MICRO WAVE NEWS

Vol.IV No.1 A Monthly Report on Non-Ionizing Radiation January/February 1984

INSIDE...

Microwave News invites contributions to *From the Field*, our monthly column featuring news and opinions from the RF/MW community. Letters from readers are also welcome.

EPA RF/MW Report Revised

The Environmental Protection Agency (EPA) has revised its draft report on the biological effects of radiofrequency and microwave (RF/MW) radiation and now states that significant effects occur at a specific absorption rate (SAR) of about 1 W/Kg. The report being prepared by EPA's Office of Research and Development (ORD), under the direction of Dr. Joe Elder, will form the basis of the first national exposure limits for the general population. EPA's limits are known as the RF/MW "guidance."

The 1 W/Kg SAR is four times lower than the threshold level cited in the 1982 American National Standards Institute (ANSI) safety guidelines, which apply to both occupational and public exposures. ANSI used a safety factor of ten to arrive at its exposure limit of 1 mW/cm^2 at body resonant frequencies of 30-300 MHz, based on an SAR of 0.4 W/Kg. EPA has not yet indicated what kind of a safety margin it will use for its RF/MW guidance.

EPA is surveying FM stations to assess the economic impact of its guidance. See p.3.

At a January meeting to review the new ORD draft, David Janes, who heads the group preparing the guidance at the Office of Radiation Programs (ORP), told *Microwave News* that the revisions have not significantly changed the report's conclusions and will not affect the numbers in the draft guidance. It is rumored that the agency will propose a 100 uW/cm^2 limit at certain frequencies, though no details have yet been made public.

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Congressional Pressure in Radar Accident Investigation

The Secretary of the Air Force has joined the investigation into the radiation accident at Clear Air Force Station in Alaska. The Air Force's Office of Environment and Safety and its Surgeon General will review the ongoing investigation and report back to the Secretary.

The growing interest in the September 14 accident in which six workers were over-exposed to radar radiation follows a call for a new investigation by Alaska Congressman Don Young. In a January 14 letter to Air Force Secretary Verne Orr, Young asked for a new survey of the workers' radiation exposure by a "neutral party at the earliest possible date" and a "full scale investigation of the internal safety practices and procedures at Clear Air Force Station." Young, a Republican who is Alaska's only congressman, asked Orr to look into the accident personally.

The six workers, all civilian technicians, have charged that there was a gross misunderstanding of radar radiation at Clear and that there were extensive delays in providing them with expert medical attention. In addition, they have questioned the reliability and accuracy of the Air Force's September 22 accident simulation (see *MWN*, November 1983).

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Radar Accident (continued from p.1)

Young's Letter

In his letter to Orr, Congressman Young wrote: "I am convinced that the Air Force and the civilian contractor have not cooperated in good faith with the affected employees." He added that some of the test equipment used in the accident simulation run by the Air Force and FELEC Services was "defective, improperly calibrated and improperly employed by operating personnel."

Young pressed Orr for a new simulation of the accident "in order to reestablish employee trust in their government and its agencies."

Captain Johnny Whitaker, an Air Force spokesman, told *Microwave News* that no new simulation of the accident was planned. He said that there is no deadline for the continuing investigation. "It will take whatever time is necessary," he said.

Alaska Senators Ted Stevens and Frank Murkowski, both Republicans, have endorsed Young's efforts, but, for the moment, are letting him take the lead in applying pressure on the Air Force.

In an interview, an aide to Senator Stevens said that the senator was pleased with the way Congressman Young was pursuing his inquiry. Earlier, Stevens had announced that he was satisfied with the Air Force's investigation.

Senator Murkowski has expressed concern over the medical attention the workers had received. In a December 5 letter to General James Hartinger, the commander-in-chief of the North American Air Defense (NORAD) Space Command in Colorado, Murkowski wrote: "I am particularly concerned about those who feel that they have not received adequate attention almost three months after the accident." He went on to ask "why there are still so many unanswered questions from the workers at this late date."

Before the Air Force Secretary became involved, the investigation into the accident was being handled by the Air Force Inspection and Safety Center at Norton Air Force Base, CA. The center is under the aegis of the Air Force's Inspector General.

Clear Air Force Station is operated for the Air Force by FELEC Services Inc., a subsidiary of ITT.

Mishap Report

At the end of December, the safety center released a "mishap report" on the Clear incident. The report states that it "appears" that the workers were exposed to radiation for eight minutes. This has been contested by the workers, who believe the exposure was longer —perhaps as long as 17 minutes.

The report also details the approximate levels of exposure experienced by the six men while they were performing routine maintenance on one of the Ballistic Missile Early Warning System (BMEWS) radars. According to the Air Force report, the workers' exposures ranged from a maximum of 105 mW/cm^2 for Karl Kepler to 12-19 mW/cm^2 for Richard Eldridge and John Jessup. Two of the men, Ronald Foster and Edward Forsling, were exposed to 45-55 mW/cm^2 and one, William Emmons, to 90 mW/cm^2. Two electricans who were at the base of the radar when the power was turned on were exposed to less than 25 uW/cm^2.

One of the workers expressed doubts about the relative intensities of the exposures. In an interview, Eldridge disputed the Air Force's contention that he and Jessup received a fraction of Emmons's dose. "Emmons could not have been standing more than three feet away from us," he said, "because he was supervising our welding." Emmons confirmed to *Microwave News* that he was very close to Eldridge at the time of the accident; he estimated that they were about 18 inches apart. Emmons added that he might have been a little closer to the trap door leading to the screen of the radar antenna.

Other recent developments concerning the radar accident include:

- The Alaska Department of Labor's Division of Labor Standards and Safety issued two citations against FELEC Services for over-exposing six workers to radiation. The citations carry a penalty of $840. On January 6, Ralph Drew, FELEC's manager at Clear, notified the state that the company would contest the citations.
- John Jessup and Ronald Foster went to Brooks Air Force Base for a medical examination in January. The other four men were examined at Brooks in October. The two FELEC employees originally declined to go to Brooks because they lacked confidence in Air Force objectivity.
- On February 1, Thomas Lucas, a field attorney with the National Labor Relations Board (NLRB) is scheduled to meet with Eldridge to hear his grievance regarding his dismissal from FELEC on November 10 (see *MWN*, December 1983).
- Repeated requests by *Microwave News* for the accident report prepared by FELEC Services went unanswered. ●

EPA Guidance (continued from p.1)

Report Revisions

At a January 24-25 meeting in Research Triangle Park, NC, a special EPA Scientific Advisory Board (SAB) panel found that the revised ORD report provides a satisfactory review of the literature and a sound basis for setting exposure guidelines. Its approval follows extensive revisions in ORD's treatment of thermal physiology, the backbone of the first draft.

ORD rewrote its summary and conclusions to accommodate criticisms made at the panel's first meeting last September (see *MWN*, October 1983).

Instead of focusing on thermoregulatory response thresholds, the draft now cites a range of considerations for pinpointing the onset of significant bioeffects at 1 W/Kg, including effects on endocrine gland function, blood chemistry, hematology and immunology. The authors also state that behavioral changes can occur in certain environments at lower threshold SARs than those cited by ANSI. In addition, they mention one experiment which indicates RF/MW radiation may be a cancer promoter and another which shows radiation may affect brain cells. Finally, the special

susceptiblity of the central nervous system to radiation and the need for more research on calcium efflux are noted.

In the initial draft, ORD calculated that human thermoregulatory response was triggered by SARs of about 0.27 to 0.81 W/Kg, or 1.2 to 2.6 mW/cm^2 at body resonant frequencies.

At the September panel meeting, Dr. Eleanor Adair and other panelists warned that EPA's ORD should not have estimated human thermal response thresholds from animal data. Accepting this criticism, ORD concluded that these thresholds cannot be adequately predicted given the lack of human data.

Although thermoregulation was the most thoroughly discussed and revised area of the report, panelist Dr. Stephen Cleary advised at the close of the January meeting that the time devoted to this topic does not reflect its importance regarding regulation of public exposures.

ORD agreed to a number of additional minor changes at the January meeting and has a little work left to do. For example, EPA's Dr. Carl Blackman will write a brief review of post-1980 literature on calcium efflux.

On the whole, the panel decided that the addition of papers published after 1980 would not affect the basic conclusions of the report.

Panel Recommendations

In addition to tentatively approving the report, the panel decided to outline a number of research areas that it believes EPA should pursue after the guidance is set. In a draft of the cover letter they will send to SAB Chairman Dr. Norton Nelson, the panel members singled out the effects of frequency modulation, chronic versus acute exposures, partial body versus whole body exposures, high power pulsed sources versus ones that are adequately characterized by average power, and several other topics.

Panel chairman Dr. Charles Susskind suggested that a final draft of the report be sent to SAB Director Dr. Terry Yosie by mid-February so that the board's executive committee can review it before its April meeting. The executive committee must approve the final report.

Speedy approval could be important for ORP, which is pushing to complete a draft guidance and supporting material by June 1. The proposal will not be released before the bioeffects report is issued and must itself receive final EPA approval and pass a review by the Office of Management and Budget.

Both the revised report, *Biological Effects of Radiofrequency Radiation,* No. EPA-600/8-83-026A, and the cover letter must still be reviewed by the following panel members who were unable to attend the meeting: Drs. Barbara Chang, Carl Durney, Steven Horvath, Abraham Lilienfeld and Charlotte Silverman.

Panel members attending the meeting were Drs. Eleanor Adair, Stephen Cleary, Arthur Guy, Sol Michaelson, Mary Ellen O'Connor and Chairman Charles Susskind. Yosie and SAB Executive Secretary Dr. Douglas Seba were also present.

EPA's guidance will only apply to federal facilities, but since it is the first and only federal exposure rule for the general public, it will become the de facto US standard. The draft has already circulated among federal agencies for review.

EPA Surveys FM Stations

EPA is surveying over 1,000 FM radio stations to better assess the economic impact of its planned public exposure guidance for RF/MW radiation. Officials at the agency's Office of Radiation Programs (ORP) in Las Vegas, NV, anticipate that the survey will show that public exposures to FM radiation are lower than EPA models currently predict.

Though the agency is evaluating the potential effect of the guidance on all types of broadcasters, the survey is limited to FM (88-108 MHz) because, as a class, these stations are estimated to produce the highest public exposures falling within the 500 kHz-100 GHz range of the guidance.

According to the cover letter sent out with the questionnaires last month, participation is voluntary but a "prompt and accurate response will help to insure that a realistic estimate" of the economic effect of the guidance is achieved.

In an interview with *Microwave News,* EPA's Ric Tell explained that land use data from the questionnaires will indicate whether or not areas near the stations with high RF/MW levels are accessible to the public. An inaccessable area will not be considered a public hazard. Of the more than 4,000 FM stations in the US, the agency sent questionnaires to those estimated to produce the highest exposure levels.

The agency has asked broadcasters how close the public can get to the targeted FM antennas and whether there are other broadcast sources either sharing a station's tower or in the immediate area, as in an antenna farm.

Although the guidance will only be enforceable for government facilities, private sector broadcasters are likely to be required to meet EPA limits by the Federal Communications Commission (FCC). Commission policy is still not set, but it has proposed rules that would require compliance from new or modified facilities. The FCC has yet to say how it will deal with existing broadcasters.

EPA will summarize the survey responses and then forward the data to a team at Lawrence Livermore National Laboratory in California, which is preparing the economic assessment for EPA (see *MWN,* December 1981). The agency hopes to have the proposed guidance and its supporting aterial ready for publication in early June.

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HIGHLIGHTS

Navy Loses ELF Suit

On January 31, Federal Judge Barbara Crabb ruled in favor of the State of Wisconsin and Marquette County, Michigan, and stopped all work on Project ELF, the Navy's submarine communications system. The Navy must now prepare a supplemental environmental impact statement (EIS) before construction can resume.

Wisconsin Attorney General Bronson La Follette had charged that the Navy's 1977 EIS failed to take into account recent studies on the health effects of extremely low frequency (ELF) radiation as well as changes in the proposed antenna design (see *MWN*, July/August 1983). The suit was filed on July 20, 1983 in US District Court for Western Wisconsin.

The judge not only barred further construction of the ELF antenna in northern Wisconsin and Michigan's Upper Peninsula, but stopped the placement of receivers on submarines. The Navy has not yet announced whether it will appeal the decision.

The verdict came as we go to press with this issue. We will publish a more detailed story with excerpts from the judge's 69-page decision next month.

EPA and NIEHS To Replicate Delgado Study

Researchers at the Environmental Protection Agency (EPA) and the National Institute for Environmental Health Sciences (NIEHS) will attempt to replicate Dr. Jose Delgado's experiment which found that very weak, pulsed magnetic fields affect growth and development. The work reported by Delgado's lab in Spain has received widespread attention because it showed that magnetic fields less intense than the earth's produced severe effects.

Dr. Ezra Berman, an expert in teratology at EPA's Health Research Laboratory in Research Triangle Park, NC, told *Microwave News* that the experiment must be repeated "simply because the results are so unusual." The replicate study could get underway by the end of this summer.

Delgado's group at the Centro Ramon y Cajal Hospital in Madrid found significant malformations in chick embryos exposed to pulsed magnetic fields of 0.12, 1.2 and 12 microTesla (uT) for 48 hours at frequencies of 10, 100 and 1000 Hz. Delgado reported that the most marked effect occurred at 100 Hz and 1.2 uT (see *MWN*, March 1983 and *Journal of Anatomy, 134*, 533, 1982).

In a recently published follow-up experiment, Delgado showed that pulse shape was the key variable in achieving an effect (see *MWN*, November 1983 and *Journal of Anatomy, 137*, 513, 1983).

Berman said the US effort will attempt to repeat the experiment as closely as possible but with more eggs. He noted that Delgado worked with a total of 68 eggs, while the US experiment will probably use 40 to 50 eggs per exposure group.

Current plans call for running the experiment at NIEHS facilities at North Carolina State University in Raleigh. The institute's Dr. Don McRee will perform the exposures and Berman will examine the eggs. Ric Tell, from EPA's Office of Radiation Programs in Las Vegas, NV, will handle the critical job of designing the exposure conditions. The exposures will take about three months to complete.

Both Berman and Tell stress that the main difficulty in doing the study is that no one knows exactly how Delgado's group set up its experiment. The researchers hope they will get more detailed information.

Tell has tried to reproduce the Delgado experiment himself with no success and told *Microwave News* he is very pleased that people with greater expertise will try it.

The importance of Delgado's study is magnified by the general lack of research on extremely low frequency (ELF) fields. EPA is just beginning to turn its attention to this area. According to an EPA spokeswoman, the agency hopes to develop an ELF research program in the coming years, now that its work on a general population guidance for the 500 kHz-100 GHz range is nearly complete. Congress has also taken an interest in ELF and last year directed the agency to investigate the effects of 60 Hz power line radiation (see *MWN*, June 1983).

Shortwave Radiation Linked to Heart Disease

Chronic exposures to 27 MHz radiation have been associated with heart disease in a new epidemiological study of male physical therapists. This report is believed to be the first from the US to make this link, although a number of Soviet and Eastern European studies have associated radiofrequency and microwave radiation with heart ailments.

Health data from 3,004 therapists who used ultrasound, infrared, microwave and shortwave diathermy equipment were analyzed. Only the link between shortwave (27 MHz) diathermy and heart disease was statistically significant. The study by Dr. Stanford Hamburger, James Logue and Phyllis Silverman of the Food and Drug Administration's (FDA) National Center for Devices and Radiological Health is reported in the *Journal of Chronic Diseases, 36*, 791, 1983.

The paper does not address the pregnancy outcomes of the therapists' wives. In a telephone interview, Silverman said that the pregnancy data from the survey are being prepared for a second paper.

The data used in this study were collected by Dr. Jeanne Stellman under a two-year FDA contract while she was at the American Health Foundation. In 1980, Stellman reported preliminary results which indicated a number of adverse health effects among the therapists including hypertension, hearing disorders, bilateral cataracts and blood and endocrine disorders —but not heart disease. Stellman is now at Columbia University in New York City.

Stellman told *Microwave News* that recent analyses confirmed her earlier findings, but she could not explain the

differences between her results and those of FDA. Stellman is in the process of writing up her results in a number of papers and expects to publish them later this year. She said that her study had been delayed by a shortage of funds: "It took the Office of Management and Budget (OMB) a year to approve my questionnaire, and after that I ran out of money." Stellman said that she has been finishing her research in her spare time.

Silverman suggested that the two sets of results might be due to differences in the statistical techniques used by FDA and Stellman.

Another possible explanation lies in the data sets analyzed by FDA and Stellman: each reports a different response rate. The FDA group claims a response rate of 58 percent, while Stellman has questionnaires from 68 percent of the original sample. Silverman said that while she believes the FDA group did not have about 400 of the original Stellman questionnaires, they did have a computer tape with all the data. (Only those cases that were accompanied by questionnaires were included in the FDA analysis.) A check of the missing responses indicated no obvious pattern of adverse health effects, according to Silverman.

New Jersey Weighs ANSI's RF/MW Exposure Standard

New Jersey is moving forward with plans to adopt a radiofrequency and microwave (RF/MW) radiation exposure standard based on the new American National Standards Institute (ANSI) guidelines. The proposed rules, which at their strictest level would limit public exposures to 1 mW/cm^2 in the 30-300 MHz frequency band, were discussed at two public hearings last month.

In a statement issued before the January 24 and 31 hearings, the New Jersey Commission on Radiation Protection maintains that the ANSI C95.1-1982 standard "represents a consensus of current thinking by scientists active in this discipline," and that it is "extremely conservative, thereby assuring a wide margin of safety." The commission is composed of representatives from state government and the private sector and has the authority to set state radiation standards.

According to the commission, the action is a response "to the public's apprehension concerning misuse of radiofrequency radiation in the absence of national safety level guidelines." Commission member Eugene Fisher of the state's Bureau of Radiation Protection told *Microwave News* that the group "is not confident that a federal standard will be in place in the near future."

If no major revisions are required, the eleven-member New Jersey committee could approve the standard in February.

Massachusetts, the first state to set RF/MW population limits, took a different standard-setting approach last year and adopted a rule five times more strict than ANSI (see *MWN*, November 1983).

One of the commission's main objectives is economic. It believes that a standard will help in eliminating "unnecessary time delays in the installation of new facilities with a cost saving to industry which will ultimately result in a reduction in the cost of such service to the public." Several communications companies planning to build new facilities or expand existing ones in New Jersey have met stiff community resistance over the RF/MW safety issue (see *MWN*, November 1982 and November 1983). A number of residents opposing new broadcast sources have announced that they believe the proposed standard is too high.

The New Jersey rules would apply only to public exposures in the 300 kHz-100 GHz frequency range. In addition to broadcast sources, the frequency-dependent standard would include an emission standard for microwave ovens. Emissions from units built after 1971 would be limited to 5 mW/cm^2 measured at a distance of 5 cm and to 10 mW/cm^2 for those built before 1971. The draft's wording regarding ovens is unclear and Fisher reports that an appliance manufacturers' group is proposing new language for this section of the rule.

In addition to the January hearings, the public was invited to comment on the action in writing before February 3. Submissions are being collected by Fisher at the Department of Environmental Protection, Bureau of Radiation Protection, 380 Scotch Road, Trenton, NJ 08628.

The committee members are Max Weiss, Chairman, AT&T Bell Telephone Laboratories; Benjamin Sonnenblick, Rutgers University; Henry Powsner, Princeton Medical Center; Seymour Baron, Burns & Roe; Fred Sterzer, RCA Laboratories; and representatives from the New Jersey Departments of Health, Labor and Environmental Protection.

Ontario Hydro Plans VDT-Pregnancy Research

Researchers at Ontario Hydro have announced they will investigate possible links between pregnancy problems among VDT operators and electromagnetic (EM) radiation from terminals. In a progress report on their continuing work on VDTs, the scientists recommend both a laboratory and an epidemiological study. The latter, which would be more costly and take longer, may not be undertaken.

The report, "Hazards Assessment of Video Display Units [HAVDU] — Report on Phase I Activities," concludes that there is no danger to operators from ionizing radiation, including X-rays, but stops short of dismissing EM radiation risks. The Ontario Hydro investigators measured EM fields and charges from flyback transformers, low-voltage circuitry and display screens.

The Ontario Hydro report recommends "an experiment involving the exposure of small animals to [EM] fields be performed to gain evidence on potential adverse pregnancy outcomes due to exposure to the types and magnitudes of the [EM] fields generated by a VDT." In an interview after the report was released, Ontario Hydro's Robert Facey told *Microwave News* that this study will use VLF fields between 15 and 17 kHz. Ontario Hydro will spend $50,000

and solicit $40,000 from outside sources for this research. The company will fund the entire project if external help is not available, Facey added.

The proposed epidemiological study would cost $500,000 and take four years to complete. Its purpose would be to increase the "limited" data available on pregnancy outcomes among VDT operators. Ontario Hydro's Phase I report calls for a limit of $100,000 on its total contributions and recommends that the company solicit additional funds starting in April 1984 unless a similar study is underway elsewhere.

The scientists also propose to measure magnetic fields near VDTs in Phase II using techniques similar to those used to characterize electric fields in Phase I.

EM fields from the flyback were in the very low frequency (VLF) range (15.8-18.5 kHz) with average (root mean square) field strengths between 3 and 30 V/m at 30 cm from the front of the terminal. These emissions are pulsed and Ontario Hydro researchers measured peak values as low as 4 V/m and as high as 170 V/m.

Electrostatic fields of up to 7,000 V/m were measured. Fields from the electronic circuitry were less than 1 V/m.

The report cautions that all the EM readings are approximately ten times the real exposure levels as a result of the measurement method used. Dr. Stuart Harvey, who supervised the EM testing, explained that the meter used in the laboratory gives a reading that exceeds actual levels by this amount.

The significance of these radiation readings is unclear. "No experimental data were uncovered which directly demonstrate evidence of biological harm due to fields generated by VDTs; however, conversely, to our knowledge there is no published work which shows the absence of such effects," the study explains.

With regard to ionizing radiation, measurements failed to find emissions above ambient levels in 80 percent of the units tested. The remainder of the units produced readings two to four times that of background apparently due to the presence of potassium-40, a radioactive isotope, in the glass screens. These levels are of "no medical significance" according to the researchers.

Ergonomic guidelines available to VDT users and supervisors are inadequate, according to the report. In most cases guidelines are not compatible or consistent. The study recommends design standards for desks, chairs, keyboards, screen characteristics and lighting.

Project HAVDU was started in 1982 in response to a labor-management agreement, and to concerns among company scientists that VDT work is a "cause of anxiety among women employees." The Phase I report was presented to Ontario Hydro's Board of Directors in mid-November and became publicly available in mid-January. The projected completion date for Phase II is April 1985.

Copies of the full report can be ordered from Mr. Robert Facey, Safety Services, Ontario Hydro, 757 McKay Road, Pickering, Ontario L1W 3C8, Canada. The cost per copy is $13 US, $16 Canadian. A 35-page summary is available from the same address for $4 US, $5 Canadian.

SHORT COURSES

March 5-6: ***Grounding, Bonding & Shielding,*** San Francisco, CA. Fee: $495. Contact: R&B Associates, 20 Clipper Rd., W. Conshohocken, PA 19428, (215) 825-1960. Repeated ***March 8-9:*** Los Angeles, CA.

March 5-7: ***Planning for and Operating an NMR Imaging Facility,*** Washington, DC. Fee: $750. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773.

March 12-15: ***Modern Microwave Measurements,*** Washington, DC. Fee: $895. Contact: Continuing Education Institute (CEI), 5410 Leaf Treader Way, Columbia, MD 21044, (301) 596-0111 or (213) 824-9545.

March 12-15: ***Computational Methods in Electromagnetics,*** Galveston Island, TX. Fee: $650. Contact: Ann Beekman, Southeastern Center for Electrical Engineering Education (SCEEE), Central Florida Facility, 11th & Massachusetts Ave., St. Cloud, FL 32769, (305) 892-6146.

March 12-16: ***Radiowave Propagation for Communications Systems Design,*** Orlando, FL. Fee: $875. Contact: GWU, see March 5 above.

March 15-16: ***Lightning Protection,*** Orlando, FL. Fee: $625. Contact: GWU, see March 5 above. Repeated ***June 4-5:*** Washington, DC.

March 19: ***Applying Military Electromagnetic Compatibility Specifications,*** St. Louis, MO. Fee: $295. Contact: Jean Tucker, ECOS Environmental Solutions, 205 W. Harrison St., Oak Park, IL 60304, (312) 383-2505. Repeated ***April 16:*** Chicago, IL.

March 19-23: ***Flat-Panel and CRT Technologies,*** Los Angeles, CA. Fee: $895. Contact: UCLA Extension Short Course Program, PO Box 24901, 6266 Boelter Hall, Los Angeles, CA 90024, (213) 825-1047.

March 20-22: ***Grounding & Shielding,*** Sunnyvale, CA. Fee: $815. Optional fourth day for $235. Contact: Don White Consultants Inc. (DWCI), Star Route 625, PO Box D, Gainesville, VA 22065, (703) 347-0030.

March 22-24: ***NMR: A Primer for Radiologists,*** Hilton Head Island, SC. Fee: $375. Contact: K.V. Pyles, Foundation for Education in Magnetic Resonance, 111 Glade Park East, Kittanning, PA 16201, (412) 545-7085.

April 3: ***EMC: The FCC Means Business,*** Boston, MA. Fee: $595. Contact: Carol Clark, McGraw-Hill Seminar Center, 331 Madison Ave., Suite 603, New York, NY 10017, (212) 687-0243.

April 9-10: ***Grounding, Bonding & Shielding,*** Washington, DC. Fee: $625. Contact: GWU, see March 5 above.

April 30-May 4: ***EMC Design & Measurement for Control of EMI,*** San Diego, CA. Fee: $995. Optional fifth day for $235. Contact: DWCI, see March 20 above.

April 30-May 4: ***NBS Noise Measurement Seminar,*** Boulder, CO. Fee: $775. Contact: Sunchana Perera, Div. 723.05, National Bureau of Standards, Boulder, CO 80303, (303) 497-3546.

April 30-May 4: ***High Frequency Spectrum: New Concepts and Technologies,*** Washington, DC. Fee: $875. Contact: GWU, see March 5 above.

May 7-11: ***Microwave High Power Tubes and Transmitters,*** Washington, DC. Fee: $875. Contact: GWU, see March 5 above.

May 7-11: ***Microwave Circuits Design: Linear Circuits,*** Palo Alto, CA. Fee: $895. Contact: CEI, see March 12 above. Repeated ***June 4-8:*** Boston, MA.

May 7-11: ***Electromagnetic Interference and Control,*** Washington, DC. Fee: $875. Contact: GWU, see March 5 above.
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May 8-11: ***Modern Antennas,*** Washington, DC. Fee:$675. Contact: Linda Billard, Technology Service Corp. (TSC) 8555 16th St., Suite 300, Silver Spring, MD 20910, (800) 638-2628.

May 15-17: ***An Introduction to EMI/RFI/EMC,*** Los Angeles, CA. Fee: $815. Contact: DWCI, see March 20 above.

May 21-23: ***Hazardous RF Electromagnetic Radiation,*** Washington, DC. Fee: $695. Contact: GWU, see March 5 above.

FROM THE FIELD

Responses to Dr. Robert Becker's Letter on Use of Electromagnetic Stimulation for Bone Growth

In our November issue, we published a letter sent to the FDA by Dr. Robert O. Becker on the risks associated with the growing use of medical devices that apply direct currents and pulsed electromagnetic fields to stimulate bone growth. Published below are the FDA's response to Becker and a letter to Microwave News *from Dr. C. Andrew L. Bassett.*

Dear Dr. Becker:

The Food and Drug Administration (FDA) has completed its initial review of your concerns regarding the safety of electromagnetic stimulation of biological tissues as a treatment therapy. The agency believes it is essential to continually evaluate the safety and effectiveness of electromagnetic stimulation as the technology evolves and new data accumulates. We would like, therefore, to thank you for your comments and encourage you to submit any additional comments or relevant data, as you feel appropriate.

We are familiar with most of the information you provided. The bulk of the data you refer to has only recently become available (articles dated 1982 and 1983). As you observed there is little, if any, corroborating evidence for much of the recent research you cited.

As you know, the agency has approved three premarket approval applications for devices involving electromagnetic stimulation for healing of bony defects. These approvals were based on all the information available at the time of approval. These approvals required that four-year follow-up examinations be performed by the sponsor on all patients in the approved trials. These examinations were explicitly requested to substantiate "long-term" safety and effectiveness of the approved devices. This four-year time period has not been reached by all patients; thus, the data which will address many concerns is incomplete.

Furthermore, we are also aware of the need to proceed judiciously in the clinical application of a new therapeutic modality such as electromagnetic stimulation. This agency has determined that all such devices are significant risk devices. As such, any sponsor wishing to clinically investigate these devices must receive FDA approval for an investigational device exemption (IDE) prior to initiating the trial. Therefore, we will continue to evaluate the most up-to-date information available regarding the safety and effectiveness of these devices.

Thank you again for your comments. If you have any questions regarding this matter contact me at (301) 427-7156.

Carl A. Larson, Ph.D.
Director, Division of Surgical and Rehabilitation Devices
Office of Medical Devices
National Center for Devices and Radiological Health
Food and Drug Administration, Silver Spring, MD 20910

To the Editor:

Dr. Robert O. Becker has called for a moratorium on clinical application of "bone growth stimulators" because he postulates a possible link between such devices and "malignant transformation." Anyone who has followed his writing and statements will recognize that this position has not changed for the past ten years. In fact, at the 1973 New York Academy of Sciences Conference on "Electrically-Mediated Growth Mechanisms on Living Systems," Dr. Becker sounded his first alarm, "When this field began to open up and clinical use was being postulated, and some patients were actually undergoing treatment, I raised the question of possible induction of malignant cellular changes." [1]

During the intervening ten years, more than 40,000 patients have been treated with various electrical devices to modify bone formation by one mechanism or another, without a single report of malignancy as the result of such use. Extensive laboratory investigations of these devices have taken place *in vitro* and *in vivo* all over the world, again, with no evidence that they *induce* cancer. This point is conceded by Becker, himself, in his FDA letter.

In the United States, where the electrical devices have been regulated by the FDA since 1979, there is a legal requirement for device manufacturers to report all untoward reaction and, to my knowledge, the cancer issue is a "non-issue" at the present time.

I will not attempt to point out or correct each of the inaccuracies which are contained in the letter. Interested readers are referred to the appended bibliography for details, which can place the issues in a more comprehensive light. There are two main inaccuracies, however, which deserve attention by your readers. The first concerns safety testing and is embodied in his sentence, "When the FDA approved these devices there were no studies on the effects of...magnetic fields on embryonic growth and development or malignant growth." The facts are: extensive data from teratologic and toxicologic studies in animals were made available to the FDA for the two pulsed electromagnetic field (PEMF) modes which were approved. These included documentation of a lack of chronic-exposure PEMF effects on multiple soft tissues and organs such as the heart, kidneys, liver, spleen, adrenals, lung and brain, among others. Furthermore, mice mated, delivered and reared through the F5 generation (constantly exposed individually to two types of PEMFs) showed no birth, development or functional abnormalities. In addition, both pulse modes were tested on Meth A sarcomas in Balb/C mice and were demonstrated to have no effect on tumor weight, mitotic indices, tumor microanatomy or behavior. Similarly, both pulses had no effect on normal animal longevity or the spontaneous tumor incidence in Swiss Webster mice. All of these data were submitted to the FDA as part of the pre-market approval and continuing monitoring processes. Under the Freedom of Information Act, I believe, these findings have been available to one and all, if they were concerned. As a matter of record, the safety of these two pulse modes has been investigated, independently, both in academic and commercial settings, and the original assessments confirmed.

The second critical issue which deserves comment is what I call the "lumping syndrome." No one would consider saying to a physician or a scientist, "I treated my patients with drugs" without specifying the agents, their dose, their routes or schedules of administration. Yet, electrical modalities of a wide variety, are now being "lumped" into the "bone growth stimulator" heading with little or no evidence that each fits [2]. Similarly, because one type of time-varying electromagnetic field produces an untoward effect under *highly selected* circumstances, *all* such fields frequently are impugned. Conversely, because PEMFs are effective in a given clinical setting, entrepreneurs who try a "coattail" approach, either are unaware, themselves, of the very selective nature of pulse specifity or are counting on an uninformed user, when "equivalency" is claimed.

With every passing month it is more and more clear that both different and similar pulses can cause different biological effects in different tissues at different times in the cell cycle [3-14]. In fact, the postulated importance of frequency, amplitude and cell cycle "windows" to achieve selected alterations in cell function is now supported by a considerable body of scientific data. Falling prey to the "lumping syndrome" signals a lack of familiarity with those data.

(continued on p.8)

FROM THE FIELD

Finally, a moratorium on FDA-approved clinical applications of *selected* PEMFs, clearly, is not justified by the facts. Deleterious effects have not been reported in the more than 20,000 patients treated with these two pulse modes. The longest follow-up, now, is nine years and the method has been used successfully on a number of occasions to heal ununited fractures in bone with quiescent (treated) primary tumors. In none of these individuals has there been any evidence of "re-lighting" the tumor for intervals exceeding five years post-treatment. Let us not risk "throwing the baby out with the bath water."

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UPDATES

BIOLOGICAL EFFECTS

Collection of Papers... The IEEE Press has assembled into one large volume a collection of more than 60 papers on the interaction of RF/MW radiation with living systems. The papers, reprinted as they were originally published, are divided into seven groups, each with an introduction and a list of references. *Biological Effects of Electromagnetic Radiation* was edited by Dr. John Osepchuk of Raytheon with the help of Drs. James Frazer, Om Gandhi, Arthur Guy, Don Justesen, Sol Michaelson and John Mitchell. The 593-page collection is available for $47.95 to IEEE members and $79.95 to non-members from IEEE Press, 445 Hoes Lane, Piscataway, NJ 08854, (201) 981-0060.

COMMUNICATIONS

WARC... Delegates from 112 nations have gone to Geneva, Switzerland, for the World Administrative Radio Conference's (WARC) five-week meeting on high frequency (shortwave) communications. For a review of the issues to be addressed, see the January 9 *Broadcasting*....The FCC has amended its rules to comply with the "Final Acts" of the 1979 WARC. The commission states that this action "provides domestic radio spectrum users with protection from harmful interference as provided by international regulations." The FCC's lengthy discussion of the rules and the public comments they generated, and a modified table of frequency allocations, appear in the January 19 *Federal Register.*

COMPATIBILITY & INTERFERENCE

Aircraft RFI... At the first meeting of the Radio Technical Commission for Aeronautics (RTCA) Special Committee 156 on "Potential Interference to Aircraft Electronics Equipment from Devices Carried Aboard" on December 1-2, a testing program was initiated to determine if there is an RFI problem caused by the use of computers aboard planes (see *MWN,* October 1983). Representatives from the airlines, the air frame manufacturers and the FAA will gather path loss data by simulating the decay of emissions through windows and the aircraft itself. At the same time, the computer companies will check the emissions from various devices. It was noted that radiation levels allowed under RTCA/DO-160A are more stringent that those allowed under FCC Part 15 and that the stricter limits may be needed to prevent harmful RFI. The next meeting of SC-156 is scheduled for February 28-29. In the meantime, the committee members agreed that interim steps to stop passengers from using computers during flight, including during take offs and landings, were not necessary.

Sonic Cable TV Fine Upheld... The FCC has refused to rescind its $6,000 fine against Sonic Cable TV (serving Grover City, Arroyo Grande and Pismo Beach, CA) for leaking signals which interfered with amateur radio communications (see *MWN,* November 1982). The commission did not find Sonic's procedural and substantive arguments persuasive: "Sonic has chosen to raise a plethora of unmeritorious arguments to mask its rule violations." The FCC responded to Sonic's charge that it was the victim of "selective prosecution" by noting that although the "commission's limited resources may result in violators going unpunished, this does not mean we cannot impose sanctions against those we find violating our rules."

Immunity Task Group...ANSI C63's ad hoc committee on enhancing the immunity of home electronic equipment to RFI is moving ahead. Meetings were held in October and December and another is planned for February 10 at the FCC Labs in Columbia, MD.vAt that time, the committee plans to put the final touches on a questionnaire, which will

be published in the American Radio Relay League's (ARRL) magazine, *QST*. FCC's Dan Yates, a member of the committee, pointed out that the questionnaire is virtually identical to the one used by the commisson's Field Operations Bureau for reporting RFI complaints. Meanwhile, the Electronic Industries Association's Consumer Electronics Group has completed its measurements on the immunity of TVs and VCRs; the results are under review. As work on TVs and VCRs winds up, the committee will soon begin studying cordless phones and home security systems. Don Heirman of AT&T Information Systems Labs, the committee chairman, said that the new and the old efforts will continue simultaneously.

NBS Noise Seminar...NBS is holding a week-long seminar on precision noise measurements, stressing applications in antenna and communication systems, April 30 to May 4 in Boulder, CO. Taught by members of the Noise Metrology Group in NBS' Electromagnetic Fields Division, the seminar costs $775. For more information contact NBS' Sunchana Perera, (303) 497-3546.

Resources... The Soviet "Woodpecker" transmitter is causing interference problems again, according to an item in the December *QST*. The magazine quotes a Norwegian official as saying that the Woodpecker, located in Kiev, is interfering with almost a tenth of the radio traffic over the shortwave band in Norway....An article in the November 3 *New Scientist* cites the dangers of trying to use signals from high power CB radios to confuse the electronics of gas station pumps. There is no way of knowing whether the radiation will make the gas meter run faster or slower. And there is the risk that it can trigger an explosion. In fact, author Barry Fox notes, this effect has been exploited in the Northern Ireland conflict....A.J. Mauriello of Radiation Sciences, Inc., in Lansdale, PA, and J.M. Clarke of the Air Force's Electronics Systems Division at Hanscom AFB have published "Measurement and Analysis of Radiated Electromagnetic Emissions from Rail-Transit Vehicles" in the November *IEEE Transactions on Electromagnetic Compatibility*....The Office of Technology Assessment (OTA) cites EMI as one barrier to magnetic levitation systems for high-speed intercity passenger service. See OTA's *US Passenger Rail Technologies*, available for $4.75 from the Government Printing Office, Washington, DC 20402. Order No. 052-003-00938-2....EMI problems in the automobile industry were featured in a December 20 *New York Times* article by John Holusha....Papers are being solicited for the *6th Symposium and Technical Exhibition on Electromagnetic Compatibility* to be held at the Swiss Federal Institute of Technology in Zurich, March 5-7, 1985. The theme of the conference is "protection of the electromagnetic environment." Professor Ralph Showers of the University of Pennsylvania is again serving as the chairman of the Technical Program Committee. Abstracts are due before March 15, 1984. For more information, contact: Dr. T. Dvorak, ETH Zentrum-IKT, 8092 Zurich, Switzerland, 256-2790....NASA has issued a RfP (No.5-79683/235) to "determine critical areas of EMI/EMC interaction between the spacecraft and electronics payload and identify areas where potential EMI problems exist." The space agency anticipates awarding one contract in March.

GOVERNMENT

IEEE Spectrum... Watch for the March issue of *IEEE Spectrum*, which will feature a major article on the current regulatory climate in Washington, DC, as it affects the use of non-ionizing electromagnetic radiation.

INTERNATIONAL

Hungarian Standards... In 1982, Hungary proposed new safety standards for workers and the general population. The proposal is comparable to other Eastern European RF/MW health standards and is more stringent that the new ANSI guidelines and other Western standards. For 300 MHz-300 GHz, the draft exposure limit for the general population is 10 uW/cm^2, while for workers it is 1 mW/cm^2. For 30 kHz-30 MHz, the limits are 20 V/m and 50 V/m for public and occupational exposures respectively; for 30-300 MHz, they are 10 V/m and 20 V/m respectively. Higher exposure levels are permitted for short periods of time, but the absolute maximum levels for *all* individuals are (1) 30 kHz-30 MHz: 1000 V/m; (2) 30-300 MHz: 500 V/m; and (3) 300 MHz-300 GHz: 10 mW/cm^2. The proposed limits do not differentiate between CW and pulsed radiation. The Hungarian paper was translated by Information Ventures, Inc., and is excerpted in its most recent edition of *Biological Effects of Non-Ionizing Electromagnetic Radiation* (Vol. VIII, No. 1, October 1983). A limited number of copies are available from the Office of Naval Research, Code 441, 800 North Quincy St., Arlington, VA 22217 (include a self-addressed mailing label).

MEDICAL APPLICATIONS

BSD's Hyperthermia Units Approved... On November 28, the FDA approved BSD Medical Corporation's BSD-1000 hyperthermia system as "safe and effective" for marketing to hospitals and clinics (see FDA's notice in the January 25 *Federal Register*). The BSD unit, which is designed to treat tumors within two inches of the skin surface with electromagnetic energy, can operate at frequencies between 50-1000 MHz. It is the first hyperthermia device to win FDA approval. Two months later, on January 27, BSD followed up its first success by winning clearance for its new mobile unit, the BSD-300, which generates heat with radiation in a narrower frequency band. The portable unit uses the same technology and applicators as the BSD-1000. The devices are now available for sale by prescription, to be used under the supervision of a licensed physician.

Resources...A multinational group of researchers has devised an innovative method of removing tumor cells from bone marrow. The tumor cells are rendered magnetic by targeting them with monoclonal antibodies which are bound to polystyrene microspheres containing magnetite. The bone marrow can then be "cleaned" with a magnet. Up to

99.9 percent of the tumor cells can be removed with this technique, which is described in the January 14 *Lancet*....The December issue of the *IEEE Engineering in Medicine and Biology Magazine* features five papers on "Therapeutic Uses of Electrical Stimulation." Topics include pain control, growth stimulation of bones, nerves and limbs, electroacupuncture, and soft tissue healing.... General Electric has published a pamphlet, *Parameters Determining the Appearance of NMR Images*. A copy is available at no charge from GE's Medical Systems Operations, PO Box 414, Milwaukee, WI 53201.

MILITARY SYSTEMS

Fourth PAVE PAWS Radar... The Air Force's Electronic Systems Division has awarded Raytheon's Equipment Division a $61.2 million contract to build, install and test a fourth phased array, PAVE PAWS, radar near Goodfellow AFB in Texas. Last November, the AF announced plans for the third PAVE PAWS radar at Robins AFB in Georgia at a cost of $76.9 million (see *MWN*, December 1983). Two other PAVE PAWS radars are already operational at Otis Air Guard Base in Massachusetts and at Beale AFB in California. The radars, which are more than ten stories tall, have two walls, each with 5,354 individual antennas. They can detect sea-launched ballistic missiles 3,000 miles away.

POWER LINES

Progress Report on NY Studies... The Scientific Advisory Panel of the New York State Power Lines Project will meet March 25-26 to review progress on its 16 ongoing studies. Plans for two epidemiological studies just getting under way at the University of Colorado in Denver and the Battelle Pacific Northwest Laboratory in Richland, WA, will be included in the discussions (see *MWN*, September and November 1983). The public is invited to the second day of the meeting, which will be held at the Health Department Labs in Albany. Project Administrator Michael Rampolla said that a written semiannual progress report will be released at the end of this month. For details, contact Rampolla at the NY Power Lines Project, New York State Department of Health, Center for Laboratories and Research, Empire State Plaza, Albany, NY 12201, (518) 474-7888.

Resources...A team from Hydro-Quebec's research institute, IREQ, has studied the corona, electric field and ion-current performance of a ± 900 kV bipolar HVDC transmission line. The results on radio interference, audible noise, corona loss, electric field and ozone generation are presented in the January 1984 issue of *IEEE Transactions on Power Apparatus and Systems*....A session on "Transmission Line Electric Field Effects" is scheduled for February 2 at the IEEE Power Engineering Society's winter meeting in Dallas, TX. Three presentations are planned: one on measurements of E-fields from transmission lines in residential environments by a team from Electric Research & Management; and two on methods of evaluating human exposures to 60 Hz E-fields by Dr. D. Deno of GE and M. Silva of Enertech, and by a group of Japanese researchers....The Minnesota Environmental Quality Board (MEQB) has issued two reports on the state's ± 400 kV DC power line. *A Health and Safety Evaluation of the ± 400 kV DC Power Line*, prepared by a seven-member advisory panel, concludes that "based on currently available scientific literature, there is no indication that the Cooperative Power Association/United Power Association ± 400 kV DC power line represents a risk of effects, symptoms or damage to the health of the general public as a result of short term exposures." One of the experts filed a dissenting report. *A Statistical/Epidemiological Study of Bovine Performance Associated with the CPA/UPA DC Power Line in Minnesota* found no significant changes in milk production or quality among herds near the line. Each report is $13.00, including handling charges, from the MEQB, 100 Capitol Square, St. Paul, MN 55101. An executive summary of each report is available free....There are now 13 gigawatts of HVDC capacity in the world, with 20 GW under construction and a projected annual growth rate of 15 percent a year through 1990, according to an article in the January issue of *IEEE Spectrum*, p.72. The report features a list of the major HVDC projects completed, built or planned around the world with a detailed map of the lines in the US....The General Accounting Office has prepared a report for the Secretary of DOE on *Expanding the Pacific Northwest/Southwest Intertie — Benefits and Impediments*. Report No. GAO/RCED-84-38, November 4, 1983 is available from GAO, Document Handling and Information Services Facility, PO Box 6015, Gaithersburg, MD 20760, (202) 275-6241.

STANDARDS

ANSI Conference... The American National Standards Institute (ANSI) is sponsoring a one-day conference on *Standards and the Law* on March 27 at the Marriott Crystal Gateway Hotel in Arlington, VA. Topics to be covered include the legality of standards, their anti-trust implications and their use in product liability cases. The registration fee is $150. On March 28, ANSI will hold a *Seminar on Administering Domestic Standards Activities*, which has a fee of $50. Those who register for both will receive a $25 discount. For more information, contact Ms. Dolly McKelvey, ANSI, 1430 Broadway, New York, NY 10018, (212) 354-3300.

Oven Leakage...FDA's National Center for Devices and Radiological Health has issued a final rule on its amended procedures for measuring leaks from microwave ovens. In 1980, the Association of Home Appliance Manufacturers had objected to the FDA proposal but both sides reached an agreement in November 1981 (see *MWN*, May 1981 and January/February 1982). Now the FDA has promulgated the rule (46 *Federal Register* 57481, December 30, 1983); and it will take effect on July 2, 1984. For more information contact FDA's Melvyn Altman, (301) 443-3426.

Resources...ANSI's C63 Committee on Radio-Electrical Coordination is proposing to change its name to Committee on Electromagnetic Compatibility and to widen its scope to include setting guidelines on immunity. Meanwhile, its new

C63.12 standard *Recommended Practice on Procedures for Control of System Electromagnetic Compatibility* won official ANSI approval on December 2....The American Society for Testing and Materials (ASTM) has published its Emergency Standard Test Methods (ES 7-83) for *Electromagnetic Shielding Effectiveness of Planar Materials* (see *MWN*, October 1983). A copy is available from ASTM, 1916 Race St., Philadelphia, PA 19103, (215) 299-5400....The IEEE Standard (145-1983), *Definitions of Terms for Antennas* has been published as Part II of the November 1983 issue of the *IEEE Transactions on Antennas and Propagation*....ANSI/IEEE 539-1979, *Definition of Terms Relating to Overhead Power Line Corona and Radio Noise*, has been published and is available for $5.00 from ANSI's Sales Dept., 1430 Broadway, New York, NY 10018, (212) 354-3300.

TECHNOLOGY

Hazeltine Wins MLS Award... The FAA awarded Hazeltine Corp. of Commack, NY, a $90.6 million contract for the production and installation of 172 microwave landing systems (MLS) at airports across the country. As many as 1,250 MLS's are planned over the next 15 years in the US; the world market is projected to be $2-4 billion. In winning the contract, Hazeltine beat out competing systems developed by Bendix Corp. and Wilcox Electric Corp., a subsidiary of Northrop Corp. Hazeltine is expecting to lose about $12 million on the deal; the loss is acceptable, according to Sal Nuzzo, Hazeltine president and CEO, because it will allow the company to diversify into a non-defense market with potential for huge worldwide sales.

VDTs

Legislation...VDT bills are off to a running start in Connecticut, Ohio, Rhode Island and Massachusetts. A special panel of legislators in Connecticut met January 4 to hear the preliminary results of a VDT health and safety study ordered last June. Scientists from the Connecticut Academy of Science and Engineering (CASE) dismissed VDT radiation risks in their report. Speaking for CASE, Dr. Robert Handschumacher of the Yale University School of Medicine said existing radiation data "do not warrant very much more attention." Dr. Robert Wheeler, also of Yale, told the legislators that electromagnetic emissions are virtually eliminated by metallic shielding inside VDT casings. This shielding is required by FCC RFI regulations. The panel is expected to report its findings to the General Assembly by March 1. The study was ordered in a law passed last June (see *MWN*, June 1983)....In Ohio, VDT legislation sponsor Rep. Barbara Pringle testified before the Health and Retirement Committee on January 25. Pringle, whose proposal includes the right to non-VDT work during pregnancy and regular ophthalmological examinations (see *MWN*, November 1983), told *Microwave News* her legislation "would benefit employers as much as the employees" by making VDT operators more productive. More hearings are expected....Influential legislators in Rhode Island and Massachusetts introduced new bills; hearings are all but certain in both states. Rhode Island Rep. Henry Boeniger, chairman of the House Labor Committee, introduced bill H7012 with the backing of the Providence Newspaper Guild. Boeniger expects to hold a hearing in early March. Opponents of the measure, including many Chambers of Commerce in the state, say they intend to kill the bill. Massachusetts Rep. Timothy Bassett wanted to show the "wide range of policy options available" on VDT health and safety, so he introduced four bills (H3023-H3026). The weakest would establish an advisory committee to the state Department of Labor and Industries; the strongest includes mandatory standards for VDT work and periodic eye exams. Bassett, who chairs his state's Committee on Commerce and Labor, told *Microwave News* he wants to encourage a "dialogue" on VDTs but he does not expect a bill to pass this year. He plans to hold a hearing in late February.

CLASSIFIEDS

CONFERENCES

March 8-10: ***NMR Imaging,*** Hyatt Regency, San Francisco, CA. Contact: Contemporary Forums, 219 Canyon Vista, Suite 300, Danville, CA 94526, (415) 820-2800.

March 13-14: ***1984 National Radar Conference: Radar Technology for the 80's,*** Atlanta, GA. Contact: Dr. Edward Reedy, Georgia Institute of Technology, Engineering Experiment Station, Radar & Instrumentation Lab, Atlanta, GA 30332, (404) 424-9621.

April 3-5: ***3rd Annual Test & Measurement World Expo,*** Brooks Hall, San Francisco, CA. Contact: Meg Bowen, 215 Brighton Ave., Boston, MA 02134, (617) 254-1445.

April 4-5: ***20th Annual Meeting of the National Council on Radiation Protection and Measurements,*** Washington, DC. Contact: NCRP, Suite 1016, 7910 Woodmont Ave., Bethesda, MD 20814, (301) 657-2652.

April 14-19: ***19th Annual Association for the Advancement of Medical Instrumentation Meeting and Exhibit,*** Washington Hilton, Washington, DC. Contact: AAMI, 1901 North Fort Myer Dr., Suite 602, Arlington, VA 22209, (703) 525-4890.

April 24-26: ***IEEE 1984 National Symposium on Electromagnetic Compatibility,*** Hyatt Regency Hotel, San Antonio, TX. Contact: William McGinnis, Southwest Research Institute, PO Drawer 28510, San Antonio, TX 78284, (512) 684-5111, ext. 2721.

April 29-May 2: ***62nd Annual Convention of the National Association of Broadcasters,*** Las Vegas Convention Center, NV. Contact: NAB, 1771 N Street, NW, Washington, DC 20036, (202) 293-3570.

April 29-May 4: ***9th Conference & Exposition on Overhead and Underground Transmission and Distribution,*** Bartle Hall, Kansas City, MO. Contact: J.R. Miller, Kansas City Power & Light Co., PO Box 19964, Kansas City, MO 64141.

April 30-May 3: ***5th Annual Meeting of the Canadian Radiation Protection Association,*** Banff, Alberta. Contact: Stuart Hunt, 15 Glacier Place, St. Albert, Alberta, T8N 1R7, Canada.

May 6-12: ***6th International Congress of the International Radiation Protection Association (IRPA),*** Berlin, West Germany. Contact: Dr. R. Neider, Bundesanstalt fur Materialprurfung, Unter den Eichen 87, D-1000 Berlin 45, West Germany.

May 7-9: ***1984 Microwave Power Tube Conference,*** Naval Postgraduate School, Monterey, CA. Contact: John Skowron, Raytheon Co., Foundry Ave., Waltham, MA 02254, (617) 899-8400, ext. 4311.

May 7-11: ***Nuclear Magnetic Resonance 1984: National Symposium,*** Hyatt Regency Grand Cypress Resort, Orlando, FL. Contact: Ms. Norine Karwel, Educational Symposia, PO Box 17241, Tampa, FL 33682, (813) 879-8765.

May 20-24: ***16th Annual Meeting of the Conference of Radiation Control Program Directors,*** Des Moines, IA. Contact: CRCPD, 71 Fountain Pl., Frankfort, KY 40601, (502) 227-4543.

May 30-June 1: ***IEEE MTT-S International Microwave Symposium,*** San Francisco, CA. Contact: Dr. Ferdo Ivanek, Harris Corp., Farinon Division, 1691 Bayport Ave., San Carlos, CA 94070, (415) 594-3529. The ***1984 IEEE Microwave and Millimeter Wave Monolithic Circuits Symposium*** will be held in San Francisco May 29-30 in conjunction with the MTT-S meeting.

June 3-8: ***29th Annual Meeting of the Health Physics Society,*** Hyatt Regency, New Orleans, LA. Contact: Richard Burk, Jr., HPS, 4720 Montgomery Lane, Suite 506, Bethesda, MD 20814, (301) 654-3080.

June 25-28: ***1984 International IEEE/AP-S Symposium and National Radio Science Meeting,*** Westin Hotel, Boston, MA. Contact: Professor Harold Raemer, Dept. of Electrical Engineering, Northeastern University, Huntington Ave., Boston, MA 02115.

June 26-28: ***7th International Symposium and Exhibition on Electromagnetic Compatibility,*** Wroclaw, Poland. Contact: W. Moron, EMC Symposium, Box 2141, 51-645 Wroclaw 12, Poland.

June 26-28: ***1984 International Conference on Lightning and Static Electricity,*** Orlando, FL. Contact: J.J. Fisher, US Naval Air Systems Command, PO Box 15036, Arlington, VA 22215, (202) 692-7822.

July 2-6: ***1984 Nuclear EMP Meeting,*** Baltimore Hilton Hotel, Baltimore, MD. Contact: Dr. Arthur Sindoris, Harry Diamond Labs, 2800 Powder Mill Rd., Adelphi, MD 20783.

July 2-6: ***4th International Symposium on Hyperthermic Oncology,*** Aarhus, Denmark. Contact: Dr. Jens Overgaard, Institute of Cancer Research, Radiumstationen, DK-8000 Aarhus C, Denmark.

July 15-19: ***6th Annual Bioelectromagnetics Society Meeting,*** Omni International Hotel, Atlanta, GA. Contact: BEMS, 1 Bank St., Gaithersburg, MD 20878, (301) 948-5530.

July 15-20: ***IEEE Power Engineering Society: 1984 Summer Meeting,*** Washington Plaza, Seattle, WA. Contact: Jack Richardson, Puget Sound Power & Light Co., 10608 NE Fourth St., Bellevue, WA. 98008, (206) 453-6800.

July 22-25: ***21st Annual Conference on Nuclear and Space Radiation Effects,*** Broadmoor Hotel, Colorado Springs, CO; followed by **July 26-27:** ***1984 Hardened Electronics and Radiation Technology (HEART) Conference,*** Fort Carson Army Base, Colorado Springs, CO. Contact for both meetings: B.D. Shafer, Sandia National Labs, Albuquerque, NM 87185, (505) 846-0629.

July 29-August 4: ***8th International Biophysics Congress,*** Bristol, England. Contact: Meon Conferences Services, Petersfield, Hampshire GU32 3JN, England.

August 20-24: ***Conference on Precision Electromagnetic Measurements,*** Delft, Netherlands. Contact: Mrs. I.J. Smits, Department of Electrical Engineering, Delft University of Technology, PO Box 5031, 2600 GA Delft, Netherlands, 31-15-781736.

August 27-30: ***Open Symposium on the Interactions of Electromagnetic Waves with Biological Systems,*** Florence, Italy. (The symposium will be held as part of the URSI Assembly, see August 29 below.) Contact: Dr. Elliot Postow, Naval Medical R&D Command, Bldg. 142, National Navy Medical Center, Bethesda, MD 20814, (202) 295-1140.

August 29-September 5: ***21st General Assembly of the International Union of Radio Science (URSI),*** Florence, Italy. Contact: Professor A.M. Scheggi, Istituto Ricerca Onde Elettromagnetiche (IROE), Consiglio Nazionale delle Ricerche, Via Panciatichi 64, 50127 Florence, Italy, 39-55-4378512.

September 10-13: ***14th European Microwave Conference,*** Liege, Belgium. Contact: Microwave Exhibitions & Publishers, Convex House, 43 Dudley Rd., Tunbridge Wells, Kent TN1 1LE, England.

September 16-21: ***19th Annual Microwave Power Symposium,*** Sheraton-Ritz Hotel, Minneapolis, MN. Contact: IMPI, Suite 520, 301 Maple Ave., Vienna, VA 22180, (703) 281-1515.

September 17-19: ***37th Annual Conference on Engineering in Medicine and Biology,*** Los Angeles Hilton, Los Angeles, CA. Contact: Alliance for Engineering in Medicine and Biology, Suite 402, 4405 East-West Highway, Bethesda, MD 20814, (301) 657-4142.

September 18-20: ***4th International Conference on Electromagnetic Compatibility,*** University of Surrey, Guildford, Surrey, England. Contact: Institution of Electronic and Radio Engineers, 99 Gower St., London WCIE 6AZ, England, (01) 388-3071.

October 2-4: ***6th Annual Electrical Overstress/Electrostatic Discharge Symposium,*** Marriott Hotel, Philadelphia, PA. Contact: Burt Unger, Bell Labs, 600 Mountain Ave., Murray Hill, NJ 07974, (201) 582-2555.

October 16-18: ***1984 International Symposium on Electromagnetic Compatibility,*** Tokyo, Japan. Contact: Professor T. Takagi, Dept. of Communications, Tohoku University, Sendai, 980, Japan, (0222) 22-1800 ext. 4266.

October 22-24: ***International Symposium on Noise and Clutter Rejection in Radars and Imaging Sensors,*** Sasakawa Hall, Tokyo, Japan. Contact: Professor T. Musha, Dept. of Applied Electronics, Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama, 277, Japan, (045) 922-1111, ext. 2546.

October 22-26: ***9th International Conference on Infrared and Millimeter Waves,*** Osaka, Japan. Contact: Professor A. Mitsuishi, Dept. of Applied Physics, Osaka University, Yamada-Oka, Suita, Osaka 565, Japan.