently turned on while undergoing routine maintenance (see *MWN*, November 1983 and January/February 1984). The Clear radar is part of the Ballistic Missile Early Warning System (BMEWS).

A basic problem in attempting to estimate the exposure levels remains unresolved. No one agrees on what the output power was when the radar was turned on. The workers believe the power setting was 1.5-1.7 megawatts (MW), whereas the Air Force maintains that it was 0.9-1.5 MW. The OSHA simulation was run at 1.5 MW.

Curtis and co-worker Dr. Allan Heins positioned a number of probes at various heights in the spots where the workers believe they were at the time of the accident. Based on a series of measurements, they estimate that the greatest exposure for worker Karl Kepler could have been twice as high as the Air Force's figure of 105 mW/cm^2. Their measurements also indicate that Edgar Forsling's exposure may have reached approximately 390 mW/cm^2, as compared to the Air Force estimate of 45-55 mW/cm^2.

The 1982 American National Standards Institute (ANSI) occupational limit for exposure to 420 MHz radiation is 1.4 mW/cm^2. The current Alaska state occupational standard is 10 mW/cm^2. The Air Force also has a 10 mW/cm^2 safety standard.

Other developments related to the Clear accident include:

- The U.S. General Accounting Office (GAO) will soon complete a draft of its report on the radar accident. The report, requested by Congressman Young, will review the general performance of ITT Felec Services Inc., which operates the Clear station for the Air Force. GAO is placing special emphasis on the safety practices at the base and the medical treatment of the six workers after the accident. The final report is scheduled for release next spring.
- On October 26, Felec paid a $420 fine and agreed to institute new procedures that should prevent another accident. In its agreement with the Alaska Department of Labor, Felec did not admit any fault or liability.
- In a June letter to EPA Administrator William Ruckelshaus, Young asked the agency to participate in the investigation of the Clear accident. At the end of July, Ruckelshaus responded that EPA staffers would calculate RF radiation levels around the station, using existing models.
- At this summer's Bioelectromagnetics Society meeting in Atlanta, GA, John Mitchell of Brooks Air Force Base in San Antonio, TX, presented some preliminary data on 58 confirmed cases of overexposure (over 10 mW/cm^2) to radar radiation documented in Air Force files. According to Mitchell, most of the accidents involved partial body exposures to radiation in the 1-10 GHz frequency range. Most incidents lasted less than six minutes. He concluded that few clinical patterns emerge from looking at all the cases together. Mitchell is preparing a report on Air Force radar accidents.
- There are very few case reports on radar accidents in the medical literature. Two which are available are: Robert A. Williams and Thomas S. Webb, "Exposure to Radiofrequency Radiation from an Aircraft Radar Unit," *Aviation, Space and Environmental Medicine, 51,* 1243-1244, 1980; and Samuel Forman *et al.*, "Psychological Symptoms and Intermittent Hypertension Following Acute Microwave Exposure," *Journal of Occupational Medicine, 24,* 932-934, 1982.

Swedish Research

Given the paucity of information on the long-term effects of exposure to radar radiation, there is now much interest in the research of Dr. Hans-Arne Hansson of the University of Goteborg in Sweden. Hansson has been examining radar workers for the Swedish military and he presented some provocative preliminary findings at the workshop on *Electromagnetic Waves and Neurobehavioral Function,* held in Corsendonk, Belgium, last August.

In a summary of the workshop, London-based Dr. Tom Rozzell of the Office of Naval Research reports on some of Hansson's findings:

> "Some [of the examined radar workers] appeared to have a type of frontal brain syndrome. These he referred to a neurology unit at the local hospital. At the hospital, their cerebrospinal fluid was examined for its protein pattern. It was found that there was an increase in a certain acidic (pH=4.9) protein that is not present in more than 10,000 patients that have been examined at this clinic and which served as controls. Thus there appears that there can be some long-term effects of microwaves and that, in the case of the radar workers, there appears to be severe brain damage. It is significant that the radar workers were examined independently by two psychiatrists and were found to be free of any other diseases or things like alcoholism that could account for their decreased brain function. The work is continuing and is not ready for open discussion at this time because of the low number (11) of cases studied to date."

Rozzell's report from the Corsendonk meeting appears in the October 1984 issue of the *Bioelectromagnetics Society Newsletter.*

FCC Revises Cable TV Rules To Avert RF Interference

The Federal Communications Commission (FCC) has revised its Part 76 rules to protect against interference from cable TV to aeronautical and marine radio services. The commission concluded that action is necessary because new frequency assignments for aeronautical radio may increase the risk of interference in coming years, and because it has found cable operators are lax in complying with existing rules.

The cable industry's overall past record of relatively little interference has not assuaged FCC concern. A key reason is the Federal Aviation Administration's decision in the past few years to assign communications frequencies at only 50 kHz, and now even 25 kHz, intervals. Commission staff also suspect that incidents go unreported because affected parties may have considered cable to be a closed system and therefore overlooked it as a possible source of interference.

The rule changes adopted October 26, based on a 1980 proposal, include extending new mandatory frequency "offsets" to all cable systems. In this case, cable TV operators are required to maintain a minimum interval between their carrier frequencies and aeronautical service frequencies. Currently, offset requirements only apply to systems within 60 nautical miles of an aeronautical station.

In addition, operators face more stringent rules for demonstrating compliance with signal leakage requirements and for monitoring systems in the 108-136 and 224-400 MHz aeronautical radio bands. Monitoring entails routine checking of a system for excessive leaks. Operators are now specifically required to monitor their entire systems at least once every three months.

Cable systems in operation before the order goes into effect will be allowed to continue under existing rules for five years.

The commission notes that it has considerably stepped up its enforcement activities, issuing 22 fines totalling $161,000 to cable TV systems in the last three years for failure to comply with pre-notification and frequency offset requirements (see *MWN*, March 1984). And the FCC plans "to continue to increase its compliance and enforcement efforts."

In its new rules (49*FR*45431, November 16, 1984), the commission cites five cases of interference with aeronautical services as reasons for action. One case in particular — involving aeronautical interference near Flint, MI, caused by a major break in a cable system — has made the FCC "considerably less confident" than when it issued a notice in March 1980 that "cable operators will diligently control signal leakage on their systems or operate safely without frequency offset requirements." (The commission's first report and order appeared in 1977.)

According to the FCC's Bernard Gorden, no case of interference has been documented since the Flint incident in late 1980. He explained that, "we are looking to the future now rather than waiting for something to happen," as the number of both aeronautical and cable TV channels grows sharply in coming years.

In each of the cited cases, listed below, signal leakage exceeded the permissible limit of 20 uV/m at 3 meters:

- April 1976: Sammons Communications of Pennsylvania caused noise in aircraft receivers near Harrisburg, PA.
- September 1978: Antietam Cable TV created a potential interference problem near Hagerstown, MD, with signal leakage into aeronautical radio frequencies.
- October 1978: Oxnard Cablevision in Oxnard, CA, caused intermittent interference in communications between aircraft and an air traffic control center.
- April 1979: Coastal Cable Company caused interference to aircraft communications as planes approached the Wilmington, NC, Airport.
- August and September 1980: Comcast Cablevision Corp. caused the most serious interference problem reported to date. Aircraft flying in the vicinity of Flint, MI, repeatedly experienced interference when attempting to communicate with the air traffic control center in Oberlin, OH. The problem was tracked to annular cracks in the outer sheathing of a cable line.

SHORT COURSES

January 21-24: **Millimeter Wave Systems and Technology,** Atlanta, GA. Fee: $550 (3 days), $725 (4 days). Contact: Dept. of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332, (404) 894-2400.

January 22-25: **Grounding & Shielding,** Phoenix, AZ. Fee: $815 (Optional fourth day: $235). Contact: DWCI, Star Route 625, PO Box D. Gainesville, VA 22065, (703) 347-0030. **Repeated** February 5-8: Orlando, FL; February 19-22: Boulder, CO. March 12-15: San Diego, CA.

January 28: **Electrostatic Discharge (ESD) Control,** Los Angeles, CA. Fee: $295. Contact: R&B Enterprises, 20 Clipper Rd., West Conshohocken, PA 19428, (215) 825-1960. **Repeated** March 4: San Francisco, CA; March 18: Dallas, TX.

January 28-29: **Grounding, Bonding & Shielding,** Washington, DC. Fee: $650. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773, or (202) 676-6106 in DC. **Repeated** May 2-3.

January 30-31: **Electromagnetic Pulse (EMP) Design and Test,** Los Angeles, CA. Fee: $595. Contact: R&B, see January 28 above. **Repeated** March 6-7: San Francisco, CA; March 20-21: Dallas, TX.

February 5-8: **Modern Microwave Techniques,** Orlando, FL. Fee: $715. Contact: Contact: Linda Billard, Technology Service Corp. (TSC), 962 Wayne Ave., Suite 600, Silver Spring, MD 20910, (800) 638-2628, or (301) 565-2970 in Maryland.

February 7: **Power System Harmonics,** New York, NY. Fee: $70. Held at IEEE PES Winter Meeting, see Conference Calendar on p.12.

February 13-14: **Microwave Devices: Present and Future,** Atlanta, GA. Fee: $475. Contact: Georgia Tech, see January 21 above.

February 13-15: **Microwave Technology and Applications for Industry,** East Brunswick, NJ. Fee: $750. Contact: Robert LaGasse, IMPI, Tower Suite 500, 301 Maple Ave. West, Vienna, VA 22180, (703) 281-1515.

February 14-19: **Fundamentals of Radar Cross Section,** Orlando, FL. Fee: $745. Contact: Ann Beekman, Southeastern Center for Electrical Engineering Education, 1101 Massachusetts Ave., St. Cloud, FL 32769, (305) 892-6146. **Repeated** May 13-17: San Diego, CA ($795).

February 19-22: **Modern Microwave Measurements and Applications,** Los Angeles, CA. Fee: $845. Contact: UCLA Extension Short Courses, PO Box 24901, Los Angeles, CA 90024, (213) 825-1295.

APL RF/MW Standard *(continued from p.1)*

According to Dr. Sam Koslov, an assistant director of the lab and a longtime member of the now-defunct Electromagnetic Radiation Management Advisory Council (ERMAC), the APL standard is based on the ALARA ("as low as reasonably achievable") principle, that has won widespread acceptance in the setting of ionizing radiation safety guidelines. He explained that current trends in biological effects research suggest that an ALARA approach is warranted.

When asked why all members of the staff were covered by the same standard, Koslov said that a single standard will not affect work at the lab and it is easier to enforce.

Robert Mallalieu, who serves on the APL safety committee, agreed: "As far as I am concerned we are all ignorant about what is going on at low levels, so we should all get the same level of protection."

APL's previous safety standard, set in 1970, was 1 mW/cm^2.

The Johns Hopkins lab, located in Laurel, MD, has 2800 employees. It does $200 million of contract research a year, primarily R&D for the Department of Defense.

The full text of the APL RF/MW standard is reprinted on pp.7-8.

CONFERENCES *(continued from p.12)*

September 23-26: **4th International Conference on AC & DC Power Transmission,** London, UK. Contact: IEE, see April 16 above.

September 27-30: **7th Annual Conference of the IEEE Engineering in Medicine and Biology Society,** Americana Congress Hotel, Chicago, IL. Contact: Dr. Barry Feinberg, Kendall Co., 411 Lake Zurich Rd., Barrington, IL 60010, (312) 381-0370.

October 13-17: **5th International Meeting of the Bioelectrical Repair and Growth Society,** Park Plaza Hotel, Boston, MA. Contact: Dr. S.R. Pollack, University of Pennsylvania, 119 Towne Bldg., 220 South 33rd St., Philadelphia, PA 19104, (215) 898-8241.

December 4-5: **International Conference on Electric and Magnetic Fields in Medicine and Biology,** London, UK. Contact: IEE, see April 16 above.

December 9-13: **10th International Conference on Infrared and Millimeter Waves,** Americana Dutch Resort Hotel, Orlando, FL. Contact: Dr. Kenneth Button, MIT, Box 72, MIT Branch, Cambridge, MA 02139, (617) 253-5561.

WHO-IRPA ELF Report *(continued from p.1)*

to predict the effects of exposure. Therefore, it recommends more basic research and more epidemiological studies. In fact, the committee goes so far as to call the need for "well done" epidemiological studies "imperative."

Epidemiological studies by Wertheimer and Leeper, Tomenius et al., Milham, Wright et al., Coleman et al., McDowell, and Vagero and Olin — all of which found an increased incidence of cancer among exposed populations (see *MWN*, March, June and December 1983) — are flawed, according to the report. Although the data from these researchers "cannot be dismissed," the committee believes that "there must be considerable study before they can serve as useful inputs for risk assessment." They note that adverse effects from exposure to ELF levels normally found in the environment or the work place "have not been established."

The report states that direct interference with cardiac pacemakers has not been reported in fields below 2.5 kV/m.

Selected excerpts from the document appear on pp.6-7.

Environmental Health Criteria 35: Extremely Low Frequency (ELF) Fields, evolved from drafts prepared over a four-year period by a number of experts, including Dr. W.R. Adey, Dr. P. Czerski and J.C. Villforth of the U.S.; Drs. M.G. Shandala and V. Akimenko of the U.S.S.R.; and members of the WHO-IRPA joint ELF committee under the chairmanship of Dr. M. Repacholi of Australia. The other committee members and their home countries are: Dr. J. Bonnell, England; Dr. B. Bosnjakovic, The Netherlands; Dr. J. Cabanes, France; Dr. M. Grandolfo, Italy; Dr. B. Knave, Sweden; Dr. J. Kupfer, German Democratic Republic; Dr. R. Phillips, U.S.; Dr. A. Portela, Argentina; Dr. A. Sheppard, U.S.. A. Duchene, France; G. Ozolins, Switzerland; and Dr. M. Shore, U.S., served as the committee's secretariat.

The document will soon be available in the U.S. from the WHO Publications Center, 49 Sheridan Avenue, Albany, NY 12210, or in Canada from the Canadian Public Health Association, 1335 Carling Avenue, Suite 210, Ottawa, Ontario K1Z 8N8. Or contact the WHO Distribution and Sales Service, 1211 Geneva 27, Switzerland. The price had yet to be set at press time.

WHO-IRPA ELF HEALTH CRITERIA

Reprinted below are excerpts from the "Health Risk Evaluations" and the "Summary and Recommendations" chapters of the World Health Organization's (WHO) and International Radiation Protection Association's (IRPA) recently released Environmental Health Criteria 35: Extremely Low Frequency (ELF) Fields. *(Citations in the text have been deleted.)* *See also story on p.1.*

Health Risk Evaluation

Interactions that lead to measurable biological effects, which remain within the normal range of physiological compensation of the body and do not detract from the physical and mental well-being of human beings, should not be considered hazardous. Interactions that lead to biological effects outside the normal range of compensation of the body may be an actual or potential health hazard....

Unfortunately, the state of knowledge of the interacting mechanisms operating when biological systems are exposed to ELF fields is very limited. At present, it is impossible to furnish any theory to predict the effects of exposure to these fields. Because of this lack of information, care must be taken in attempting to predict or extrapolate effects in man from effects found in animals. Physical differences (size, shape, fur-bearing, etc.) result in marked differences in the internal field distribution and in different behavioral and homeostatic responses....

It would be ideal to make health risk evaluations on the basis of well-conceived, well-conducted, and well-analyzed epidemiological studies. Unfortunately, all such studies on human beings exposed to ELF fields have suffered from one or more deficiencies...

With such a limited scientific data base, the determination of the existence of a true threshold exposure level below which no adverse health effect occurs, cannot be made with confidence. Thus, any health risk analysis for the development of standards must inevitably adopt a phenomenological approach. In this case, a review of the literature is made to determine the lowest exposure levels at which adverse biological effects have been established. A biological effect that occurs in living organisms or animals may be detected as some general or specific alteration. If the change appears irreversible or pathological, it might be presumed that it could be hazardous to man under comparable exposure conditions. This assumption is made only because insufficient information is available on the effect or the underlying interaction mechanism to make an extrapolation to exposure conditions producing similar effects in human beings and to make a well-substantiated health risk evaluation.

The epidemiological studies suggesting a relationship between childhood or adult cancer and residence in houses at various distances from high current flow due to external electrical wiring configurations, can only be considered as preliminary because of the many criticisms that have been levelled at the studies.

The studies suggesting an association between electrical occupations (exposure to electric and magnetic fields) and cancer were analyses of occupational mortality data and subject to many sources of errors.

Thus, although these reports suggest potential adverse health effects, they cannot be evaluated in terms of health risk until the potentially confounding factors and sources of errors are eliminated. It is of concern, however, that no studies have yet been published following up these reports.

Laboratory studies on human volunteers exposed for short periods to electric fields (up to 20 kV/m) have, in general, shown no effects. The results of these studies suggest that no apparent acute effects are likely from exposure to strong electric fields. However, they cannot be used as indicators that no health effects will occur from long-term exposure (months or years).

Studies on the health status of linemen and switch-yard workers have not revealed any differences between exposed and control groups....These epidemiological studies, although among the more complete, have still suffered from a lack of numbers of persons exposed to high electric field strengths for extended periods. However, these workers are exposed to potentially the highest electric field strengths albeit for short periods of time. These studies do not provide a good data base on which to evaluate the possible health effects from long-term exposure of the general public to electric fields near transmission lines. More definitive information is needed, which in general, can only be provided through both large-scale epidemiological studies and developments in dosimetry that will make it possible to extrapolate the experimental animal results to human beings.

While attempting to arrive at general conclusions concerning the health hazards of ELF electric fields for protection purposes, the fundamental question that requires an answer is whether or not exposure to these electric fields induces any physiological or pathological effects in man.

From a careful review of laboratory studies *in vivo* and *in vitro*, and from human studies, the following conclusions can be drawn:

a. Adverse human health effects from exposure to ELF electric field levels normally encountered in the environment or the work place have not been established.

b. Some human beings feel spark discharges in electric fields of about 3 kV/m and perceive the fields between 2-10 kV/m. At present, there are no scientific data that suggest that perceiving a field produces an adverse pathological effect.

c. Exposure to ELF electric fields can alter cellular, physiological, and behavioral events. Although it is not possible to extrapolate these findings to human beings, at present, these studies serve as a warning that unnecessary exposure to electric fields should be avoided.

d. The preliminary nature of the epidemiological findings on the increased incidence of cancer among children and adults exposed to ELF fields from electric wiring and the relatively small increment in reported incidence, suggest that, although the epidemiological data cannot be dismissed, there must be considerable study before they can serve as useful inputs for risk assessment.

Conclusions and Recommendations

1. In order to relate biological findings from *in vitro* and *in vivo* studies on experimental animals to human beings, it is recommended that dosimetry studies should be continued to measure and relate external electric field strengths and internal current density distributions in the whole body of both animals and human beings.

2. From studies on man and animals, observed sensitivities are consistent with two proposed models, one on the basis of stimulation of peripheral sensory receptors in strong local electric fields at the body surface, and the other on the basis of current densities induced in the extracellular fluid. It is recommended that models be devised that correlate exposure and biological effects in terms of physical factors, such as surface electric field, tissue current density, spark discharges, and waveform.

3. The continuation of basic research on electric and magnetic field interaction mechanisms is strongly recommended. Investigations should be conducted on the possible synergism or antagonism of

field influences with physical and chemical agents, since such data are not available.

4. In some studies, restriction of ELF effects to certain "windows" in frequency and amplitude has been reported. It is recommended that the window concept be further investigated to determine the applicability of data obtained with various frequencies and waveforms, and to relate the findings to potential health detriment in human beings.

5. Studies have been performed on workers with long-term exposure to electric and magnetic fields, but no adverse health effects have been identified. However, these studies were not designed to evaluate effects on reproductive functions, or long-term carcinogenic risks. In two of the studies, electric field exposure was carefully evaluated, and it was found that average exposures in the occupationally exposed groups were remarkably low.

A suggestion of increased cancer incidence has been reported by a number of investigators who have examined occupational and general population groups exposed to electric and magnetic fields. The studies performed have serious deficiencies in epidemiological design and do not adequately characterize levels and duration of exposure.

The limited knowledge of the potential human health risk associated with exposure to electric and magnetic fields makes it imperative that well-designed epidemiological studies should continue to be undertaken to provide a firmer basis for risk assessment.

6. Occupational exposure to strong electric fields is generally intermittent and of short duration; exposed populations have been identified, and there are some limited data based on practical experience. At field strengths where spark discharges are prevalent, prolonged exposures may impair performance. Such exposures should be avoided, where possible.

7. Linemen working on energized extra- or ultra-high-voltage conductors experience extreme electric field conditions, and the use of appropriate protective clothing or devices is desirable.

8. Whilst it would be prudent in the present state of scientific knowledge not to make unqualified statements about the safety of intermittent exposure to electric fields, there is no need to limit access to regions where the field strength is below about 10 kV/m. Even at this field strength, some individuals may experience uncomfortable secondary physical phenomena such as spark discharge, shocks, or stimulation of the tactile sense.

9. It is not possible from present knowledge to make a definitive statement about the safety or hazard associated with long-term exposure to sinusoidal electric fields in the range of 1-10 kV/m. In the absence of specific evidence of particular risk or disease syndromes associated with such exposure, and in view of experimental findings on the biological effects of exposure, it is recommended that efforts be made to limit exposure, particularly for members of the general population, to levels as low as can be reasonably achieved.

10. In principle, electric and magnetic field interference with implanted cardiac pacemakers can lead to reversion to a fixed rate, but cessation of stimulation is possible. Direct interference has not been reported in fields below 2.5 kV/m. Although body currents produced by contact with a vehicle in a weaker field may cause interference, the risk of pacemaker reversion is believed to be slight.

It is recommended that pacemaker designers and manufacturers of other similar electronic equipment ensure that their devices are resistant to failures caused by electric or magnetic field-induced currents.

JHU-APL RF/MW Safety Standard

Reprinted below is the full text of the Johns Hopkins University (JHU) Applied Physics Laboratory's (APL) new health and safety standard for exposures to radiofrequency and microwave (RF/MW) radiation. The standard, adopted on October 19, 1984, replaces the lab's 1970 standard.

The APL Microwave Radiation Subcommittee recommends that the APL operating standard for permissible exposure to radiofrequency electromagnetic fields be revised to reflect evolving scientific understanding of the biological effects of non-ionizing radiation, the difficulties of properly measuring complex fields, and the desirability of a conservative safety factor. There is no evidence that permissible power levels stated in the old standard were unsafe, and this revision is intended only to increase the factor of safety over the old APL standard of 1 mW/cm^2.

The standard calls for averaging over a 0.1 hour period for all modulations. Typically, the maximum equivalent power density is 0.1 mW/cm^2 for frequencies above 30 MHz. Both mean-squared field strength and equivalent power density are specified according to frequency. These several parameters describe similar levels of exposure. Unusually high peak power levels should be noted. The safety office shall be consulted whenever the peak equivalent power density, during the pulse, is greater than 100 mW/cm^2 in any area of potential personnel exposure.

For personnel directly involved in the operation of RF equipment, exposures to higher intensity fields are permissible for very brief periods. The average power density during the period of exposure to the higher intensity fields shall not exceed ten times the values given in the exposure standard. Such exposures should be no longer than six minutes total in any one hour. Staff members responsible for the operation of various RF equipment must ensure that personnel exposures be as low as reasonably achievable below the maximum levels. The safety office must be notified if field levels are expected to approach the maximum levels so that a survey can be conducted.

Radiofrequency Exposure Limits (Averaged Over 0.1 Hour)

Frequency	Equivalent Power Density (mW/cm^2)	Mean-Squared Electric Field Strength (V/m)^2	Mean-Squared Magnetic Field Strength (A/m)^2
0.3-3 MHz	10	40,000	0.25
3-30 MHz	90/f^2	360,000/f^2	2.25/f^2
30 MHz-100 GHz	0.1	400	0.0025

(f=frequency in MHz)

This standard does not apply to emissions from consumer electronic products such as microwave ovens and hand held transceivers which are controlled by product performance standards administered by the Food and Drug Administration (FDA). It also does not address intentional exposures during the course of medical experimentation such as RF hyperthermia for cancer therapy.

Mark W. Woods, Chairman
Safety Committee

H.L. Hall, Jr.
Safety Officer

Definitions

A few definitions are required to allow a consistent interpretation of the standard. Except for Hermitian magnitude, all quantities that follow have units of mW/cm^2:

Equivalent power density: The power density of a hypothetical plane wave in free space having the same electric or magnetic field strength (Hermitian magnitude) as that measured in a complex reflective field or in an antenna near-field. Equivalent power density varies from point to point within a complex field.

Hermitian magnitude: For a vector **A**, the Hermitian magnitude is $|A|=\sqrt{A \cdot A^*}=\sqrt{AxAx^*+AyAy^*+AzAz^*}$ in which the asterisk denotes the complex conjugate. It implies a time averaging when used with the electric (**E**) or magnetic (**H**) field vector. The Hermitian magnitude provides a means of comparing fields with different polarizations.

Power density: The time average of the Poynting vector.

Poynting vector: The vector product of the electric and magnetic field vectors of an electromagnetic wave (**S=ExH**). When summed over a closed surface, the Poynting vector represents the total instantaneous power entering or leaving that surface. At a single point, the Poynting vector is generally accepted to denote the instantaneous power flow per unit area.

Discussion

Traditionally, radiation hazard standards have specified power density (mW/cm^2). This parameter is a valid indicator of potential hazard only for plane wave exposure. Under more complicated conditions, such as antenna near-fields or regions containing direct and reflected waves, true power density cannot be properly measured, and the parameter itself is not well related to potential hazard.

Mean-squared field strength, the square of the Hermitian magnitude, is an accepted indicator of hazard in a complex field. This is the quantity measured by the isotropic field probes which have become available commercially in recent years. Equivalent power density is derived from the observed level of mean-squared field strength. Although this parameter has little physical meaning, it retains the familiar units of mW/cm^2, and most isotropic field meters are so calibrated. Accordingly, the exposure limits are defined for each of three parameters: mean-squared electric field strength, mean-squared magnetic field strength, and equivalent power density.

The instrumentation used to measure potentially hazardous fields must have an isotropic probe which responds to mean-squared field strength. The only exception is for far-field zones within an RF anechoic chamber or other situations in which a simple unidirectional field exists. In those cases, true power density may be measured or calculated.

When their source is a radar, RF electromagnetic fields will have a very complex time modulation. This is caused by the combination of the transmitter's pulse modulation and the scanning of the radar's antenna. The standard calls for averaging over a 0.1 hour interval to ensure all such modulations are included.

UPDATES

BIOLOGICAL EFFECTS

EPA RF/MW Report Out... Over the last year, we have devoted a great deal of space to EPA's development of a criteria document for its guidance on public exposures to RF/MW radiation (see *MWN*, October 1983 and January/February 1984). Although EPA has now indefinitely delayed the proposed guidance, it has released the criteria document. Copies of *Biological Effects of Radiofrequency Radiation* (EPA-600/8-83-026F, September 1984) edited by Drs. Joe Elder and Daniel Cahill are available at no charge while supplies last from ORD Publications, CERI, U.S. EPA, Cincinnati, OH 45268. Afterwards, they will be available for $22.00 from the National Technical Information Service (NTIS), Springfield, VA 22161. NTIS Order No. PB 85120848.

ELF Resources... Details on the frequency and intensity windows for the efflux of calcium ions from brain tissue (in vitro) for ELF fields between 1-120 Hz, observed by Dr. Carl Blackman and co-workers at EPA, will appear in the first issue of Volume 6 (1985) of *Bioelectromagnetics*. ...DOE has released *Biological Responses to Extremely Low Frequency Electromagnetic Fields: Some Underlying Hypotheses,* (June 1984; Aerospace Report No. ATR-84-(7045)-1) by Professor H.B. Graves of Pennsylvania State University. Copies are available at no charge while supplies last from Dr. William Wisecup, Aerospace Corp., 955 L'Enfant Plaza, SW, Suite 4000, Washington, DC 20024....IITRI's J.E. Zapotosky, M.M. Abromavage and J.O. Enk have prepared a summary progress report on the ten projects that make up the Navy's ecological monitoring program on the ELF communication system for the Naval Electronic Systems Command in Washington, DC. Technical Report E06549-9 is available for $10.00 from the National Technical Information Service (NTIS), Springfield, VA 22161. IITRI has also assembled the annual reports from each of the contractors. The two-volume *Compilation of 1983 Annual Reports of the Navy ELF Communications System Ecological Monitoring Program* Technical Report No. E06549-8 is also available from NTIS, though the price has not yet been specified.

COMMUNICATIONS

Hawaii Report & Other Resources...EPA has not yet issued its report on RF/MW radiation levels in Honolulu, HI (see *MWN*, April and June 1984). An agency staffer told *Microwave News* that final editing is nearly complete and release is scheduled for December. Background information is being added to the original draft to put the measurements in context....The November *Proceedings of the IEEE* is a special issue on "Satelitte Communications Networks." Among the twenty papers is one which lists satellite locations....A subcommittee of the National Association of Broadcasters (NAB), under the chairmanship of William Wisniewski of the Mutual Broadcasting System, has issued *AM Technical Improvement*. Among its recommendations, the report urges work to mitigate existing and potential interference from RF electrical equipment, especially RF lighting devices. Copies are available from NAB's Science and Technology Dept., 1771 N St., NW, Washington, DC 20036, (202) 293-3557....A team from Kyoto University

and Nippon Telephone and Telegraph in Yokosuka, Japan, has devised a way of modelling the mean field strength in urban areas from mobile radio systems. Their analysis appears in the August *IEEE Transactions on Antennas and Propagation*.

COMPATIBILITY & INTERFERENCE

FM-Avionics Rules Due Soon... The Federal Communications Commission (FCC) and the Federal Aviation Administration (FAA) are planning to issue separate Notices of Proposed Rulemaking (NPR) by early 1985 to control FM broadcast interference with radio navigation equipment aboard aircraft. Though FM broadcasts occasionally are picked up by airplane receivers, the FCC's Ralph Haller told *Microwave News* that, "We don't know of any cases where it has actually caused a safety hazard." The FAA NPR is expected to require broadcasters to inform the agency of proposed new construction or facilities changes. According to an FAA staffer, the purpose of the new rules is to force notification at the time changes are made so that the agency can try to avert potential interference before it happens. The National Association of Broadcasters (NAB) is opposing the notification provision. The FCC's proposed rule, which according to Haller would supersede the FAA's in the event of a conflict, will set specific protection standards for receivers. Haller said that this is solely a receiver problem but that FM stations would still be required to protect FAA facilities affected by broadcasts. If the FAA disagrees with the FCC's final regulations, it can either file a petition for judicial reconsideration of the rules or change its own rules.

Struzak on ISM... Professor R.G. Struzak of the Institute of Telecommunications in Wroclaw, Poland, has published "Protection of Radiocommunications Against Interference from ISM Equipment," in the May-June issue of *Annales des Telecommunications*, the journal of the Centre National D'Etudes des Telecommunications, based in Cap D'Ail, France. Struzak, the chairman of the CCIR Interim Working Group on Radiation from ISM Equipment, which is developing new international standards for ISM emissions (see *MWN*, September 1983 and May 1984), presents a simple model of the interference problems with strategies to resolve them. He concludes with an overview of the current status of recommendations made by CCIR and CISPR.

INTERNATIONAL

Therein Lies the Rub...A BBC plan to place six 300 kW high frequency towers near Stratford-on-Avon, England, to broadcast to eastern Europe has met stiff opposition from officials of the Royal Shakespeare Theater (RST). Concerned about interference with the theater's electronic equipment — including the stage lighting console — Artistic Directors Trevor Nunn and Terry Hands have been waging their fight since the BBC proposal was announced late last year. Stratford residents are also concerned about the plan because they fear their TV and radio reception will suffer. Low power tests run by the BBC incapacitated the theater's lighting equipment and erased the electronic memories of two typewriters. In letters to *The Times* of London on June 23 and July 9, Nunn and Hands claimed that the towers, which would be built two-and-a-half miles from Stratford at Bearley Ridge, would force the theater to close. BBC officials maintain that the broadcast towers should cause minimal interference and that simple shielding could eliminate any problems. In a June 29 response to the RST, the BBC's chief engineer for external broadcasting wrote to the *Times:* "It is, of course, inconceivable that the BBC, a leading patron of the arts, would contemplate, much less pursue, any action which could have this devastating effect."

MEDICAL APPLICATIONS

More on PEMF Therapy... In our May issue, we reported on a paper describing the successful treatment of rotator cuff tendinitis (shoulder pain) with pulsed electromagnetic fields (PEMFs). In a follow-up letter published in the June 9 *Lancet*, Drs. M.J. Lunt and A.T. Barker warn that there are two mechanisms which might have confounded the double blind study by a team from Addenbrooke's Hospital and Strangeways Research Labs in Cambridge, England. In addition to magnetic and electrical interactions, Lund and Barker cite a possible heating effect from the treatment coils and the ability of the patients to distinguish between active and dummy coils. They suggest that a "bifilar" coil, with an equal number of clockwise and counterclockwise turns, could eliminate the magnetic field. Since many PEMF systems produce noise, the two researchers further argue that patients should be asked whether they think they have active or dummy coils. Barker was the lead author of another recent PEMF paper, also published in *Lancet*, which concluded that PEMFs may not be effective for the treatment of non-union tibial fractures (see *MWN*, June 1984). That paper was also addressed in the June 9 *Lancet* by Dr. David Le Vay, a practicing orthopedist, who was somewhat incredulous that PEMF therapy does not work given the available animal data and its past success in treating congenital non-unions. In a follow-up letter which appeared in the July 21 *Lancet*, Professor Brian O'Connor of the Robert Jones and Agnes Hunt Orthopedic Hospital in Oswestry, England, raised further objections to Barker's conclusions. First, O'Connor expressed surprise that the results of an interim analysis were published and warned of the dangers of extrapolating from such a small sample. He concluded: "It would be a tragedy if even one surgeon was dissuaded from using PEMFs to treat difficult non-unions as a result of Barker and colleagues' paper." Dr. W.J.W. Sharrard, one of Barker's co-authors, replied in the same issue of *Lancet* that he agreed that the "very small trial did not show that PEMFs do not have any effect," and that it would be premature to extrapolate their study to the entire population until a larger study is completed. He went on to note that the study might have been biased because a greater number of patients among those treated with PEMFs, as compared to controls, had non-unions of *both* the tibia and the fibula, a condition which Sharrard's own research group has shown to be a "detrimental factor in the treatment of tibial non-union."

Sharrard added that he believes PEMFs can have an effect; so can conservative management. His compromise is to advocate both types of treatment. In a personal communication to *Microwave News*, Dr. Andrew Bassett of Columbia University's College of Physicians and Surgeons in New York City pointed out that there are significant differences between the signals used in his studies and those reported in Barker's papers.

Diagnosing TB...A group from the University of Sheffield in England has found a way of using a microwave oven to speed up the Ziehl-Neelsen method for the diagnosis of tubercule bacilli. Slides heated with microwaves gave results that were as accurate and reliable as the classical Ziehl-Neelsen method but took only 30 seconds instead of the usual 15-20 minutes. A short letter on the new method was published in the November 3 *Lancet*.

MEETINGS

Bioeffects of Light... The New York Academy of Sciences' *Conference on Medical and Biological Effects of Light*, held October 31-November 2, was the first meeting of its kind, according to Dr. Richard Wurtman of MIT, the conference organizer. Among the 29 presentations, Dr. Alfred Lewy of the Oregon Health Sciences University in Portland reviewed the effects of bright light on human melatonin production. Dr. Norman Rosenthal of NIH in Bethesda showed how seasonal affective disorder (SAD), a winter depression, can be treated with bright, not standard indoor, light; he pointed out that no research has yet been done on the influence of the spectral content of the light. Dr. Richard Edelson of Columbia University in New York City discussed how UV-A light can activate the effectiveness of 8-methoxypsoralen in treating psoriasis. The proceedings of the conference will be available in about six months, according to an academy spokesman. Meanwhile, medical writer Jane Brody has a two-part overview of the meeting in the November 13-14 editions of the *New York Times*.

Power Systems Harmonics... The proceedings of the *International Conference on Harmonics in Power Systems* held at the Worcester Polytechnic Institute (WPI) in Worcester, MA, October 22-23, is avaiable for $50.00 (postage included). Some 40 papers are included in the volume which can be ordered from the Dept. of Electrical Engineering, WPI, 100 Institute Rd., Worcester, MA 01609....There will be a tutorial course on "Power System Harmonics," coordinated by A.A. Mahmoud of Iowa State University, at the *1985 Winter Meeting of the IEEE PES*, to be held in early February in New York City (see Conferences p.12). The registration fee is $70. The course text will also be available by mail.

Zurich EMC Symposium... The preliminary program is out for the *6th Symposium & Technical Exhibition on EMC* to be held in Zurich in early March. Six two- or three-hour workshops are scheduled for March 4-7: "EMI Control Using Computer-Aided Design," "Measurements Related to the Interaction of EM Fields with Biological Systems," "EMP Protection by Filters Combined with Surge Arrestors," "The New CISPR RFI Specification for Information Technology Equipment," " Methods and Results of Open Area Test Site Calibration," and "Existing and Required EMP Instrumentation." For more information see Conferences p.12, or contact: Herb Mertel, EMACO Inc., 7562 Trade St., San Diego, CA 92121, (619) 578-1480.

OVENS

An Exchange on Burns... Last year, Dr. Henry Fleck of Albert Einstein College of Medicine in the Bronx, NY, published a case report of burns suffered by a 51-year-old woman who accidently stuck her hands into an oven that was still operating (see *MWN*, May 1983). Dr. John Osepchuk of Raytheon has responded, charging that Fleck's "speculations about microwave oven hazards" are "an undesirable source of fear and misinformation to the non-engineer and lay person." Specifically, he writes that Tappan estimates the chance of this type of oven failure is one in 300 million (at the 95 percent confidence level) and that "it is very unlikely that the woman would receive burns in five seconds." Osepchuk reveals that the woman who suffered the burns was Helen Farmakis, who lost a suit against Tappan over this injury (see *MWN*, December 1981 and December 1982). He concludes that the "microwave oven as regulated by the FDA is practically a fool-proof device." Fleck is undaunted. He replies that, whatever the stated odds, the "oven did operate when the door was opened," and that "ovens are practically *not* foolproof, no more than cars, airplanes, trains, bridges." He also states that Farmakis had no money to appeal the jury's decision and that "the court had no other option but to affirm the jury's verdict." The Osepchuk-Fleck exchange appears in the October 1984 *Bulletin of the New York Academy of Medicine;* Fleck's original report was in the bulletin's April 1983 issue.

POWER LINES

Resources... Officials of Southern Railway have raised the issue of EMI from power lines as a reason for not siting a Virginia Electric & Power Co. high-voltage line along the railroad's right-of-way. Although this type of EMI problem has gained increasing attention among engineers, this could be the first time it has come up at a formal hearing (see *MWN*, September and December 1983). On November 26, *The Washington Post* quoted a county official as saying, "It never dawned on me that Southern would object to an overhead power line."...The November 28 *Wall Street Journal* ran a front page story on how dairy farmers are dealing with stray voltages in the midwest. Some dairy and rural electric coops have even set up the Stray Voltage Research Council....Can power lines cause allergies? Dr. Jean Munro in England thinks so; indeed, according to an October 24 article in the British *Guardian*, she believes that an electrical reaction is the basis of nearly all allergic reactions. Munro has been collaborating with Dr. Cyril Smith of the University of Salford....Over the last few months, the *IEEE Transactions on Power Apparatus and Systems* has featured a number of papers on electromagnetic effects related to power lines: June: "Electromagnetic Effects of High Volt-

age High Power Equipment," by M.M.A. Salama and R. Hackam of the University of Windsor in Windsor, Canada; July: "Application of Finite Element Method to Analysis (sic) of Induced Current Densities Inside Human Model Exposed to 60 Hz Electric Field," by a group of Japanese researchers; July: "Method for Evaluating Human Exposure to 60 Hz Electric Fields," by GE's Don Deno and Mike Silva of Enertech; August: "Measurements of Transmission Line Electric Fields in a Residential Environment," by P.D. Jacobs and F.M. Dietrich of Electric Research & Management Inc. in Pittsburgh, PA; and September: two papers on "Lightning Induced Voltages on Power Lines," "Theory" and "Experiment" by Maneck Master and Martin Uman of the University of Florida in Gainesville.

STANDARDS

Occupational Rules in Massachusetts and New Jersey ... The state of Massachusetts' Department of Labor and Industries is drafting regulations to protect workers from harmful exposures to non-ionizing radiation in the frequency range 10 kHz-100 GHz. The proposal, which will be the subject of public hearings during the first half of next year, is identical to the 1982 ANSI standard, except that, like the ACGIH guidelines, it covers frequencies down to 10 kHz. Facilities maintained by the federal government are exempted. All employers who are currently using radiating equipment, such as radio and TV stations, radar units, RF heaters and sealers, industrial microwave ovens, mobile communications equipment with an output power of more than 100 watts, and diathermy and hyperthermia units, must notify the state within 12 months after the rules are adopted. Users of new equipment must give prior notification. For more information contact: Frank Archibald, Division of Occupational Hygiene, Massachusetts Dept. of Labor and Industries, 1001 Watertown St., West Newton, MA 02165, (617) 727-3982....A subcommittee of the New Jersey Commission on Radiation Protection is also working on developing occupational exposure limits. The group will submit its recommendations to the commission before next summer. Earlier this year, the state adopted the 1982 ANSI standard for general population exposures (see *MWN*, April 1984). For information, contact Eugene Fisher, Bureau of Radiation Protection, 380 Scotch Road, Trenton, NJ 08628, (609) 292-8392.

SAE on Susceptibility...SAE has completely revised its recommended practice for *Electromagnetic Susceptibility Procedures for Vehicle Components (Except Aircraft)*. The new standard, designated J1113 and dated June 1984, was prepared by the SAE EMI Standards and Test Methods Subcommittee, under the chairmanship of Myron Crawford of NBS. J1113 will be published in the 1985 edition of the SAE Handbook. It covers the testing and measurement of transients as well as radiated and conducted emissions — making them consistent with ISO standards. Crawford is submitting the new standard to ANS C63 for consideration as a national standard. For more information, contact SAE Customer Service, Dept. 346, 400 Commonwealth Dr., Warrendale, PA 15096, (412) 776-4970.

IEC Electroheat Standard... The International Electrotechnical Commission (IEC) has issued Publication 519-1 *Safety in Electroheat Installations, Part 1: General Requirements, 1984*. The new standard covers a host of different types of equipment, including those using low and high frequency non-ionizing radiation. Copies of the standard will be available soon from the International Sales Dept., ANSI, 1430 Broadway, New York, NY 10018, (212) 354-3300.

VDTs

NIOSH Reproductive Study...NIOSH will discuss plans for its epidemiological study of reproductive risks among 2000 female VDT workers at a public meeting on December 17. In preparation for the meeting, the agency has distributed a limited number of copies of the draft protocol for the study. The document states that no radiation measurements will be made in the course of the study, unless "an excess of abnormal pregnancy outcomes is identified." According to the protocol, the study "should have a 90 to 95 percent chance of detecting an increase in spontaneous abortions of about 1.6 times that in an unexposed population, and a similar chance of detecting an increase in total major birth defects in liveborns of 3.0 to 3.5 times that in unexposed groups. The ability to detect a single common birth defect, such as cleft palate, is limited to relative risks of 14 fold." According to the current schedule, the completion date is April 1988. Dr. Teresa Schnorr is leading the NIOSH effort.

IBM Study Released...IBM has published a summary report of VDT emission measurements by Dr. Arthur Guy of the University of Washington, Seattle, despite an earlier policy that the document was for internal use only (see *MWN*, September 1984). The report focuses on pulsed very low frequency magnetic fields and concludes that there are no health hazards associated with non-ionizing radiation emissions from VDTs. Guy discusses apparent similarities between the VDT fields and very weak magnetic fields found by Dr. Jose Delgado's research group to cause developmental abnormalities in chick embryos. "None of the combinations used [by Delgado's team] for producing the effects had characteristics that simultaneously matched the VDT magnetic field waveform," Guy wrote. This conclusion, which has already been cited by NIOSH researchers in their November draft protocol for the agency's epidemiological study (see above), will no doubt have to be reevaluated in light of a recently released correction from Delgado's group (see p.2). For a copy of the IBM summary, contact Les Szabo, Corporation Information, IBM, Old Orchard Rd., Armonk, NY 10504, (914) 765-6408.

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CONFERENCES

1985 Conference Calendar

January 3-5: **2nd International Conference on Clinical and Basic Factors Influencing Bone Growth,** Los Angeles, CA. Contact: Dr. Andrew Dixon, UCLA School of Dentistry, Center for Health Sciences, Los Angeles, CA 90024, (213) 825-9187.

January 14-15: **Symposium on Dielectric Phenomena in Honor of the 70th Birthday of Professor Robert H. Cole,** Providence, RI. Contact: Dr. Edward Greene, Dept. of Chemistry, Brown University, Providence, RI 02912, (401) 863-1193.

January 23: **A Review of the State-of-the-Art in EMC in Commercial and Military Electronics,** LA Airport Hilton, Los Angeles, CA. Contact: Ms. Terry Cantine, Eaton Corp., 5340 Alla Rd., Los Angeles, CA 90066, (213) 822-3061.

January 23-25: **RF Technology Expo,** Disneyland Hotel, Anaheim, CA. Contact: Kathy Kriner, RF Tech Expo, 6530 S. Yosemite St., Englewood, CO 80111.

February 3-8: **1985 Winter Meeting of the IEEE Power Engineering Society,** Penta Hotel, New York, NY. Contact: J.G. Derse, 1030 Country Club Rd., Bedminster, NJ 07921, (201) 725-4388.

March 5-7: **6th Symposium & Technical Exhibition on Electromagnetic Compatibility,** Zurich, Switzerland. Contact: EMC Symposium & Exhibition, ETH Zentrum-IKT, 8092 Zurich, Switzerland, 256-27-90.

March 21-22: **IMTC/85: Instrumentation/Measurement Technology Conference,** Hyatt Regency, Tampa, FL. Contact: Dr. Robert Ashley, Sperry Corp., PO Box 4648, Clearwater, FL 33518, (813) 577-1900, ext. 2228.

April 3-4: **21st Annual Meeting of the National Council on Radiation Protection and Measurements,** Washington, DC. Contact: NCRP, Suite 1016, 7910 Woodmont Ave., Suite 1016, Bethesda, MD 20814, (301) 657-2652.

April 16-17: **8th International Colloquium on the Prevention of Occupational Risks due to Electricity,** London, UK. Contact: International Fire Security & Safety Exhibitions & Conferences Ltd., Cavendish House, 128/134 Cleveland St., London W1P 5DN, UK, (01) 387-5050.

April 16-19: **4th International Conference on Antennas and Propagation (ICAP 85),** Coventry, UK. Contact: Institution of Electrical Engineers (IEE), Savoy Place, London WC2R 0BL, UK, (01) 240-1871, ext. 222.

April 17-19: **3rd International Conference on Developments in Power System Protection,** London, UK. Contact: IEE, see above.

April 24-27: **3rd European Workshop on NMR in Medicine,** Copenhagen, Denmark. Contact: Dr. S.B. Petersen, Dept. of Neurology 2082, State University Hospital, Rigshopitalet, Blegdamsveg 9, DK 2100 Copenhagen 0, Denmark.

April 29-May 2: **23rd International Magnetics Conference,** St. Paul, MN. Contact: R.O. McCary, GE, Corporate R&D, Schenectady, NY 12345, (518) 385-5436.

May 4-7: **5th Annual Meeting of the North American Hyperthermia Group,** Biltmore Hotel, Los Angeles, CA. Contact: NAHG, 925 Chestnut St., Philadelphia, PA 19107, (215) 574-3153. Held in conjunction with the Radiation Research Society Meeting.

May 5-9: **33rd Annual Meeting of the Radiation Research Society,** Biltmore Hotel, Los Angeles, CA. Contact: RRS, 925 Chestnut St., Philadelphia, PA 19107, (215) 574-3153.

May 6-9: **IEEE 1985 International Radar Conference,** Washington, DC. Contact: J.Q. Adams, ITT-Gilfillan, M/S 45, 7821 Orion Ave., PO Box 7713, Van Nuys, CA 91409, (818) 988-2600, ext. 6903.

May 14-16: **Test & Measurement World Expo,** Convention Center, San Jose, CA. Contact: Meg Bowen, T&M Expo, 215 Brighton Ave., Boston, MA 02134, (617) 254-1445.

May 15-18: **1st Annual Meeting of the Electromagnetic Energy Policy Alliance,** Inter-Continental Hotel, San Diego, CA. Contact: Richard Ekfelt, EEPA, 1800 M St., NW, Washington, DC 20036, (202) 452-1070.

May 19-23: **17th Annual Meeting of the Conference of Radiation Control Program Directors,** Milwaukee, WI. Contact: CRCPD, 71 Fountain Place, Frankfort, KY 40601, (502) 227-4543.

May 20-24: **8th International Conference on Electricity Distribution,** Brighton, UK. Contact: IEE, see April 16 above.

May 26-31: **30th Annual Meeting of the Health Physics Society,** Chicago, IL. Contact: HPS, Suite 300, 1340 Old Chain Bridge Rd., McLean, VA 22101, (703) 790-1745.

June 4-6: **1985 IEEE MTT-S International Microwave Symposium,** St. Louis, MO. Contact: John Bogdanor, McDonnell Aircraft, Dept. 313, St. Louis, MO 63166, (314) 232-3936.

June 10-12: **International Aerospace and Ground Conference on Lightning and Static Electricity,** Paris, France. Contact: Lawrence Walko, USAF, AFWAL/FIESL, Wright Patterson AFB, Dayton, OH 45433 in US; or Dr. Joseph Taillet, ONERA, BP 72, 92320 Chatillon, France.

June 11-13: **6th Annual Meeting of the Canadian Radiation Protection Association,** St. John, New Brunswick, Canada. Contact: John Paciga, New Brunswick Electric Power Commission, PO Box 10, Lepreau, New Brunswick, Canada E0G 2H0, (506) 659-2102, ext. 324.

June 16-20: **7th Annual Meeting of the Bioelectromagnetics Society,** Hilton Hotel, San Francisco, CA. Contact: BEMS, 1 Bank St., Suite 307, Gaithersburg, MD 20878, (301) 948-5530.

June 17-21: **1985 North American Radio Science Meeting and International IEEE/AP-S Symposium,** University of British Columbia, Vancouver, Canada. Contact: Mr. K. Charbonneau, Conference Services, National Research Council, Ottawa, Ontario Canada K1A 0R6, (613) 993-9009.

June 24-29: **8th International Symposium on Bioelectrochemistry and Bioenergetics,** Bologna, Italy. Contact: C. Bonfiglioli, Institute of Botany, Via Irnerio 42, 40126 Bologna, Italy, (051) 234376.

July 14-19: **1985 Summer Meeting of the IEEE Power Engineering Society,** Vancouver, Canada. Contact: PES Special Activities, IEEE, 345 East 47th St., New York, NY 10017.

July 22-24: **22nd Annual Conference on Nuclear and Space Radiation Effects,** followed by July 25-26: **1985 Hardened Electronics and Radiation Technology (HEART) Conference** Monterey, CA. Contact: K.F. Galloway, Div. 726, NBS, Gaithersburg, MD 20899, (301) 921-3541.

July 22-25: **1985 International Symposium on Microwave Technology in Industrial Development —Brazil,** Campinas, Brazil. Contact: Attilio Jose Giarola, SBMO Symposium Committee, UNICAMP-CCPG (Reitoria), CP 1170, 13100 Campinas, SP, Brazil.

August 11-16: **14th International Conference on Medical and Biological Engineering and 7th International Conference on Medical Physics,** Espoo, Finland. Contact: Congress Office, PO Box 105, SF-00251 Helsinki, Finland.

August 19-21: **10th Annual Conference of the Australian Radiation Protection Society,** Melbourne, Australia. Contact: Dr. T.H. Gan, Australian Radiation Lab, Lower Plenty Rd., Yallambie, Victoria 3085, Australia.

August 20-22: **1985 IEEE International Symposium on Electromagnetic Compatibility,** Hilton at Colonial, Wakefield, MA. Contact: Dr. Chester Smith, PO Box 536, Bedford, MA 01730, (617) 271-7086.

August 20-22: **International Symposium on Antennas and Propagation,** Kyoto International Conference Hall, Kyoto, Japan. Contact: Professor Kazuaki Takao, Dept. of Electrical Engineering, Kyoto University, Kyoto 606, Japan.

August 26-28: **1985 International Symposium on Antennas and EM Theory,** Beijing, China. Contact: Professor Mao Yukuan, Northwest Telecommunication Engineering Institute, Xi'an Shaanxi Province, China.

August 26-30: **International Conference on Magnetism 1985,** San Francisco, CA. Contact: Diane Suiters, Suite 300, 655 15th St., NW, Washington, DC 20005.

September 10-12: **7th Annual Electrical Overstress/Electrostatic Discharge Symposium,** Radisson South Hotel, Minneapolis, MN. Contact: Michael Martin, 3M/Static Control Div., 2111 W. Braker Lane, Bldg. 501, PO Box 2963, Austin, TX 78769, (512) 834-3117. *(continued on p.5)*