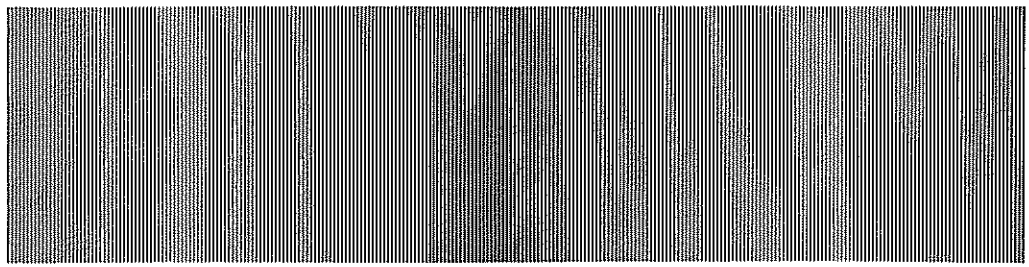


MICRO WAVE NEWS



A Monthly Report on Non-Ionizing Radiation

April 1983

Vol. III No. 3

INSIDE...

HIGHLIGHTS

pp.3-5

More Comments on EPA's RF/MW
Guidance

EMP and Nuclear Power

NAS To Study EMP Threat

Air Force EMC Center to Close

FDA Withdraws Diathermy Standard

FY84 Military Budget: Requests and
Dissent

COMMENTS ON EPA'S PLANS FOR RF/MW GUIDANCE

p.3-4

Selected Excerpts

SHORT COURSES

p.8

UPDATES

pp.5-8

Biological Effects

Communications

Compatibility & Interference

Government

Measurement

Medical Applications

Satellite Communications

Standards

VDTs

Microwave News invites letters from readers. We ask writers to be brief, and we reserve the right to edit contributions for length.

A report on the 1983 EMC conference held in Zurich on March 8-10 will appear next month.

States Propose VDT Legislation

State regulations for video display terminals (VDT) may be on the way. An informal survey conducted by *Microwave News* last month found safety bills or requests for VDT studies pending in five states and planned in four others.

For the most part, legislators are addressing ergonomic issues. As the list of proposed actions on page 2 shows, guidelines for lighting, furniture and terminal design are the central elements in bills from Connecticut, Illinois, Maine, Massachusetts and Oregon. Groups in California, Ohio, Texas and Washington are also considering introducing legislation.

Only Oregon and Massachusetts would require employers to offer alternative work to pregnant women, a clause included in several Canadian union contracts. Many of the states would require regular eye examinations.

No state has proposed monitoring VDT radiation emissions. A provision requiring radiation checks for VDTs was cut from Connecticut's safety bill before it left committee.

In addition to bills with specific regulations, Connecticut and Massachusetts are considering setting up committees to investigate VDTs and then draft legislation if necessary. In New York, a hearing on VDTs scheduled for April 14 could result in the introduction of a safety bill.

Several bills have also been introduced in Canadian provincial legislatures but none has become law.

Though growing public awareness of VDT health issues has prompted some legislators to propose rules, the need for regulations is under dispute. At a March hearing on Connecticut's proposed VDT safety bill, for example, spokesmen for IBM advised that long experience and numerous studies show that VDTs are completely safe. Further, the company maintained that marketplace competition assures manufacturer responsiveness to the needs of users.

(continued on p. 2)

VDT-VLF Radiation Tests in Canada

Two recent reports from Canada describe measurements of the very low frequency (VLF) radiation emitted by video display terminals (VDTs). One by Dr. Stuart Harvey of Ontario Hydro details the characteristics of pulsed 16 kHz radiation. The other by Dr. Hari Sharma of the University of Waterloo, Ontario, presents the results of his VDT surveys at Surrey Memorial Hospital in Vancouver, BC.

As part of an ongoing investigation of VDTs at Ontario Hydro, Harvey measured and analyzed terminal emissions below 10 MHz. His tests of four VDTs found "no fields having characteristics presently known or suspected of being detrimental to human health."

For VLF, the peak pulse value of the 16 kHz field ranged from 19 to 170 V/m at a distance of 30 cm from the front of the sets: the pulses had a rise time of 2 to 4 microseconds and harmonics were observed up to 1 MHz. The root mean square (rms) varied from 3 to 30 V/m at 30 cm. VLF levels at the back of the terminals near the flyback transformers were much higher than at the front and Harvey notes that someone working within one foot of a VDT's rear casing "could receive an exposure in excess of the most restrictive standards." He describes this risk as being "largely confined to service personnel."

(continued on p. 2)

VLF Radiation Tests *(continued from p.1)*

Sharma, on the other hand, is not convinced exposure to pulsed VLF fields is safe. On the basis of his radiation tests at Surrey Memorial and an informal survey of workers at seven other British Columbia hospitals, Sharma believes a careful study at the hospitals is warranted. But he warns that a "linkage" between adverse health effects and VLF radiation may not be inferred at this time. He recommends shielding to reduce VLF emissions as a precautionary step.

Radiation measurements were taken at the request of the Hospital Employees Union last fall after six out of seven pregnancies among workers in Surrey's accounting office ended in miscarriage, birth defects or premature birth (see *MWN*, July/August 1982). Sharma's survey of hospital clerks using the same type of plastic-cased VDTs found an unexpectedly high incidence of pregnancy problems: workers, including the Surrey operators, reported only five normal births out of 17 pregnancies.

An arbitration panel was recently set up to hear the union's grievance against Surrey's administration for its handling of VDT safety issues. The hospital maintains that the terminals are safe; radiation tests by its consultant, Professor A.W. Guy of the University of Washington, Seattle, found no emissions over a few volts/meter (see *MWN*, March 1983). The union seeks guaranteed safeguards against potential VDT health hazards. Meanwhile,

concerned workers in the accounting office staged a protest last month and turned off their machines for four days.

According to Sharma's preliminary report released last month, the "maximum average value" of VLF radiation at the back of the VDTs near the flyback transformers was as high as 1,250 V/m, with a peak pulse value of up to 15,000 V/m. The average value of the field at 30 cm from the sets dropped to 25 V/m. Sharma found no evidence of significant emissions of X-ray, ultraviolet, infrared or microwave radiation or of PCBs.

The December 16 Ontario Hydro report states that available evidence suggests shielding for VLF is unwarranted. Harvey did investigate the effectiveness of shielding, however, and found that lining the inside of a plastic-cased terminal with copper foil and then grounding the foil substantially reduced 16 kHz emissions.

Harvey, who is with Ontario Hydro's research division in Toronto, also looked at the DC fields produced by the positively charged display screen: field levels ranged from 700 to 7,000 V/m at a distance of 30 cm. The DC field was "modulated, when a display is present, by the process of writing on the CRT screen." He found that "the modulation waveform has a 60 Hz repetition rate and can be quite complex, depending on the display format." The report states that "although there are no known direct health effects from such fields, an indirect effect from atmospheric positive ions has been suggested."

Ontario Hydro has also completed an ergonomics survey among some of its clerical workers. See the VDT update on page 8. ●

VDT Legislation *(continued from p.1)*

Labor representatives disagree. Carl Rude of the CWA in Washington state argued that "we need rules because there are still too many unanswered questions and too many user complaints. Until more research is done, we need some type of protection." Commenting for the Newspaper Guild, David Eisen said "legislation will provide a minimum workplace standard to protect millions of non-union workers." He is confident that

"sooner or later, laws will be pushed through."

The Computer and Business Equipment Manufacturers Association (CBEMA) opposes the proposed regulations. The trade association maintains that "inflexible regulation" of this fast developing technology will hurt businesses, users and manufacturers. The threat of VDT legislation has been targeted as a major issue by CBEMA and will be addressed by Columbia University Professor Alan Westin at the group's annual spring meeting in Phoenix, AZ. ●

Proposed State VDT Legislation

Connecticut: House Study Bill 5132: An Act Establishing a Committee To Investigate Workplace Hazards Caused by Video Display Terminals. Sponsor: Rep. William Kiner. Would set up a study committee which could develop appropriate VDT legislation. Status: approved by the Committee on Labor in March and sent to the Appropriations Committee.

Connecticut: Senate Bill 811: An Act Concerning Protection for Users of Video Display Terminals. Sponsor: Senator Michael Skelley. Employers would be required to inform workers of potential hazards associated with VDTs, including eye problems, headaches and musculoskeletal problems. Workers would also be informed of the advisability of annual eye exams and the need for a rest period of up to 20 minutes after two hours of work. Also calls for study of VDTs. Status: approved by the General Law Committee in March.

Illinois: House Bill 274: An Act to Provide Occupational Safeguards for Operators of Video Display Terminals. Sponsor: Rep. John Matijevich. Parallels Maine's proposed bill (see below) with the addition of specific requirements for terminal design, office furniture and lighting as presented in an earlier Maine bill (HP 880, 1981). Status: tabled after March hearing and unlikely to see action this session.

Maine: House Paper 657: An Act to Provide Occupational Safeguards for Operators of Video Display Terminals. Sponsors: Reps. Edith Beaulieu and James Mayo. Would require employers to ensure safe workplace conditions, inform employees of potential hazards associated with VDTs, provide semiannual terminal maintenance, pay for annual eye exams, provide a 15-minute rest break every two hours. Status: hearing before the Joint Standing Committee on Labor expected late March or early April. An almost identical bill, HP 880, failed to win approval in 1981.

Massachusetts: House Study Bill 2267: Untitled. Sponsor: Rep. Timothy Bassett. Order for the Committee on Commerce and Labor to investigate

VDTs and draft legislation, if necessary. Status: hearing scheduled for April 20 in Boston.

Massachusetts: House Bill 2658: An Act to Provide Occupational Safeguards for Employees Resulting from the Introduction and Utilization of Video Display Terminals. Sponsor: Rep. Elizabeth Metayer. Employer intending to install over \$5,000 in hardware would be required to notify employees six months in advance, pay for annual eye exams, provide properly designed furniture, terminals, and lighting and adequate air quality, provide 15-minute breaks every one or two hours depending on visual demands of work, provide semiannual terminal maintenance and offer alternative work to employees during pregnancy without loss of pay. Limit total VDT work to five hours per day. Status: hearing scheduled for April 20 in Boston.

New York: Hearing on VDT safety issue and possible need for legislation tentatively scheduled for April 14 in New York City. Sponsor: Rep. Frank Barbaro.

New York: Hearing on consumer products and radiation, including VDTs, expected in late spring. Sponsor: Senator Tony Masiello.

Oregon: Senate Bill 568. Untitled. Sponsor: Senator Margie Hendriksen. Employers would be required to ensure adequate lighting, furniture and terminal design, pay for annual eye exams, provide semiannual terminal maintenance, inform workers of potential hazards associated with VDTs, provide 30-minute break from VDT work after two hours at terminal, provide alternative work for pregnant women on request. Status: hearing before Labor Committee expected mid- to late April.

Washington: Plans underway to place rules similar to those in the Maine bill (see above) in the state's administrative code. Status: the Department of Labor and Industries plans to form a committee this spring to draft rules.

HIGHLIGHTS

More Comments on EPA's RF/MW Guidance

The Environmental Protection Agency (EPA) has received 23 sets of comments on its plans to propose a public exposure guideline or "guidance" for radiofrequency/microwave (RF/MW) radiation. Of the fifteen responses summarized below and the eight reviewed last month (see *MWN*, March 1983), the majority call for quick action in adopting a pre-emptive federal guideline.

Federal Communications Commission (FCC) Chairman Mark Fowler summed up the concern of his agency and of the companies it regulates: both, he wrote, "are concerned about safe exposure levels and the possibility of a confusing and costly proliferation of inconsistent state and local standards." Fowler asked EPA to set standards for use by the FCC and other agencies "as expeditiously as possible." The problems posed by local regulations were also addressed by the American Radio Relay League (ARRL), Raytheon, RCA and Westinghouse Electric.

The New Jersey Department of Environmental Protection cited its own plans to adopt an RF/MW exposure standard in urging the EPA to speed up its schedule for the guidance. Comments submitted by the Commission on Radiation Protection Chairman M.M. Weiss of Bell Labs and Frank Cosolito of the NJ Bureau of Radiation Protection explained why the state's action is necessary: local decision makers, spurred by growing public apprehension, are "inhibiting the often vital expansion of the nation's communications system by declining to issue required permits, variances, etc."

Many of those commenting suggested modeling federal rules on the American National Standards Institute (ANSI) standard. Robert Misterka of the New England Power Service, for example, called the ANSI guideline "the latest most comprehensive document available" and "well recognized as the authoritative guide" for evaluating exposure to non-ionizing radiation. Also recom-

mending the ANSI standard were John Mitchell of the Air Force School of Aerospace Medicine, Raytheon's John Osepchuk, F.S. Beal of Western Electric, S. Baron of Burns and Roe and Christopher Imlay for the ARRL.

EPA received the following responses to specific questions in its advanced notice of proposed recommendation (47 *FR* 57338, December 23, 1982):

- Many of the comments recommended that the guidance cover frequencies below the 300 kHz cutoff in the ANSI standard. L.J. Chapman of Madison, WI, urged including frequencies down to 1 Hz, Ford and the Motor Vehicle Manufacturers Association recommended starting at 60 Hz and the ARRL at 1 kHz. Raytheon suggested including frequencies down to at least 100 kHz. Westinghouse preferred ANSI's 300 kHz and the air force suggested starting higher, at 3 MHz.
- All comments comparing a flat with a frequency dependent standard concluded the guidance should set different exposure limits for different frequencies.
- Responses varied over whether limits should be set for partial body exposures. The Air Force, the ARRL, the Federal Aviation Administration and Westinghouse recommended addressing only whole body exposures. Raytheon and the NJ Department of Health supported partial body exposure rules and Ford suggested that these rules be developed later. Motorola advocated a detailed approach, which is excerpted below.

EPA's Office of Radiation Programs is finishing its preliminary draft of the guidance and plans to meet April 14 with the inter-agency group established to help with guidance development. The final draft of the agency's criteria document on RF/MW bioeffects, the basis of the guideline, will be reviewed by an ad hoc committee of the Scientific Advisory Board in May (see *MWN*, March 1983). The document will be made public at that time.

For a review of EPA's notice of proposed recommendation, see *MWN*, January/February 1983. ●

Excerpts From Comments on EPA RF/MW Guidance Development

The 15 sets of comments excerpted below, along with eight sets reviewed in Microwave News last month, were submitted to EPA in late February. (See MWN, March 1983.)

Air Force School of Aerospace Medicine: Whole body average specific absorption rate (SAR) with a maximum localized SAR should be used to establish exposure limits in terms of incident power density (mW/cm²)....The ANSI standard...is intended to apply to non-occupational (general public) as well as to occupational exposures and should receive serious consideration in setting safety guidelines for public exposure to [RF] radiation.

American Radio Relay League: We emphasize the need to distinguish between biological effects from RF energy and biological hazards from RF energy. While advances in technology and science may increase our ability to detect biological effects, such advances need not directly result in changes in protection standards.

Burns and Roe: Our view is that the ANSI standard provides sufficient guidance while additional necessary research is being performed and we therefore endorse the proposed standard.

L.J. Chapman: Present standards and research programs do not adequately address the low frequency portion of the RF spectrum. Especially in the frequency range from 1 to 100 Hz, population exposures may have significance and the existent research information base is minimal.

Federal Aviation Administration: In developing your guidance document you should consider setting limits for maximum as well as average exposure. We urge you to address nonthermal effects and their health implica-

tions, an issue which is far more sensitive in the general public arena than in the occupational.

Federal Communications Commission: The FCC lacks the necessary expertise and statutory authority to promulgate its own health and safety standards and, therefore, must look to EPA and other responsible agencies for guidance in this area....We would like to make clear our support for your guidance development. We encourage the EPA to complete this process as expeditiously as possible so that a uniform federal standard will be available for use by the FCC and other affected agencies.

Ford: We see no reason to limit the range of frequencies included in the guidance. In particular, those frequencies which are known to be used by powerful radiating sources should be included. These frequencies could extend, for example, from the 60 Hz employed in domestic electric power transmission and the 10.2 to 13.6 kHz employed by Omega radionavigation systems through the commercial AM and FM broadcast spectrums to the frequencies employed by microwave radar and the satellite communications/energy systems.

Motor Vehicle Manufacturers Association: MVMA is particularly interested in whether mobile radio transmitters, not specifically identified in the ANPR, will be considered in the course of this rule making....MVMA recommends that the [frequency] ranges not be limited. In particular, we recommend that frequencies of known high field strengths in the proximity of public roads should be included.

Motorola: In the close vicinity of sources, reactive electric energy can cause high readings in E-field sensing instruments, even though limited

power flow (in the far-field sense) may be present. It is therefore recommended that the EPA weigh the H-field levels more heavily than E-field levels in the case of partial body exposure. In addition, it is recommended that the EPA allow the same peak and average SAR in human organs for whole and partial body exposure....The best known (and independently repeated) of [non-thermal] effects is the change of [calcium ion] efflux from brain tissue in certain amplitude modulated fields... This effect may concern the EPA because it points out that there might be particular windows of bio-response to certain weak electric signals. Motorola would like to point out that the frequency modulated (FM) signals usually employed by the land mobile communications industry do not cause such [a calcium ion] efflux effect.

New England Power Service: It is in the best interest of the public and the users of devices which generate electromagnetic fields that any regulations promulgated to regulate exposures to these fields provide a clear, understandable and straightforward standard of compliance which will allow both EPA and the radio users to easily insure that exposure guidelines are not exceeded....We recommend that EPA consider [adopting the ANSI standard] in its guidance.

New Jersey Department of Environmental Protection: The subject of radiofrequency hazards has become of increasing concern to this [Commission on Radiation Protection] in the face of increasing proliferation of [RF] radiation sources in the state and an accompanying and inevitable apprehension on the part of residents as to whether they are being unduly exposed to possibly hazardous radiations....In the absence of a national guide for [RF] radiation limits, and lacking the resources to independently develop state limits, this commission is in the process of adopting guideline limits patterned after [ANSI's].

New Jersey Department of Health: Even though the Eastern European studies, which were based on behavioral and clinical studies, have not been repeated in the United States, we recommend that the data from these studies be used for setting exposure limits until a peer reviewed study from the Western countries either confirms or disproves the findings of the Eastern European countries.

Raytheon: The exposure limits should exhibit frequency dependence as in ANSI C95— so that the safety factor or real risk is the same regardless of which part of the spectrum is involved. Furthermore, such limits should be

expressed as continuous functions of frequency. Mixed fields or sources can be evaluated as in ANSI C95 by adding fractions representing ratios to exposure limits for the respective frequencies. The relatively minor calculations are a minor burden to those responsible for using the guidance (professional users, not the public) and are a small price to pay for the avoidance of a distorted and unfair perspective on risk which would result if a simplistic single number approach were to be followed....Survey instruments will measure only time-averaged fields (averaging time in the order of 1 second). At present there is no limit on instantaneous fields or power densities such as exist in a pulsed radar beam. There is no evidence that existing environmental radar fields are hazardous. Certainly any limitation on peak fields should be set above those already in the environment accessible to the general public. In such existing cases the peak values may be 10,000 times the six-minute average or more.

RCA: The lack of a general population radiation limit has seriously complicated siting plans for the communications industry....In the absence of national guidance, state and local jurisdictions have felt the need for establishing radiofrequency exposure limits. Not surprisingly, these limits lack uniformity; e.g., Texas has an exposure limit of 10,000 uW/cm², New Jersey is proposing 1,000 uW/cm², and Massachusetts is proposing 200 uW/cm². The consequences of this regulatory patchwork quilt are that those who are concerned about the potential hazards are confused and fearful, and those who have responsibility for maintaining the communications resources of this country cannot allay these fears by comparing their predicted exposure levels with nationally accepted, uniform exposure limit levels.

Westinghouse Electric Corp.: The ANSI committee, as well as other scientific committees (e.g. National Council on Radiation Protection), use the threshold for adverse biological effects concept and include an order-of-magnitude safety factor when establishing limits for exposure to humans. This conceptual approach should be used by EPA in order to maintain consistency in establishing limits for exposure to the general public....The range of frequencies to be included should be from 300 kHz to 100 GHz....The standard should consider only whole body exposure rate. The only partial body exposure rate to the general public would be from sources to which they are in close proximity such as microwave ovens. Exposure rates from these and other consumer products are best controlled through product performance standards.

EMP and Nuclear Power...

Electromagnetic pulse (EMP) radiation from a high altitude nuclear blast would not stop a nuclear power plant from achieving a safe shut down, according to a report prepared for the Nuclear Regulatory Commission (NRC) by Sandia National Laboratories. A number of experts have taken issue with the study's conclusions, however.

Critics of the report contend that the study's assumptions—especially the way the EMP problem is defined—seriously undermine the value of its findings. As Dr. Conrad Longmire cautioned, "with a sufficiently long chain of plausible assumptions one could reach almost any conclusion desired." He advocated an investigation of the EMP threat on reactors "with the maximum degree of realism." Longmire, who is with Mission Research Corp. in Santa Barbara, CA, offered these comments on a draft of the report. The authors contend that the assumptions are "solid and reasonable" and that running tests with a nuclear power plant would be "extremely expensive."

In an interview, NRC's Demetrios Basdekas said that "the report presents a pre-conceived set of conclusions." Calling the study a potential "embarrassment" for the agency, Basdekas said that the primary damage from EMP is not due to the energy imparted by the radiation itself, but from the secondary and tertiary effects on the system as a whole. "These can be very significant and are left out of the report," he said. Basdekas was the first to publicly raise the issue of an EMP-nuclear power plant threat at congressional hearings in 1976.

A spokesman for the NRC said that the question of whether or

not more research is needed is still "under review and is not resolved."

Interaction of Electromagnetic Pulse with Commercial Nuclear Power Plant Systems by David Ericson, Jr., et al. (No. NUREG/CR-3069; SAND82-2738/1&2; Volume 1: Executive Summary, Volume 2: Main Report) is available from the NRC/GPO Sales Program, NRC, Washington, DC 20555 or from the National Technical Information Service, Springfield, VA 22161. The GPO price for Vol. 1 is \$4.75 and Vol. 2 is \$11.00. An appendix to the main report contains reviewers' comments. ●

...NAS To Study EMP Threat

The National Academy of Sciences (NAS) has set up a committee to evaluate models which estimate electronic stress and failure due to EMP radiation from nuclear explosions. The Committee on Electromagnetic Pulse Environment of the National Research Council held its first meeting in early February, and is scheduled to issue its report in the summer of 1984.

The committee, which is working under the council's Energy Engineering Board, will determine the reliability of methodologies now used to determine EMP effects and the efficacy of shielding and other protective strategies.

Much of the data for the committee's work is classified, but according to Dr. John Richardson, the study's director at the NAS, "the present thinking is that an unclassified report would make the widest and greatest contribution to the problem."

Members of the committee are: Dr. John Pierce, Professor Emeritus, California Institute of Technology (chairman); Profes-

sor Herman Chernoff, MIT; William Cory, Southwest Research Institute; Professor Donald Gaver, Naval Postgraduate School, Monterey, CA; Professor Walter Karplus, University of California, Los Angeles; Dr. Nancy Mann, University of California Medical School, Los Angeles; Dr. Stewart Personick, TRW Technology Research Center, El Segundo, CA; Professor Allen Peterson, Stanford University; Dr. Henry Pollack, Bell Labs., Murray Hill, NJ; and Professor Nozer Singpurwalla, George Washington University. ☐

Air Force EMC Center to Close

The Air Force's Electromagnetic Compatibility Intrasystem Analysis Program (EMC/IAP) Support Center at the Rome Air Development Center (RADC) will close at the end of September after five years of operation. The support center, which is located at Griffiss Air Force Base in the heart of New York state, develops techniques and computer codes to diagnose and correct system-level and specific EMC problems for the air force and industry.

According to the center's Kenneth Siarkiewicz, the electric field analysis group at Rome will now turn its attention to compatibility and interference issues associated with the new generation of technology based on very-high-speed integrated circuits (VHSIC). Because these chips have higher speeds, higher frequencies, greater "broadbandness" and closer spacings, they have a greater susceptibility to low-level signals than earlier integrated circuits, he said.

When the center opened in 1978, its services were free. Two years ago a nominal fee was imposed. Now, the government is leaving it up to industry to keep the ball rolling, according to Siarkiewicz. After the EMC/IAP closes, the EMC computer codes will still be available from RADC but there will no longer be any support for users. Some of the computer codes are 19,000 lines long.

There are now about 100-150 active users of the center's services, including Boeing and McDonnell Douglas. (The EMC/IAP mailing list has some 1800 names.) The F-14 and F-15 are examples of equipment tested with EMC/IAP programs.

The EMC/IAP Support Center is run by the IIT Research Institute. IITRI's Program Manager John Dobmeier expressed his disappointment over the air force's decision, but said "we understand the economic realities." Both Dobmeier and Siarkiewicz stressed that the move to close the center was the result of a change in direction and not a budget cut.

Although the navy has used the EMC/IAP center on occasion, it is writing its own computer codes at the Naval Ocean System Center in San Diego, CA. Of special interest to the navy is the problem of below deck EMC. Industry users may now turn to TRW Defense and Space System's Electromagnetic Environmental Effects Branch in Redondo Beach, CA, the developer of the SEMCAP codes, which are similar to the EMC/IAP programs. ☐

FDA Withdraws Diathermy Standard

The Food and Drug Administration (FDA) has withdrawn its proposed performance standard for microwave diathermy devices. The FDA decided to withdraw the rule because few, if any, new diathermy units operate in the microwave band and because the agency does not have the authority to set a performance standard for equipment already in use.

The standard, as proposed in July 1980, applied to new diathermy and hyperthermia equipment operating at 915 MHz and 2450 MHz. It specified that the units' applicators must deliver heat efficiently (depositing over 235 W/Kg in standardized phantoms) and not leak more than 10 mW/cm² at a distance of 5 cm.

The FDA's National Center for Devices and Radiological Health plans to issue a technical report that could serve as the basis

for a voluntary standard for the 15,000 microwave diathermy units in use. No publication date has yet been set, however.

The center will continue to monitor both microwave and shortwave diathermy equipment—the latter is becoming increasingly popular. The center's Dr. Melvyn Altman said that while the agency could not set standards for existing diathermy equipment, it does have the authority to regulate any units that present a health risk.

The proposed standard drew widespread criticism from researchers who feared that it would inhibit the development of improved cancer therapies (see *MWN*, February 1981). Altman pointed out that if the standard had been promulgated, the FDA could have excluded hyperthermia devices. In any case, such equipment is classified as Class III and requires FDA approval prior to marketing, he said.

Notice of the FDA decision appears in the March 11 *Federal Register* (48 *FR* 10373) and the original proposal is in the July 29, 1980 issue (45 *FR* 50359). ☐

FY84 Military Budget: Requests and Dissent

Congress and the Pentagon continue to wrangle over the fiscal year 1984 (FY84) Department of Defense (DoD) budget. Outlined below is a recap of some of the military's requests for radar, communications and weapons systems, with some responses from critics.

Aegis Weapon System: The first Aegis guided missile cruiser, USS Ticonderoga (CG-47), joined the fleet in January and a second, the USS Yorktown, is scheduled for christening in mid-April. Criticisms are mounting as the navy continues to request funds for the program in FY84—\$16.6 million for R&D on the Aegis system and \$3.4 billion for procurement (each cruiser costs more than \$1 billion). The General Accounting Office (GAO) has released a digest of a classified report (No. GAO/C-MASAD-83-11, February 22), which found that the Aegis system was inadequately tested before the CG-47 was commissioned and that the ship may be unstable. The GAO recommended a stop to the acquisition of SPS-49 air search radars for future cruisers. DoD responded that the SPS-49 adds to the CG-47's flexibility and that the navy does not believe the CG-47 is "overweight or unsafe." Meanwhile, presidential hopeful Senator Gary Hart (D-CO) is urging a delay in funding three cruisers while a rigorous testing program for the CG-47 and Aegis system is set up. Hart wants to know if the Aegis radar can shoot down a sea-skimming missile, like the Exocet used by the Argentinians against the HMS Sheffield in the Falklands war.

Over-the-Horizon Backscatter Radar: The air force is requesting \$99 million for R&D and \$176 million for procurement of the OTH-B radar system. In another classified report (GAO/C-MASAD-83-14, March 15), the GAO found that the air force intends to begin the production of the OTH-B radar before development is complete. Noting that "the air force and the navy plan to develop tactical warning systems for use during the 1990s that will withstand a greater threat environment than the OTH-B," the GAO recommended that the air force "fully reassess the need and justify the decision to acquire the OTH-B radar system." DoD replied that the OTH-B hardware was successfully tested and only refinements to the design are needed.

PAVE PAWS: The air force wants \$101 million for procurement and \$3.8 million for R&D for the PAVE PAWS radar system, which detects and tracks submarine launched missiles.

Project ELF: The navy has asked for \$58.5 million for full-scale development of its submarine communication system in Michigan and Wisconsin. Meanwhile Senator William Proxmire (D-WI)

issued the results of a poll showing that 60.5 percent of his constituents oppose the system.

Other DoD budget requests include: \$7.2 million for R&D on EMP radiation at the air force's radiation test facility at Kirtland AFB, NM; \$4 million for R&D on the Joint (AF and Army) STARS (Surveillance Target Attack Radar System) program—the old PAVE MOVER program; and \$7.3 million for the navy's electromagnetic spectrum management program to reduce interference among deployed systems and run electromagnetic compatibility analyses.

Last month President Reagan added new complexity to the military budget debate by proposing an ambitious plan for devel-

oping an anti-ballistic missile (ABM) system based on directed energy weapons. The program is still in the definition phase, but this type of research already has some \$500 million in the proposed FY84 budget. According to an article by Jeff Hecht in the December 16 *New Scientist*, about 90 percent of this sum is for high energy lasers, with most of the balance for particle beam systems. About one percent, or \$5 million, will be spent on research for new microwave weapons.

As part of its plan to convince the public that a military buildup is needed, DoD has released *Soviet Military Power 1983*. The report opens with an artist's rendering of the new Pushkino ABM phased array radar, which provides 360 degree coverage and is 120 feet high and 500 feet wide. ●

UPDATES

Biological Effects...A team from Bowman Gray School of Medicine (Winston-Salem, NC) and Tulane University (New Orleans, LA) has found evidence of an intensity window due to exposure to a 60 Hz electric field at 10 kV/m. In a paper published in *Life Sciences* (32, 691, 1983), the researchers report that exposure of rat adrenal tissue *in vitro* to 60 Hz radiation appears to "directly alter an important cellular activity." No statistically significant effects were found at 5, 100 or 1,000 kV/m. Noting that intensity windows have already been reported by Bawin and Adey and confirmed by Blackman, they argue: "Intensity and frequency windows might be a general characteristic for all biological reactions to electromagnetic fields and might help explain many of the inconsistencies and controversies in the literature on biological effects of ELF fields." ...Two researchers from the University of Salford in the UK have raised an interesting hypothesis about the effects of power line radiation. In a letter to *Health Physics* (December), C.W. Smith and E. Aarholt suggest that long-term exposure to 50-60 Hz fields could give rise to the production of opiates in the human body: "Thus it is possible that the continuous production of beta-endorphins by electric currents induced in the body for extended periods by environmental circumstances might give rise to unpleasant symptoms only on withdrawal from the field or the cessation of the current." ...Dr. Asher Sheppard of Redlands, CA, has submitted his report on *Biological Effects of High Voltage AC Transmission Lines* to the Montana Department of Natural Resources and Conservation's Energy Division in Helena. Sheppard's study specifically addresses the Bonneville Power Administration's 500 kV line, which will be built in Montana as part of the Colstrip Power Project....Two review papers have recently been published: EPA's Drs. Claude Weil and James Kinn's "Advances in Experimental Exposure Methods and Dosimetric Techniques Used in Radiofrequency Radiation Biological Effects Studies" is in the February issue of the *Proceedings of the IEEE*; and University of Illinois Professors Alan Segal and Richard Magin's "Microwaves and the Blood-Brain Barrier" appears in Volume 1, Number 3 of the *Journal of Bioelectricity*. With respect to the BBB, Segal and Magin conclude that "many questions remain unanswered, and more questions are emerging with each new study" and that "there is a definite need to carry out [studies on] long-term chronic exposure to low-level microwaves." ...*Microwaves and Thermoregulation*, the proceedings of a symposium held at Yale University in October 1981 (see *MWN*, November 1981) will be published this month by Academic Press. The volume was edited by Dr. Eleanor Adair of the John Pierce Foundation Laboratory at Yale.

Communications...New Jersey Assemblyman Dean Gallo and Assemblywoman Leanna Brown have proposed that the governor's Science Advisory Committee investigate RF/MW bioeffects and that the state impose a 90-day moratorium on new broadcast towers until the study is completed. Their resolution was referred to the assembly's Energy and Natural Resources Committee on March 14....The FCC's Office of Science and Technology has issued *Advanced Technology UHF Receiver Study, Part I, Receiver Performance Measurements*. A limited number of copies are available from the Office of Public Affairs, (202) 254-7674....The FCC has okayed teletext, the one-way transmission of information to home TVs. With a special decoder, viewers will be able to tune into news, games, guides, announcements and more....Comments on the

FCC's rules to allow land mobile and fixed services to share some UHF television channels are reviewed in the March 21 *Broadcasting*.... A 300-page report on US long-range goals in international telecommunications and information (No. PB83-175893) has been released by NTIA.

Compatibility & Interference...Among recent contract awards are: ● ESL, Inc., a subsidiary of TRW in Sunnyvale, CA, will investigate the potential for RF interference on the tracking and data relay satellite system (TDRSS) under a \$230,000 contract from NASA. According to ESL, the most likely sources of RFI are foreign, mostly military, radar systems operating in the S-band (2-2.3 GHz) and the Ku-band (13.4-15.3 GHz). ESL will evaluate the accuracy and limitations of an already developed RFI synthetic model. ● In a study for ONR, Professor J. Reese Roth of the University of Tennessee in Knoxville will do experimental and theoretical research on RF emissions from plasmas, particularly at low frequencies, that are capable of interfering with submarine communications. Roth will place special emphasis on the "newly discovered RF emission at the geometric mean plasma frequency." ● The Naval Air Development Center in Warminster, PA, has negotiated an award to Dayton Brown of Bohemia, NY, for the development of techniques to reduce electromagnetic vulnerability and interference in the LAMPS MK III avionic and armament systems. LAMPS stands for Light Airborne Multipurpose System and is designed to enhance the capability of surface ships in anti-submarine and anti-ship warfare by allowing ships and helicopters to work together electronically. ● The Southeastern Center for Electrical Engineering Education in St. Cloud, FL, has won a \$1 million contract from the Naval Surface Weapons Center, Dahlgren, VA, for a host of studies on electromagnetic environmental effects on aircraft and ships. Among the tasks are the development of ways to improve EMI-EMC programs and an assessment of the shipboard test equipment being developed under the navy's CREAM (combat readiness electromagnetic analysis and measurement) program. ● And, the FAA is inviting bids for the measurement of RF emissions from ISM (industrial, scientific and medical) equipment and ILS (instrument landing systems) to ADF (automatic direction finding) receivers. If the FAA fails to receive qualified bids, it will try and extend its contract with Ohio State University, which is now doing similar work for the agency (see *MWN*, January/February 1983)....The National Association of Broadcasters (NAB) is opposing any decrease in the FCC's minimum required mileage separation among FM stations. One of the NAB's concerns is "unnecessary interference" when the separation is at a minimum.

Government...The turmoil at EPA has taken its toll on the agency's senior management: most have resigned under pressure. Their positions remain unfilled as William Ruckelshaus, Reagan's nominee for EPA administrator, awaits Senate confirmation. What all this will mean for the agency's FY84 budget is still unclear. Meanwhile, two congressional subcommittees are looking into the proposed closing of the RF/MW radiation program at the agency's Health Effects Research Laboratory in North Carolina (see *MWN*, January/February 1983). At a March 2 hearing before the subcommittee on HUD-independent agencies of the House Committee on Appropriations, Congressman Bill Green (R-NY) asked EPA managers some pointed questions about the RF/MW cuts: "Why do you believe the job for R&D is over with the completion of [EPA's RF/MW guidance]?"

Aren't there areas of radiation which require additional monies?" Acting Assistant Administrator for R&D Courtney Riordan replied in part: "As a result of [past research] programs...we have yet to come up with what we call a potential significant risk and adverse health effects from exposure to non-ionizing radiation....we feel this is not a terribly productive area of research..." Green followed up with: "[Haven't] such things as central nervous system involvement and response to low-level exposures, so-called calcium efflux in neural tissue and behavioral effects as well as immune responses, been demonstrated? Wouldn't these have important health implications?" Later Green asked the EPA team: "Can you give us assurances that work in this area will in fact be picked up and funded by NIEHS or other agencies?" No assurances were offered, though Assistant Administrator for Air, Noise and Radiation Kathleen Bennett said, "We have discovered that DOE and other budgets contain research in this area we can tap into." The subcommittee plans to invite outside experts to discuss the EPA budget at hearings scheduled for late April. The RF/MW research budget cuts were also addressed by Congressman James Scheuer's (D-NY) subcommittee on natural resources, agriculture research & environment of the House Committee on Science and Technology at hearings on March 17. Afterwards, the subcommittee submitted a number of questions to Riordan on RF/MW R&D. The answers were due at the end of March. Overall, congressional staff say there is a good chance that at least some of the RF/MW research funds will be restored. As Green's legislative director John Cuttall explained, the subcommittee is aware of and interested in this issue and there is a general feeling that too much has already been cut from EPA's R&D program. The first real indication of the status of the RF/MW program will come when the appropriations subcommittee marks up the EPA budget bill later this spring. (For a review of the impact of ex-EPA Administrator Anne (Gorsuch) Burford on EPA's R&D program, see Eliot Marshall's article in the March 25 *Science*.)...One of the many irregularities to surface during the congressional investigations at EPA was a "hit list" of scientific consultants. Made up by the incoming Reagan Administration, the list indicates who should stay on EPA's advisory committees and who should go. One member of the RF/MW community is on list: Professor Sol Michaelson of the University of Rochester. Written next to his name is: "reported to be liberal and environmentalist." In an interview with *Microwave News*, Michaelson said he "deplored" the whole idea of the list....President Reagan has nominated David Markey to replace Bernard Wunder as the administrator of NTIA. Markey, a former lobbyist for the National Association of Broadcasters, is serving as a special advisor to Deputy Administrator Susan Stuebing until he is confirmed.

Measurement...The first portable isotropic magnetic field meter developed by NBS has been delivered to NIOSH. Although the new MFM-10 meter was designed to measure worker exposures in industrial settings (especially at RF sealer plants), it can measure and display each of the three orthogonal H-field components—ideal for monitoring the fields associated with broadcast antennas. The battery-operated meter operates over a frequency range of 300 kHz to 100 MHz, with an uncertainty of less than ± 1 dB, for magnetic fields of 0.01 to 16 A/m. According to NBS's Joe Cruz, Holaday Industries of Eden Prairie, MN, has expressed an interest in manufacturing the meter. A paper by Cruz and L.D. Driver describing the MFM-10 was presented at the 1982 EMC conference in Santa Clara, CA, and appears in the conference proceedings. Those wishing to get a copy should contact Fred McGehan, Division 360.2, NBS, Boulder, CO 80303, (303) 497-3246....NBS' R.G. FitzGerrell has developed an easy and cheap way of measuring the antenna factor of electrically small antennas. The method is accurate to within ± 2 dB in the 250 kHz-1 GHz frequency range. For more information contact FitzGerrell at NBS, Division 723.04....Narda Microwave Corp. of Hauppauge, NY, is now offering calibration services down to 300 kHz for its broadband isotropic meters. The company is extending the range from 10 MHz in response to the needs presented by the new ANSI RF/MW exposure standard (ANSI C95.1-1982). Priority service is available. For price information contact Narda's Bill Reich, (516) 231-1700....Donald Griffin of the University of Adelaide in South Australia will report on "A Microwave Antenna Method of Measuring the Effect of Metal-Framed Spectacles on Microwaves Near the Eyes" at the *International IEEE/AP-S Symposium and National Radio Science Meeting* on May 24 in Houston, TX.

Medical Applications...What cures asthma, hemorrhoids, stomach cramps, arthritis, whiplash and insomnia? It's *Pocketdoc*. Or so claims its

manufacturer, the Igon Corp. of Minden, NV. An Igon leaflet entitled "Relief from Pain Without Drugs" suggests that *Pocketdoc* "induces healing by the use of low frequency low power electric field." An FDA investigation did indicate that *Pocketdoc*, which is the size of a cigarette pack, is a very low power ELF generator. But FDA said there is no evidence in the scientific literature that weak ELF fields are a panacea for all these ills. The agency charged Igon with false and misleading labeling and asked the US District Court in Nevada for permission to stop the distribution of the device (Complaint No. CV-R-83-002-BRT, filed January 6, 1983). The judge agreed and on January 20 issued an order for the government to seize all the *Pocketdocs* FDA could find....Reinhard Knoechel of Phillips Research Lab in Hamburg, West Germany, describes his studies with multi-applicator arrays for hyperthermia treatment in the January issue of *IEEE Transactions on Microwave Theory and Techniques*.

Satellite Communications...KOMO Radio in Seattle, WA, has agreed to provide satellite communications facilities for RCA Americom. The company is seeking a conditional use permit to add three satcom dishes to its facilities on Vashon Island. A public hearing on the request is scheduled for April 26 at the King County Courthouse in Seattle. Americom's proposal to build its own station in Kitsap County was rejected by the Kitsap County Board of Commissioners for the second time early this year....The New York City Planning Commission has approved plans for Teleport, the huge communications complex proposed for Staten Island. An *Electromagnetic Energy Study* prepared by the NYC engineering consulting firm of Ammann & Whitney and the project's final environmental impact statement have been released. The February 1983 Ammann & Whitney report, which includes radiation calculations and frequency coordination data, concludes, "There will be no health effects from radiofrequency energy levels to the public both within and without the Teleport complex. Estimated energy intensities are well below current accepted tolerances and anticipated future standards."

Standards...The new American Conference of Governmental and Industrial Hygienists (ACGIH) exposure standard for RF/MW radiation has cleared a major hurdle on the road to final approval. The ACGIH's Physical Agents TLV Committee voted to accept proposed revisions at a meeting in San Antonio, TX, March 23-24. The new standard is similar to, though less stringent than, ANSI's and will cover frequencies down to 10 kHz (see *MWN*, September 1981 and July/August 1982). For example, the ACGIH will stay with a 10 mW/cm² limit above 1 GHz. The committee approved the changes by a vote of 13-1; the one dissenting ballot was cast by Dr. Zory Glaser of the FDA's National Center for Devices and Radiological Health. In a February 3 letter to the committee, Glaser and some of his associates at the center explain that they have objections to the standard's "exposure limits, their frequency dependence, and the lack of an appropriate rationale for these parameters." They note that the 10 mW/cm² value "leaves no thermal safety factor at high environmental temperatures and humidities" and state "the belief that thermal effects are the only factors to be accounted for in evaluating health hazards is untenable in the present state of knowledge." In a telephone interview, Herbert Jones, the chairman of the physical agents committee, said that he was happy an agreement was reached. He said that the standard and its accompanying documentation will undergo some minor revisions for "editorial clarification" and be submitted for final approval to the ACGIH Board of Directors and membership at the *American Industrial Hygiene Conference* in Philadelphia, PA, in May....The National Radiological Protection Board (NRPB) in the United Kingdom has proposed a new standard for ELF and RF/MW radiation. The RF/MW exposure limits for adults are nearly identical to those of ACGIH, while those for the general population including children are like those of ANSI. For power line frequencies (50 Hz), the board "accepts that exposures to power frequency fields of less than 10 kV/m are safe, although the field may be perceptible at lower values, and that exposures to fields of up to 30 kV/m are unlikely to be harmful." Comments on *Proposals for the Health Protection of Workers and Members of the Public Against the Dangers of Extra Low Frequency, Radiofrequency and Microwave Radiations: A Consultative Document* are welcome through July 1. For more information contact: The Secretary, NRPB, Chilton, Didcot, Oxon, OX11 0RQ, UK....The Standards Association of Australia's Committee TE/7 on Hazards of Non-Ionizing Radiation is also proposing a revision to its RF/MW standard. According to an August 1982 draft, occupational exposure limits will be

SHORT COURSES

identical to those of ANSI, while those for the general population will be a factor of 10 lower. Thus at 30-300 MHz, the limits will be 1 mW/cm² for workers and 100 uW/cm² for others. For more information contact the association at 80 Arthur Street, North Sydney, NSW, 2060, Australia....ANSI's Committee C63 on Radio-Electrical Coordination is set to meet on April 6 in Washington, DC. On April 6 and 7, C63's subcommittee 1 will review its work on open area test sites, immunity test procedures and a general EMC standard....Canada has proposed amendments to its RFI regulations. Notice No. DGTR-021-82, published in the December 11 *Canada Gazette* prescribes limits for radio noise produced by AC high voltage power systems. For more information contact: Director General, Telecommunication Regulatory Service, 300 Slater Street, Ottawa, Ontario K1A 0C8.

VDTs...The possible effect of VDT use on pregnancies will be examined as part of an extensive two-year study underway in Montreal, Canada. The project, sponsored by the Occupational Health and Safety Research Institute, began last fall and will include information on approximately 50,000 pregnancies. The city's 11 major hospitals and the doctors affiliated with them are helping with the study....FDA's National Center for Devices and Radiological Health has concluded that "the reported clusters of problem pregnancies among VDT users would be expected from chance alone, and it is highly unlikely that they have been caused by low radiation emissions from the machines." This assurance was published in the center's February 22 *Radiological Health Bulletin* in response to inquiries it has received. The center "has found no evidence that the levels of radiation from VDTs are responsible" for clusters, such as the one reported at Surrey Memorial Hospital in Vancouver, BC....A survey of 1,160 Ontario Hydro clerical workers found a significant link between VDT use and complaints of eye irritation, blurred vision and neck and shoulder aches. According to the study's head, Dr. Roland Mallette, confounding factors were carefully weeded out. The Canadian utility plans to do more detailed VDT health studies, particularly on the effects of VDT use on vision. Hydro currently has 1,700 VDTs and plans to have 6,000 by 1990....A number of meetings on VDTs are scheduled for this spring. *The Pandora Connection: Dangers and Hazards of Video Display Terminals*, will be held April 16 in Madison, WI. It is sponsored by the Health Writers, 1127 University Avenue, Madison, WI 53715, and the Madison Federation of Labor. On April 30, the Labor Council of Metropolitan Toronto and the Humber College for Labor Studies are holding a conference on *VDTs and Stress*. For information, call (416) 675-3111, ext. 414. *Vision et Ecran Cathodique* will be addressed by the Quebec Association of Optometrists at their conference in Quebec City on May 6. Contact the association at 465 rue St. Jean, Montreal, Quebec H2Y 2R6, (514) 849-8051. M. Lundquist, a consultant from Milwaukee, WI, will teach a course on "Health Hazards of VDTs" at the *American Industrial Hygiene Conference* on May 22 in Philadelphia, PA. Lundquist does not believe radiation emissions are a problem and will focus on ergonomic issues. In the fall, those willing to do serious traveling can attend the *International Scientific Conference on Ergonomics and Health Aspects of Modern Office Jobs*, November 7-9 in Turin, Italy. The senior American advisor for the gathering sponsored by the International Ergonomics Association is H.L. Davis of the Human Factors Group, Eastman Kodak, in Rochester, NY....If you are in the market for an alternative to the common CRT, IBM has introduced a gas panel display screen for use with its 370, 30XX and 4300 series computers. The 3290 screen has a wire grid with 730,000 intersections surrounded by neon-argon gas; electrical charges in the grid make the gas glow. The panel can be yours for \$7,100. Another new screen based on tungsten-oxygen technology is being developed by Professor Paul Holloway at the University of Florida in Gainesville. The screen does not require constant refreshing and requires relatively little power, according to a brief report in the March 14 *Computerworld*....Is VDT screen glare driving you crazy? Anti-Glare Material Inc. claims you can spray it away. The Fort Myers, FL, company says its product will relieve up to 95 percent of the problem and last for three years. ●

MICROWAVE NEWS is published monthly, except in January and July • ISSN 0275-6595 • PO Box 1799, Grand Central Station • New York, NY 10163 • (212) 794-9633 • Editor: Louis Slesin, Ph.D., Associate Editor: Martha Zybko • Subscription: \$200 per year (overseas \$235) • Copyright © 1983 by Louis Slesin • Reproduction in any form is forbidden without written permission.

- April 26-28: *Seminars on How to Cope with the FCC and VDE Regulations on Radio Frequency Interference*, Washington, DC. Three one-day seminars on (1) *Regulatory Requirements and Grounding Methods*, (2) *Shielding and Packaging Concepts*, and (3) *Cost Saving Design Techniques for Achieving Compliance*. Fee \$250 for any one day; \$475 for two days, and \$675 for three days. Contact: EMXX Corp., 6706 Deland Drive, Springfield, VA 22152, (703) 451-4619. Repeated • May 3-5, in Dallas, TX; and • May 24-26 in San Diego, CA.
- April 26-29: *Radar System Simulation*, Eglin AFB, FL. Fee: \$550. Contact: Marie Saunders, Mark Resources, Inc., 2665 30th St., Santa Monica, CA 90405, (800) 874-8104.
- May 2-4: *Radiowave Propagation in Satellite Communications Systems*, Washington, DC. Fee: \$685. Contact: Continuing Engineering Education Program, George Washington University (GWU), Washington, DC 20052, (800) 424-9773.
- May 2-4: *Spread Spectrum and Anti-Jam Communication*, Los Angeles, CA. Fee: \$750. Contact: Continuing Education Institute, 10889 Wilshire Blvd., Los Angeles, CA 90024, (213) 824-9545.
- May 2&4: *EMI Test and Evaluation*, San Jose, CA. Fee: NA. Contact: Don White Consultants, Inc., Star Route 625, PO Box D, Gainesville, VA 22065, (703) 347-0030. This course will be given at the *Test & Measurement World Expo*. A number of other courses and workshops are also scheduled. Contact: Meg Bowen, (617) 254-1445.
- May 2-6: *HF Spectrum: New Concepts and Technologies*, Washington, DC. Fee: \$855. Contact: GWU, see May 2 above.
- May 2-6: *EMI Design and Testing*, Chicago, IL. Three one-day sessions on *Requirements & Testing per FCC Docket 20780*, *Designing to Meet FCC Docket 20780* and *Printed Circuit Board and Wiring Design for EMI Control*. And one two-day session on *Grounding, Bonding and Shielding*. Fee: \$260 for one-day sessions and \$495 for two-day session. Contact: R&B Enterprises, 1050 Colwell Lane, Conshohocken, PA 19428, (215) 828-6236. Repeated • May 9-13 'n Boston, MA.
- May 9-11: *Trends in Military Satellite Communication Systems*, Vienna, VA. Fee: \$650. Contact: Satellite Systems & Technology Inc., 3134 Juniper Lane, Falls Church, VA 22044, (703) 532-6274. Repeated • May 23-25 in Torrance, CA.
- May 16-20: *Spread Spectrum Communications Systems*, Washington, DC. Fee: \$855. Contact: GWU, see May 2 above.
- May 16-20: *Basic Radiological Health Course*, San Antonio, TX. Fee: \$450. Contact: University of Texas (UT) Health Science Center, Medical School Continuing Education Services, 7703 Floyd Curl Drive, San Antonio, TX 78284, (512) 691-6295.
- May 22: *Recognition, Evaluation and Control of RF/IMW Radiation Hazards*, Philadelphia, PA. Fee: NA. The three-hour course will be held at the *American Industrial Hygiene Conference*. Contact: AIHA, 475 Wolf Ledges Parkway, Akron, OH 44311, (216) 762-7294.
- May 23-24: *Grounding, Bonding and Shielding*, Washington, DC. Fee: \$625. Contact: GWU, see May 2 above.
- May 23-27: *Radar Systems and Technology*, Washington, DC. Fee: \$855. Contact: GWU, see May 2 above.
- May 26-27: *Satellite Fundamentals*, Washington, DC. Fee: \$445. Contact: Walter Morgan, Communications Center of Clarksburg, 2723 Green Valley Road, Clarksburg, MD 20871, (301) 428-9000. Repeated • June 6-7 in Los Angeles, CA, and • August 19-20 in St. Louis, MO.
- June 2-3: *FCC Regulation of Computing Devices: EMI Design, Testing and Compliance with Part 15 Subpart J Rules*, Washington, DC. Fee: \$315. Contact: GWU, see May 2 above.
- June 6-8: *Electromagnetic Pulse and Its Effects on Systems*, Washington, DC. Fee: \$685. Contact: GWU, see May 2 above.
- June 13-17: *The Modern Geometrical Theory of Diffraction*, Columbus, OH. Fee: \$750. Contact: Ohio State University, Engineering Short Courses, 2070 Neil Avenue, Columbus, OH 43210, (614) 422-6153.
- June 14-15: *Radar Principles for the Non-Specialist*, Washington, DC. Fee: \$625. Contact: GWU, see May 2 above.
- June 27-29: *Microwave Technology and Applications for Industry*, Central NJ. Fee: \$695. Contact: Center for Professional Advancement, PO Box 964, East Brunswick, NJ 08816, (201) 249-1400.
- July 10-15: *Design Against RF Emission*, University of Sussex, UK. Fee: NA. Contact: Institution of Electrical Engineers (IIE), Savoy Place, London WC2R 0BL, United Kingdom, 01-240-1871, ext. 272 or 282.
- August 8-12: *Non-Ionizing Radiations: Biophysical and Biological Basis, Applications and Hazards in Medicine and Industry*, Cambridge, MA. Fee: \$850. Contact: Director of Summer Sessions, Room E19-356, MIT, Cambridge, MA 02139.