limited support to suggestions of excess deaths from leukemia," they concluded.

Loomis and Savitz, both at the University of North Carolina School of Public Health in Chapel Hill, found that "brain cancer was concentrated among men aged 65 or older, whereas leukemia was associated with electrical work only among younger decedents and those with acute lymphocytic leukemia."

The results have been slightly revised since Loomis and Savitz first reported the findings in 1989 (see *MWN*, N/D89). The paper appeared in the *British Journal of Industrial Medicine, 47*, pp.633-638, 1990.

Wertheimer and Leeper on Breast Cancer

In an August 13 memo, Dr. Nancy Wertheimer and Ed Leeper called attention to data from their original adult-EMF cancer study indicating an EMF-female breast cancer link. Wertheimer and Leeper addressed their memo to researchers who are studying the association between EMF exposure and breast cancer (see *MWN*, N/D89 and J/A90).

They pointed out that their 1982 paper showed a statistically significant increased risk of breast cancer among women who lived near high-current power lines (see *MWN*, J/F83) and, in their 1987 follow-up paper, they showed that the strongest association was seen among women diagnosed before they reached the age of 55 (see *MWN*, N/D87).

See Wertheimer and Leeper's papers: *International Journal of Epidemiology, 11*, pp.345-355, 1982, and *Annals of the New York Academy of Sciences, 502*, pp.43-53, 1987.

Around the U.S.: Litigation & Regulation

EMF Wrongful Death Suit Dropped

On September 11 the mother of a teenage leukemia victim dismissed her wrongful death suit against the Clark County, WA, Public Utilities District (PUD). The suit, filed in June 1990, alleged that exposure to electromagnetic fields (EMFs) at home and at school was to blame for the 1987 death of Ariana Hightower, who had been a student at the Crestline Elementary School (see *MWN*, J/A90).

Between 1982 and 1989, there were seven reported cases of cancer among Crestline students (see p.9). An investigation by the Southwest Washington Health District recently concluded that magnetic field levels at Crestline were similar to those at other schools and were probably not to blame for the apparent cluster.

Clark PUD General Counsel Wayne Nelson said that the dismissal "was voluntary...and presumably reflects their findings that electric and magnetic fields at Crestline School were not significant and were not the cause of the girl's leukemia."

NJ Scraps 200 mG Limit, Opts for ALARA

The New Jersey Commission on Radiation Protection has dropped its proposal to set a 200 mG magnetic field limit at the edge of power line right-of-ways (ROWs), according to Dr. Fred Sterzer, the chairman of the commission's Non-Ionizing Radiation Advisory Committee (see *MWN*, J/A90). Instead, Sterzer told *Microwave News*, utilities will be required to demonstrate to the state Department of Environmental Protection (DEP) that field levels from any new transmission line will be "as low as reasonably achievable" (ALARA).

The commission's new proposal will also prohibit the siting of playgrounds under power lines, and will require warnings to be posted at playgrounds that are already located under power lines.

The proposal requires all utilities planning to build new lines to get permits from the DEP, which will consider design, siting and economics when applying the ALARA standard. Sterzer gave the following example: If the line is planned near a playground, the field levels will have to be "very, very low," but if it goes through an unpopulated area, there will be more leeway.

The proposed 200 mG limit had been criticized as too weak by some citizens, who pointed to studies that link adverse health effects with levels as low as 2 mG. The new proposal will probably be addressed at the commission's next meeting on October 18.

NY Sets Interim 200 mG Standard

The New York Public Service Commission (PSC) has formally adopted an interim magnetic field limit of 200 mG at the edge of power line ROWs. The interim standard, which was proposed in March, is based on the concept of prudent avoidance (see *MWN*, M/A90). Originally, the PSC had supported the recommendations of a staff task force which advocated a 100 mG limit (see *MWN*, M/A88). The new 200 mG limit applies at 75 feet from new 345 kV lines, 60 feet from new 230 kV lines and 50 feet from lines operating at lower voltages.

EMF-Prudent Avoidance Meeting

A workshop on *Exploring the EMF Dilemma: Prudent Avoidance & Public Involvement* will be held January 17-18, 1991 at the Dunfey San Mateo Hotel in San Mateo, CA. NewsData Corp., the publisher of *Clearing Up* and *California Energy Markets*, two weekly regional utility and energy industry newsletters, is sponsoring the meeting. For more information, contact: NewsData Corp., ATTN: Conference Coordinator, Box C900928, Queen Anne Station, Seattle, WA 98109, (206) 285-4848.

HIGHLIGHTS

The Talk of Prague

"We are participants in one of the great revolutions in the history of biology," Dr. Ross Adey† of the VA Hospital in Loma Linda, CA, told an overflow crowd at the symposium on the *Interaction of Electromagnetic Fields [EMFs] with Biological Systems*, organized as part of the triennial URSI meeting.* A week of meetings in Prague, Czechoslovakia, during the last week of August indicate that the revolution is thriving in Europe—perhaps more so than in the U.S.

After reviewing the literature linking EMFs to cancer, Poland's Dr. Stanislaw Szmigielski concluded, "My personal opinion is that the cancer risk is significant—but it will take two-to-three years to resolve." Szmigielski is at the Center for Radiobiology and Radiation Safety in Warsaw.

In an interview with *Microwave News*, Szmigielski said that the data collection has been completed for his prospective epidemiological study of Polish servicemen exposed to radiofrequency and microwave (RF/MW) radiation and that the analysis is now under way (see *MWN*, J/F87 and J/A89). Because of the potential military implications of the study, Szmigielski indicated that he is not yet sure how the findings will be announced. "We will need permission to publish the results," he said. "But if it is denied, we will present them at conferences."

In other news, Szmigielski is planning new experiments on the immunological and carcinogenic effects of RF/MW radiation using a new exposure system, designed and built by Dr. Piotr Debicki of the Department of Electronics and Microwave Techniques at the University Technical School in Gdansk, Poland. The system will allow thermal and subthermal exposures at 2450 MHz with sinusoidal modulation.

On the regulatory front, Szmigielski anticipates a major re-evaluation of Polish safety standards for exposures from 50 Hz to 300 GHz. He predicted that, if the effort is funded, work will begin in 1991 directed by Dr. Henrik-Richard Korniewicz, a physicist at the Central Institute of Labor Protection in Warsaw.

Finland's Dr. Jukka Juutilainen, of Kuopio University's Department of Environmental Sciences, reported that, as residential magnetic fields rise above 1.3 mG, women are more likely to suffer early pregnancy loss, as measured by changes in human chorionic gonadotropin (HCG) in their urine—the technique is very sensitive and can indicate clinically unrecognized miscarriages. Women exposed to more than 6.3 mG at home had a rate of early pregnancy loss five times greater than that of those living in homes with low magnetic fields. The trend of increasing risk with higher exposures was statistically significant.

More than half the women who participated in the study lived in apartment buildings and very few used electric heat, Juutilainen said in an interview. He said that it was not at all clear what the sources of the magnetic fields were but he speculated that household wiring may be partially responsible.

Juutilainen cautioned that his study was limited by the small number of cases, but added that, "Together with the experimental findings suggesting effects of extremely low frequency (ELF) magnetic fields on embryonic development, the new results encourage continued investigation of the relationship between ELF magnetic fields and pregnancy." (Juutilainen has also recently published an epidemiological study linking on-the-job exposures to cancer; see p.3.)

Germany's Dr. Ute Boikat, a scientific advisor at the Hamburg Department of Labor, Health and Social Affairs, reported that there is growing concern at the local and national levels over power line EMFs. As a result, last year, Hamburg authorities advised that power lines not be built near homes and that there be a 15-meter right-of-way (ROW) on each side of 110 kV lines.

Also in 1989, the Federal Office of Radiation Protection in Salzgitter recommended an even larger ROW—60 meters on each side of 110 and 380 kV lines. Boikat stressed that this was not a regulation per se, but rather an exercise in "prudent avoidance." She noted that the 60-meter ROW is controversial and that utilities are challenging its scientific basis. "My opinion is that the power companies are concerned over liability for future damages," she said.

Boikat also said that there is continuing German interest in studying the possible pregnancy risks associated with working with video display terminals (VDTs), but that research has been frustrated by the inability to secure funding.

In a poster presentation, Drs. Yuri Dumansky and Mikhail Shandala of the Republican Scientific Hygienic Center in Kiev, U.S.S.R., reported that the recommended exposure levels for 50 Hz electric fields are 0.5 kV/m inside homes and 1.0 kV/m in residential areas—and no one should be allowed in areas where the levels exceed 20 kV/m.

The closing session of the symposium promised details of RF/MW radiation occupational and public health standards in the U.S.S.R. and in China. Unfortunately, Drs. Boris Savin of the Institute of Industrial Hygiene and Occupational Diseases in Moscow, Li Ji-xi of Xidian University in Xi'an and Zongqun Zhao and coworkers of Beijing Medical University were unable to attend and the session was canceled.

France's Dr. Bernard Veyret, of the University of Bordeaux, reported that interest in the European Bioelectromagnetics Association continues to grow and that its first scientific meeting will be held in Brussels, Belgium, in December 1991 (see *MWN*, M/J89 and N/D89).

†Adey's invited paper appears in J. Bach Andersen, ed., *Modern Radio Science 1990*, New York, NY: Oxford University Press, which was distributed at the conference and will be marketed by Oxford in January 1991. As at past conferences, a review of recent research was released in Prague. See G. Hyde, ed., *Review of Radio Science 1987-1989*, Brussels, Belgium: International Union of Radio Science (URSI), 1990. The volume includes a well-referenced chapter on "Biological Effects of Electromagnetic Fields," edited by Dr. Maria Stuchly. It is available for $20.00 (including surface postage) from: URSI, 3 Avenue Circulaire, B-1180 Brussels, Belgium.

**XXIII General Assembly of the International Union of Radio Science* (URSI), Prague, Czechoslovakia, August 28-September 5, 1990.

Sweden Proposes Voluntary ELF Emission Limits for VDTs

On October 4, the Swedish National Board for Measurement and Testing (Statens Mät och Provstyrelse, or MPR) recommended the first guidelines to limit emissions of extremely low frequency (ELF) electromagnetic fields (EMFs) from video display terminals (VDTs). The board called for an ELF magnetic field limit of 2.5 mG at 50 cm from a VDT. The MPR also proposed an ELF electric field limit, as well as revised guidelines for very low frequency (VLF) electric and magnetic fields.

"There is not a complete consensus in Sweden on the limits," Lars-Erik Paulsson, of the Swedish National Institute of Radiation Protection (NIRP), told *Microwave News* in a telephone interview. Paulsson is the chairman of the working group that drafted the measurement and emission guidelines. He said that Swedish unions want a lower ELF limit—to be defined by the minimum level that can be measured by the new protocol.

In announcing the new guidelines, the MPR stressed that the emission limits are voluntary as the board does not have the authority to regulate occupational health risks. Similarly, the testing of VDT emissions is not mandatory. The MPR noted that the recommended limits are based on what is technically feasible to measure and on what is achievable "today or within the near future." MPR's Merih Malmqvist told *Microwave News* that the guidelines are not based on health risks because "there are no proven biological reasons" for limiting VDT EMFs, according to Swedish experts.

The MPR is issuing two different documents: a description of the test methods and a "handbook" to help people interpret the test results. The emission guidelines are in the handbook and apply to all types of displays, not only those with cathode ray tubes.

The draft documents were released on October 8, with comments due by October 31. The final guidelines will be published on December 1. The revised test methods will go into effect on January 1, 1991. Paulsson said that he does not expect many changes in the final version because the key problem, the disagreement over the magnetic field limits, "cannot be resolved."

For both ELF and VLF magnetic fields, the guidelines specify that measurements be taken in three planes: one around the middle of the terminal, one 25 cm above the center and one 25 cm below it. In all, 48 readings are now required (the previous protocol called for 82). Thus, to comply with the guidelines, the proposed magnetic field limits would have to be met around, above and below a VDT.

The limit for VLF magnetic fields is now 0.25 mG (25 nT) average root mean square (rms), rather than the previous limit of 0.5 mG (50 nT) peak. "The two limits are essentially the same," Paulsson explained, since the magnetic field emissions limits are specified by average rms rather than peak levels.

The guidelines recommend an ELF electric field limit of 25 V/m at 50 cm from the front of a terminal and a limit for VLF electric fields of 2.5 V/m at 50 cm from all sides of a VDT.

EPA To Study Maglev EMFs

The Environmental Protection Agency (EPA) will investigate the electromagnetic fields (EMFs) associated with magnetic levitation (maglev) trains for the Federal Railroad Administration.

Under an interagency agreement signed in August, EPA's Office of Radiation Programs will measure the electric and magnetic fields from the German Transrapid system, as well as other maglev technologies.

EPA is also charged with interpreting the measured EMFs in relation to potential adverse health effects and comparing them to U.S., German, Japanese and Swedish exposure standards and to standards set by national and international regulatory groups.

The test protocols now call for measuring the magnetic field (B) rather than the time rate-of-change of the magnetic field (dB/dt). The protocols for electrostatic fields remain the same.

The former Swedish guidelines and testing protocols for VDT EMFs only covered VLF fields from 1 kHz to 400 kHz (see *MWN*, S/O88 and M/J89). Now, two frequency ranges are specified: 5 Hz–2 kHz in the ELF band and 2 kHz-400 kHz in the VLF band.

Meanwhile, in the U.S., the Institute of Electrical and Electronic Engineers' (IEEE) P-1140 Working Group has established an ad hoc committee to develop a standard testing methodology for VDT ELF and VLF EMFs. In 1987, P-1140 was charged with developing testing standards solely for VDT VLF EMFs. In 1989, its authority was extended to all types of electronic equipment (see *MWN*, J/A87, M/A88 and M/J89).

At an August 21 meeting, the group concluded that the strong interest in VDT test methods and the existence of Swedish guidelines justified developing VDT test methods separately, not only for VLF EMFs, but for ELF EMFs as well. The working group does not, however, anticipate recommending emissions limits.

The ad hoc committee, which held its first meeting in Cupertino, CA, on September 20 under the chairmanship of Stan Roberts of Apple Computer, is drafting a standard, which will be discussed at its next meeting on November 8.

Ron Petersen, a cochairman of P-1140, told *Microwave News* that he thinks that the IEEE testing protocols will closely resemble Sweden's. Roberts said that, while the committee is considering adapting the Swedish protocols, it is looking at other testing methods as well.

Copies of the Swedish test methods and the handbook will be available in English on December 1. The test methods will cost approximately 800 Swedish Krona ($145.00) outside Sweden; the price of the handbook has not yet been set but will be approximately 400 Krona ($72.50). Order from: Merih Malmqvist, National Board for Measurement and Testing, Box 878, S-501 15 Borås, Sweden, (033) 16 55 53, Fax: (033) 10 13 92.

SPECIAL REPORT

Cancer Clusters and EMFs: A True Link or an Epidemiologist's Nightmare?

Paul Brodeur's account of cancer and other illnesses among people living near a Guilford, CT, substation in the July 9 *New Yorker* has sparked widespread interest in the question of disease clusters and electromagnetic fields (EMFs).

The issue of EMFs and clusters is not, in fact, new. It continues to be one of topical concern,* not only for power line EMFs, but for radiofrequency and microwave (RF/MW) radiation. Indeed, the study of clusters, which is more often associated with chemicals and nuclear radiation, is a hot topic of debate. An editorial in the September 22 *Lancet* focuses on the split in the scientific community over the desirability of studying clusters: For some, such study is a "keystone of medical progress," providing insight into new diseases; for others, it's an "epidemiologist's nightmare"—the search for an elusive, possibly nonexistent, cause under mounting pressure from an outraged community.

The following is a compilation of reported occupational and residential cancer clusters that have been linked—correctly or incorrectly—to various sources of EMFs. Both cluster reports and epidemiological surveys are included.

*Recent articles and journals covering the cluster debate include: "Guidelines for Investigating Clusters of Health Events," *Morbidity and Mortality Weekly Report*, July 27, 1990; Raymond Neutra, "Reviews and Commentary: Counterpoint from a Cluster Buster," *American Journal of Epidemiology, 132*, pp.1-8, July 1990; Chris Raymond, "Nagging Doubt, Public Opinion Offer Obstacles to Ending 'Cluster' Studies," *Journal of the American Medical Association, 261*, pp.2297-2298, April 28, 1989; Richard Rothenberg, Karen Steinberg and Stephen Thacker, "The Public Health Importance of Clusters: A Note from the Centers for Disease Control," proceedings from a *National Conference on Clustering of Health Events, American Journal of Epidemiology, Supplement, 132*, pp.S3-S5, July 1990.

ELF EMFs

Jacksonville, FL: Ovarian Tumors

Between 1974 and 1978, five girls living near a 69 kV power line in Jacksonville, FL, developed endodermal sinus tumors—an extremely rare type of ovarian cancer (see *MWN*, J/F85). The girls ranged in age from 1.5 to 18 years old. A team led by Dr. Tim Aldrich, now at the North Carolina Department of Health Services, wrote that these malignancies were "so rare that virtually no information has been compiled concerning their etiology" and that this cluster was "too remarkable to go unreported." They proposed that magnetic fields from the power line may have had "a mutagenic or a promoter effect," complementing initiation by lead or polycyclic hydrocarbons from a nearby lead smelter plant and highway. Genetics (all of the girls were black) or some combination of genetic and environmental factors may also have been contributors, suggested the team. See T.E. Aldrich, A. Glorieux and S. Castro, "Florida Cluster of Five Children with Endodermal Sinus Tumors," *Oncology, 41*, pp.233-238, 1984.

Milltown, NJ: Brain Tumors

For the past 42 years, Irene Pardun has lived in a house in Milltown, NJ, along the right-of-way of a 230 kV and a 138 kV power line. Pardun said that when she moved in, there was also a substation within 100 feet of her back door—the substation was dismantled in 1976. In 1981, Pardun was diagnosed with a nonmalignant brain tumor, which was surgically removed. Since that time, she has noticed the high incidence of cancers and tumors in her neighborhood. Pardun gave the following information to *Microwave News:* Two doors down from her home, a 14-year-old girl died of a brain tumor in 1961, and in 1989, the girl's mother was diagnosed with a brain tumor. An eight-year-old girl who had previously lived there died of cancer in 1960. Two houses down the street in the other direction, a man died of a cancer in the mid-1980s; his daughter, who currently lives next door, was recently diagnosed with cancer. In a four-family house directly across the street, a three-year-old boy died of cancer in 1957, and a woman died of a brain tumor in 1989. In addition to her brain tumor, Pardun has suffered from recurring cysts, some requiring surgery. Her daughter was diagnosed with myasthenia gravis—a progressive muscular disease—when she was 12. Magnetic field levels in Pardun's backyard on a weekend morning this March were 12-15 mG; inside the house, they were above 10 mG.

Monroe County, NY: Brain Tumors

An investigation of a cluster of childhood brain tumors by the Monroe County (NY) Health Department concluded "...beyond a reasonable doubt that a common source for these cases of childhood brain cancer does not exist." Dr. Mark Merkens, the former deputy director of the department, told *Microwave News*, "I found nothing that tied my patients together in any way." In 1986, a local pediatric oncologist reported seeing four children ages five through nine with brain tumors within an 18-month period. Among these were three girls who attended the same school. Eight cases of childhood brain tumors and three of adult brain tumors were eventually identified in the area. Rochester Gas & Electric measured EMFs in six of the children's homes and found that, in most instances, the levels were under 2 mG except near appliances. None of the homes was located near high-voltage power lines or substations, according to a parent of one of the children. See Mark J. Merkens, *Investigation of Childhood Brain Cancer Cluster Irondequoit and Webster—Census Tracts 110 and 113*, Final Report, Monroe County Health Department, Rochester, NY, May 11, 1989.

Montecito, CA: Leukemia at a School

Between 1981 and 1989, six children in Montecito, CA, were diagnosed with leukemia or lymphoma—five times the expected rate. Of these, four attended the Montecito Union Elementary School, which is located next to a 66 kV overhead power line, three lower-voltage underground lines and a substation. State health officials investigating the cluster stated in a February 1990 report that they "found nothing that would increase cancer risk in the area." A recent survey showed average field levels of 5-30 mG along the north side of the school and approximately 1 mG in most classrooms (the exception was the computer room, with an average of 4-10 mG) and a hotspot of 920 mG next to a pad-mounted transformer in the parking lot; levels of 12 mG and 17 mG were measured at 36 inches and 6 inches, respectively, from the ground above the buried lines (see *MWN*, M/A90). In March, the school board voted unanimously to limit the students' exposures to less than 2 mG by relocating playgrounds and marking off areas with EMF hotspots. There was also an unexplained childhood leukemia cluster in Montecito in the 1950s. See *Investigation of the Montecito Leukemia and Lymphoma Cluster*, Final Report, California Department of Health Services, February 1990; *Montecito Union School Magnetic Field Survey*, Draft Report, California De-

partment of Health Services, May 1990; and Melinda Burns, "Pathologist Suggests Montecito Had Cancer Cluster in 1950s," *Santa Barbara News-Press*, June 14, 1990.

Guilford, CT: Cancer on Meadow Street

A number of residents of Meadow Street in Guilford, CT, have been afflicted with tumors (four brain tumors among them), birth defects, cysts or severe headaches, according to Paul Brodeur in the July 9 *New Yorker*. Meadow Street, which has only ten houses, is the site of a high-voltage substation and power lines. At an August 20 public meeting, state Department of Health Services (DHS) officials briefly displayed a residential map of all Guilford residents who developed brain tumors between 1968 and 1988, which, they said, showed no clustering around the substation. When the map was made public, however, it did indicate an apparent clustering of cancers along the route of a power line running north from the substation (see p.2). DHS epidemiologist Dr. Sandy Geschwind told *Microwave News* that the number of cases is too small to show a true cancer excess. In 1989, George Corrigan of Northeast Utilities took measurements at 48 Meadow Street, the house directly across the street from the substation, and found background levels of 1 mG inside the house and 5 mG beside the substation. Measurements of the whole street were taken in July 1990 revealing field levels of 3-36 mG in front of the houses (the high reading was found next to a riser on a pole) and 7-16 mG in front of the substation, Corrigan told *Microwave News*. See Paul Brodeur, "Annals of Radiation: Calamity on Meadow Street," *The New Yorker*, pp.38-72, July 9, 1990, and Jonathan Brinkman, "Map Raises Doubts of Power Line Safety," *New Haven Register* (CT), pp.15,21, October 3, 1990.

Darrington, WA: Neighbor's Cluster Concern

In a Darrington, WA, neighborhood there have been at least 12 cases of cancer in 19 homes located near two 230 kV power lines, according to Betsy Diedrick, a local resident—in the four houses closest to the lines there were cases of leukemia, lymphomas and brain tumors. An investigation by Dr. Samuel Milham Jr. of the Washington state Department of Health did not reveal any systematic increase of cancer incidence in the area. "It doesn't look like there's anything suspicious," he told *Microwave News*, noting that there were various types of cancer, with no one type predominating. However, Diedrick's survey did generate enough concern among other residents to compel the Snohomish Public Utilities District to relocate a planned substation to an unpopulated area. See Bill Dietrich, "Of Current Concern," *Pacific* (magazine in the Sunday *Seattle Times and Post-Intelligencer*), April 8, 1990; the cover story features Diedrick's map of the cluster.

Vancouver, WA: Crestline School

Between 1982 and 1989, there were seven cases of cancer reported among students who attended the Crestline Elementary School in Vancouver, WA, according to Dr. Karen Steingart of the Southwest Washington Health District. Adjacent to the school's property are a 12.5 kV distribution line and a 115 kV transmission line. Steingart's investigation failed to uncover a cause for the cluster. She told *Microwave News* that measurements taken by the Clark County Public Utilities District (PUD) showed that Crestline does not have significantly elevated EMF levels compared with other schools in the area. She also noted that there were four different types of cancer among the seven children, and four of the seven had lived in the area for less than one year prior to diagnosis. Last June, the mother of a former Crestline student who died of leukemia in 1987 filed a "wrongful death" suit against the PUD, claiming that exposure to EMFs from power lines at home and at school and from a substation near her home caused her daughter's cancer. The suit has since been dropped (see p.5).

RF/MW Radiation

Griffiss AFB, NY: Childhood Leukemia

In a letter to the editor in the November 23, 1963 issue of *The Lancet*, Dr. Samuel Milham Jr. documented a cluster of acute leukemia deaths between 1948 and 1960 among children in Rome, NY. Milham, who is now with the Washington state Department of Health, was unable to identify a common factor, although he "was convinced there was a huge excess," he recently told *Microwave News*. Milham first began to consider a possible connection with RF/MW exposures after reading two studies by Drs. John Lester and Dennis Moore in the *Journal of Bioelectricity (1*, pp.59-76 and pp.77-82, 1982), which showed higher rates of cancer among, respectively, people living on hills in the path of radar signals and people living in counties with an air force base. "I said 'Aha!' when I read them," Milham continued—he recalled seeing a big strategic air command base with "huge radars...looming over" the town: "I could see the radars around the town when I was visiting people." Milham said, however, that, at this point, a link between the cluster and the radars is "pure conjecture."

Rutherford, NJ: Childhood Cancer

In early 1978, a cluster of leukemia and Hodgkin's disease was identified among children living in Rutherford, NJ—many of whom attended the Pierrepont School. Of the potential causes considered, two were RF radiation emitters: the ITT RF/MW test facility in nearby Nutley and Clifton, and the many commercial radio broadcast antennas in the area. The then National Bureau of Standards (NBS) measured the RF levels at the school in May 1979 and the Environmental Protection Agency (EPA) measured them again in July and August 1980. The cause of the cluster was never discovered. See letter of NBS's C.K.S. Miller to New Jersey Department of Environmental Protection, July 17, 1979; EPA's David Hawkins's letter to Congressman Andrew Maguire, February 6, 1980; and Jill Jonnes and Michael Hoyt, "One Stone Left Unturned in Rutherford Cancer Inquiry," *New Jersey Monthly*, pp.38-39, March 1979.

Beaver Falls, NY: RF Sealers

In 1980, the National Institute for Occupational Safety and Health (NIOSH) investigated an alleged cluster of six cases of cancer—including breast and ovarian cancers and lymphoma—among 20 female RF heat sealer operators at the Beaverite Products plant in Beaver Falls, NY (see *MWN*, N81). NIOSH's Terry Leet, the principal investigator, terminated the project, stating that, "There is no convincing evidence in the scientific literature to indicate that RF radiation causes cancer in humans and animals." A NIOSH RF survey of the plant found electric and magnetic field levels as high as 896 V/m and 1.41 A/m, respectively (see also *MWN*, J/F82). Indeed, members of the survey team reported experiencing "heating sensation in the forearms and legs," indicating that "exposed personnel are absorbing significant amounts of RF energy."

Ragerville, OH: AT&T Workers

In 1981, NIOSH could not identify a link between a cluster of five cases of cancer among seven AT&T long lines workers and one cleaning woman employed at a site in Ragerville, OH, and exposure

to MW radiation (see *MWN*, F81). The NIOSH team measured maximum levels of 0.1 mW/cm^2 at the site, but there was some uncertainty as to the actual exposures to RF/MW radiation. James Cole of the Communications Workers of America Local No.4354, who called for the investigation, maintained that the cause of the cluster was associated with the site: "I suspect there could still be a hazard, but we aren't sophisticated enough to measure it or find it."

Portland, OR: Cancer Excess

In the early 1980s, Drs. William Morton and David Phillips of the Oregon Health Sciences University in Portland reported a significant association between certain types of cancer (including leukemia and breast cancer) and RF/MW radiation. They observed the strongest link with the VHF bands—54-88 MHz and 176-216 MHz. See Morton and Phillips, *Radioemission Density and Cancer Epidemiology in the Portland Metropolitan Area*, a report to EPA, June 1983. For another Portland area cluster report, see Michael Daley et al., "Community Fear of Non-Ionizing Radiation: A Field Investigation," *IEEE Transactions on Biomedical Engineering*, 32, pp.246-248, March 1985. (See also *MWN*, J/F82 and My82.)

Lualualei, HI: Cancer and Navy Towers

Between 1979 and 1985, children living within five miles of the U.S. Navy communications complex in Lualualei on Oahu, HI, developed leukemia at four times the expected rate (see *MWN*, M/J87). The Navy measured the RF/MW levels inside the Radio Transmitter Facility (RTF) and at its border. On the basis of those measurements, the Navy concluded that, "There is *no* reason to believe" that people living outside the RTF boundary are suffering any adverse biological effects from electromagnetic radiation (Navy's emphasis). In 1982, when the measurements were taken, the RTF had one VLF antenna, one LF antenna and several HF antennas. There were also a number of MW towers. Concern over the cluster continues to this day: the issue was raised at a state hearing in June 1990.

Honolulu, HI: Excess near Broadcast Towers

In 1987, the Hawaii Department of Health reported that people living near radio and TV broadcast antennas in Honolulu had "significantly higher" cancer rates than those living in other parts of the city (see *MWN*, M/J87). In the past, towers were sited in downtown residential areas to preserve the scenic beauty of the surrounding hills, but in 1986, the Honolulu City Council adopted a zoning regulation barring new broadcast towers in residential and business districts (see *MWN*, N/D86). A 1984 radiation survey of Honolulu by EPA and the Federal Communications Commission found the highest levels of RF radiation ever measured in an urban area (see *MWN*, J/F85).

Giants Stadium, NJ: Football Players

Between 1980 and 1986, four New York Giants football players were diagnosed with cancer. The Giants play in the New Jersey Meadowlands Sports Complex in East Rutherford, where RF radiation residential exposures from 15 AM radio broadcast antennas within eight miles of the complex are among the highest in the country (see *MWN*, N/D88). An epidemiological study of stadium workers (non-players) failed to support a link to RF, though a formal report has yet to be released. See memorandum from Dr. Philip Landrigan, *Meadowlands Sports Complex Cancer Investigation: Executive Summary*, Mount Sinai School of Medicine, New York, NY, July 1989, and Eve Markowitz, "Music Not Only Thing in the Air," *The Record* (NJ), May 6, 1990.

Thurso, Scotland: Leukemia near Dounreay

A cluster of leukemia among children living on hills in the small town of Thurso on the northern coast of Scotland eludes explanation. In a 1988 report, the U.K. Committee on Medical Aspects of Radiation in the Environment (COMARE) was unable to link the cluster to radioactive emissions from the Dounreay nuclear complex, less than ten miles from Thurso. Halfway between Thurso and Dounreay is a U.S. Navy communications complex at Forss—similar to the one in Lualualei, HI (at left). Despite calls for an investigation of the possible link between the cluster and the Forss station, COMARE has not pursued this lead. A new analysis is expected soon. See COMARE, *Investigation of the Possible Increased Incidence of Leukaemia in Young People near the Dounreay Nuclear Establishment, Caithness, Scotland, 1988*, and Louis Slesin, "Thurso & McFarland: A Second Look at Two Childhood Cancer Clusters," *SCRAM* (Edinburgh, Scotland), pp.13-16, February/March 1989.

McFarland, CA: Childhood Cancer

In McFarland, CA, 13 children have developed cancer since 1975, but state health officials have been unable to determine why. Investigations into pesticides as the potential cause of the cluster have not identified anything to distinguish this agricultural community from other towns in the area (see *MWN*, J/F88). Indeed, a report released on May 10, 1990 by the state Department of Health Services concluded that the childhood cancer rates in Kern county—in which McFarland is located—and in three neighboring counties "are not statistically different than rates seen elsewhere in California or in other parts of the United States." What may set McFarland apart is a high-power Voice of America (VOA) shortwave transmitter—located in nearby Delano—with nearly two million watts in total output, which broadcasts at 9 and 11 MHz. A number of experts and McFarland residents believe that the VOA station may play a role in the etiology of the cluster; the possibility of a synergy between toxic chemicals and RF radiation is also being considered. In 1989, EPA measured RF levels in McFarland and found nothing unusual (see *MWN*, M/A89 and J/F90).

Mount Sutro, CA: Childhood Cancer

Between 1973 and 1985, children under the age of 15 in San Francisco's Noe and Eureka valleys developed cancer at twice the expected rate (*MWN*, M/A89). The search for a cause has centered on Mount Sutro tower, a radio and TV tower, and on radioactive and toxic chemical emissions from a nearby hospital. There are five VHF and four UHF TV stations and four FM radio stations transmitting from Mount Sutro tower. In December 1988, engineers from Hammett & Edison, a San Francisco consulting firm, found levels in the range of 3-10 $\mu W/cm^2$ near the base of the tower and 0.5 $\mu W/cm^2$ with a maximum of 2.6 $\mu W/cm^2$ in Noe and Eureka valleys. A recent survey by Dr. Steve Selvin at the University of California, Berkeley, indicated an unusual number of cancer cases in the area around the tower. "This is just a hint of a possible clustering, and not a very good hint," Selvin cautioned in an October 1990 interview with *Microwave News*. The state Department of Health Services will look into the cluster.

Upper Cape Cod, MA: High Cancer Rates

Elevated rates of cancer—particularly lung cancer and leukemia—have been documented among residents of five upper Cape Cod towns, according to an exploratory survey by the Massachusetts Department of Public Health (see *MWN*, M/J88). Researchers at the Boston University (BU) School of Public Health are nearing the end

of a $500,000, two-year investigation of a potential link between the high cancer incidence and such environmental factors as high- and low-frequency radiation from the nearby PAVE PAWS radar and from power lines. BU's Dr. Ann Aschengrau, one of the lead investigators, told *Microwave News* that they expect to issue their report this December.

University of Rochester, NY: NHL

There have been at least 12 cases of non-Hodgkin's lymphomas (NHLs) among employees and students who worked or still work at the University of Rochester's River Campus. Five of the cases are among people who worked at Lattimore Hall. No cause for the cluster has been identified, although some have pointed to the campus's 1,000-watt FM radio antenna located 100 feet from Lattimore Hall (see *MWN*, J/A90). Dr. James Melius of the New York Department of Health told *Microwave News* that, "It's a striking cluster," and that RF radiation is a "legitimate concern." A June 9, 1990 RF survey of Lattimore Hall and nearby buildings found no detectable levels, but the meter used in the survey—Holaday Industries' HI-3002—was not sensitive enough to detect levels in the microwatt range. For more on the cluster, see Mary Ellin Arch, "Mystery of Lattimore Hall," *Times-Union* (Rochester, NY), May 21, 1990, and "Still Puzzling over Cancer 'Cluster,' " April 10, 1990.

EMP-Leukemia Lawsuit Settled *(continued from p.1)*

along with codefendant Lovelace Biomedical and Environmental Research Institute in Albuquerque, NM, used Strom and the other Boeing EMP workers as research subjects without their knowledge or consent. The case against a third codefendant, EG&G, was dismissed.

Unlike many previous EMF settlements, the Boeing agreement is a matter of public record. Part of the settlement with Lovelace remains confidential, however.

Boeing does not admit any liability. "Neither the suit nor the settlement has anything to do with Mr. Strom's leukemia," Russ Young, a Boeing spokesman, told *Microwave News*. "We haven't seen any conclusive scientific evidence that EMP poses a health hazard, but we continue to treat it with great care." However, he added that, "We readily acknowledge that there are still questions about EMP health risks."

Indeed, the leukemia causation issue would not have been directly addressed had the case gone to trial because of the 1988 denial of Strom's workers' compensation claim that EMP radiation caused his leukemia. Although the claim was being appealed, the superior court judge ruled that the parties had to abide by the workers' compensation decision and could not introduce the issue. (Strom ultimately dropped the claim as part of the settlement.)

Medical Program

The Boeing medical program will provide up to ten years of free medical examinations for the 700 EMP workers. Participation will be voluntary, although Young said that all EMP workers exposed to 5 kV/m or more are currently required to undergo medical screening. In addition, Boeing and Lovelace will contribute over $200,000 to a medical fund to be used by an independent medical administrator to evaluate the examinations and assist workers with any EMP-related concerns.

All Boeing EMP workers, except for Strom, can still seek compensation for any illness or injury due to on-the-job EMP exposures.

Strom, a Boeing employee for the past 29 years, worked with EMP from 1983 through 1985, testing its effects on the electrical and electronic components of the MX "Peacekeeper" missile. He worked inside a shielded room containing the EMP power supply and pulsers which, he said, were fired hundreds of times a day. In 1985, at the age of 45, Strom was diagnosed with chronic myelogenous leukemia. He continues to work for Boeing in its commercial avionics division.

"I feel vindicated," Strom told *Microwave News*, but added that he feels "somewhat bittersweet" about the settlement: "It would have been good to go to court and argue the health issues." If the suit had gone to trial, some of the country's leading EMF experts would have testified (see *MWN*, J/A90). Strom acknowledged that the trial might have taken years.

With at least $100,000 of the settlement money, Strom and his wife Barbara plan to establish the Robert Carl Strom Foundation to "ensure that the public continues to learn about the terrible hazards of electromagnetic radiation." The foundation will provide information to the general public through schools, unions and other organizations, sponsor symposia on EMFs and support legislation and EMF-related litigation. An inaugural reception honoring the Stroms will be held in Seattle on November 8. It will be open to the public.

The settlement paves the way for a host of future EMF-health effects lawsuits, according to Withey. "We have amassed significant medical and scientific evidence that EMFs, from power lines near our schools and in our neighborhoods and from

Terms of the Settlement

Listed below are the major points of both the Strom and the class action settlements.

- Boeing pays Robert Strom $500,000 in cash and in an annuity for his family.
- Boeing sponsors a comprehensive medical program for the class of approximately 700 Boeing EMP workers that includes:
  1) Ten years of medical examinations—participation by workers is voluntary;
  2) A $200,000 fund from Boeing and Lovelace to cover expenses associated with the medical exams;
  3) The appointment of a medical administrator, approved by both parties, to oversee the program.
- Strom releases Boeing from all claims, including his workers' compensation claim.
- All of the other class members retain their right to seek compensation for injuries and illnesses related to occupational EMP exposures.

electrical and electronic products like electric blankets and VDTs, do cause biological effects, including leukemia, lymphomas and brain tumors." Withey predicted that, "There is going to be massive litigation." Bryant agreed, adding that, "This case is only the beginning of our efforts to protect the public from these dangers."

The Lovelace Connection

During the discovery phase of the case, the Stroms' legal team turned up a number of documents that revealed that both Boeing and Lovelace had long been aware of the potential health hazards of EMP exposures. For instance, in 1979, Dr. William Morgan, Boeing's chief of radiation health protection, circulated a memo stating that there were indications that EMP radiation disturbs "the whole chemical balance within the body" (see *MWN*, S/O88).

Lovelace researchers working on an EMP bioeffects survey were informed by Boeing in the early 1970s of three cases of leukemia and lymphomas—and instances of other blood abnormalities—among approximately 200 Boeing EMP technicians working at a Montana test site between 1968 and 1972. Yet in its February 1977 report, *Review of Occupational Safety and Health Aspects of EMP Exposure*, Lovelace concluded that "...no adverse health effects of [EMP] exposure have been determined from either the repeated physical examinations performed or the personal observations of the nearly 600 individuals covered in this review." In 1988, Dr. Samuel Milham Jr. of the Washington state Department of Health called for a national study of EMP workers after reviewing the same data (see *MWN*, N/D88).

Strom charged in court documents filed in 1990 that Lovelace's "manipulation, suppression and cover-up of the cancer incidence and potential adverse health effects of EMP exposure..." led to Boeing's relaxation of its in-house EMP exposure standard. The standard was first set at 0.4 kV/m in 1970, but rose to 1 kV/m and then to 5 kV/m over the next seven years. In 1977, the year of the Lovelace report's release, Boeing raised the standard to 50 kV/m (see *MWN*, J/A87).

Over the past two years, the case has captured the attention of the national media. On March 5, 1989, CBS-TV's *60 Minutes* broadcast a segment with Mike Wallace on the Stroms' claims (see *MWN*, N/D88 and M/J89). An update aired on September 2, 1990. Although Wallace did not make the leap from EMP to other EMF-related health risks, some have. For example, an editorial in the August 19, 1990 *Seattle Post-Intelligencer* declared that: "In addition to improving the lot of workers in Boeing plants, this case has helped focus public attention on a potential health hazard that as yet is little understood by scientists and the medical profession—the effect of exposure to electromagnetic fields on the human body. Disturbing—if as yet not definitive—findings in numerous studies suggest that much more is to be learned about [EMFs] before anyone can say with certainty that they do not harm humans."

For information on the Strom Foundation and the inaugural reception, contact: Michael Withey, Schroeter, Goldmark & Bender, 810 Third Ave., Suite 500, Seattle, WA 98104, (206) 622-8000.

Federal Agencies on EMFs *(continued from p.1)*

as 2,000 animals and cost as much as $6-10 million, according to Dr. Gary Boorman of the National Institute of Environmental Health Sciences (NIEHS).

The NTP initiative is the largest government effort to date to investigate EMF health effects. As one observer put it, "The new attitude at NIEHS is entirely appropriate. They have woken up and smelled the coffee." The NTP coordinates research for the Department of Health and Human Services (of which NIEHS is a part), the Food and Drug Administration (FDA) and the National Institute for Occupational Safety and Health (NIOSH).

The draft protocol for the cancer study calls for exposing mice and rats of both sexes to magnetic fields of 20 mG, 200 mG, 2 G or 10 G over a period of two years. Boorman is also considering exposing one group of animals to fields that are switched on and off to gauge the impact of intermittent exposures.

The first draft of the protocol had called for exposures at 2 mG, but, at a September 19 public meeting in Research Triangle Park, NC, a number of experts argued that 2 mG was too close to background levels. The discussion also convinced the NTP to double the number of animals per dose group from 50 to 100. The final protocol is still under review, because, as Boorman pointed out in a telephone interview, "No one really knows what is best." The NTP anticipates issuing a request for proposals by the end of January 1991, and the studies are expected to begin by next fall.

Boorman said that the NTP studies are being coordinated with the two ongoing major animal studies—one at the University of California at Los Angeles, sponsored by the Electric Power Research Institute (EPRI), and one at the University of Quebec, sponsored by Health and Welfare Canada, Hydro Quebec and Ontario Hydro (see *MWN*, J/A89 and M/J90). Health and Welfare Canada also has a smaller, in-house animal study under way.

NIEHS is also planning to fund studies on mechanisms of EMF interactions. Dr. Chris Schonwalder of NIEHS's Division

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of Extramural Research and Training told *Microwave News* that he plans to issue a "program announcement" by the end of this winter. But, he added, "We are ready to entertain applications now." Schonwalder said that NIEHS could fund three or four grants, each in the $120,000-150,000 range.

For more information, contact: Dr. Gary Boorman, Chief, Chemical Carcinogenicity Branch, NIEHS, PO Box 12233, Research Triangle Park, NC 27709, (919) 541-3440; Dr. Chris Schonwalder, Chief, Scientific Programs Branch at NIEHS, (919) 541-7634.

EPA's Cancer Assessment and Research Agenda

The second review draft of the Environmental Protection Agency's (EPA) *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields* is now scheduled to be released in early November (see *MWN*, M/J90). EPA's Science Advisory Board (SAB) is assembling an expert panel to review the document—a meeting is tentatively scheduled for mid-January 1991. Dr. Genevieve Matanoski of Johns Hopkins University's school of public health in Baltimore, MD, will chair the SAB panel.

On June 28, EPA gathered a panel of experts from outside the agency to review the cancer report. To date, the agency has refused to release the panel's written comments, submitted after the meeting. Dr. Robert McGaughy of EPA's Office of Health and Environmental Assessment (OHEA), the project manager for the report, told *Microwave News* that the comments will be released with the second review draft. This external review draft, which will be available to the public, will incorporate the advice of the peer review panel.

EPA is planning to release a *National Research Agenda for Human Exposures to EMFs* as a companion report to the cancer assessment. It will address exposure assessments, biological effects and control technologies for EMFs in the 0-500 kHz frequency band.

EPA's Dr. Joe Elder, who is in charge of writing the agenda, told *Microwave News* that it will not be limited to cancer but will also cover reproductive, developmental, immunological and nervous system effects. Elder stressed that the agenda will address research needs for all government agencies, not just EPA, as well as for private sector organizations, such as EPRI.

For more information, contact: Dr. Robert McGaughy, OHEA (RD-689), EPA, 401 M St., SW, Washington, DC 20460, (202) 382-5898; Kathleen Conway, Science Advisory Board (A-101F), EPA, 401 M St., SW, Washington, DC 20460, (202) 382-2552; Dr. Joe Elder, Office of Health Research (MD-51), EPA, Research Triangle Park, NC 27711, (919) 541-2542.

FDA and Electric Blankets

On the morning of November 14, staffers from the FDA's Center for Devices and Radiological Health (CDRH) will host a seminar on ELF health risks with a special emphasis on electric blankets.

The FDA's interest in electric blankets—a marked change from last year, when the agency dismissed such concerns (see *MWN*, M/J89)—was prompted by 18 members of Congress. In a June 26 letter, first addressed to the U.S. Consumer Product Safety Commission and later to the FDA, they urged immediate action to require a warning label on all electric blankets to discourage their use by children and pregnant women and a public service advertising campaign to publicize the possible hazards. The FDA has the legal authority to regulate "electronic products" such as video display terminals (VDTs) and electric blankets. The members of the House of Representatives wrote that the federal government "has a moral obligation" to warn the public.

Among those signing the letter were Rep. George Miller (D-CA) and Rep. Peter Kostmayer (D-PA), each of whom has held congressional hearings on power line EMFs (see *MWN*, N/D87 and M/A90, respectively).

The seminar will be followed by a meeting of the CDRH's Technical Electronic Product Radiation Safety Standards Committee (TEPRSSC). The safety of electric blankets is on TEPRSSC's agenda for the afternoon of November 15, according to the committee's executive secretary, Arlene Underdonk. A number of ionizing and ultraviolet radiation issues will also be discussed.

For more information, contact: Arlene Underdonk, Office of Standards and Regulations (HFZ-83), CDRH, 5600 Fishers Lane, Rockville, MD 20857, (301) 443-3426.

NIOSH Workshop for a National Research Strategy

NIOSH will hold a scientific workshop in Cincinnati, OH, on January 30-31, 1991 "to develop a national research strategy on the health effects of electromagnetic radiation on workers." At the meeting, the available data will be reviewed, gaps in knowledge will be identified and a research agenda will be discussed. The workshop, which will cover EMFs below 1 kHz, will be open to the public, but attendance will be limited to 250.

Philip Bierbaum, the director of NIOSH's Division of Physical Science and Engineering, who is organizing the workshop, told *Microwave News* that NIOSH Director Dr. Donald Millar had called for the meeting. "Dr. Millar wants to understand what NIOSH should be doing in this area," he said. There are indications that Millar was prompted to study EMFs after a number of congressional inquiries were directed at NIOSH.

For more information, contact: Philip Bierbaum (R-2), Electromagnetic Radiation Workshop, NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226, (513) 841-4321.

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UPDATES

BIOLOGICAL EFFECTS

Now in Print... Two key papers, already much discussed in policy debates, have now been published in *Bioelectromagnetics, Vol.11*, No.2, 1990: (1) The results of the Henhouse Project on the effects of weak PMFs on developing chick embryos—they were first presented in June 1988 (see *MWN*, M/A88), and (2) The findings of Dr. Kurt Salzinger and coworkers on the altered behavior of adult rats exposed perinatally to ELF fields—this study was part of the New York State Power Lines Project; in its report, the project's scientific advisory panel called Salzinger's results "dramatic" (see *MWN*, J/A87)....The results of a 1988 study by Dr. W.Q. Sturner and colleagues which found babies who died of sudden infant death syndrome (SIDS) to have depressed melatonin levels (see *MWN*, S/O88) were published in *Forensic Science International, 45, pp. 171-180*, 1990. Sturner, the chief medical examiner for Rhode Island, along with Dr. Richard Wurtman and other researchers from the Massachusetts Institute of Technology in Cambridge, found that mean melatonin concentrations in cerebrospinal fluid were significantly lower in SIDS infants than in infants who had died of other causes. Though possible reasons for the depressed melatonin levels were not discussed, the paper comes at a time when more and more research is pointing to a connection between exposure to EMFs and altered pineal-melatonin rhythms (see *MWN*, M/J88 and J/A90). Sturner declined to comment on a possible link between SIDS and EMFs, noting that, "We don't work in that area."

EMP

Army Says No to Health Effects Study... The U.S. Army does not plan to study the health of personnel who worked at its EMP test facility in Woodbridge, VA, according to the August 31 *Potomac News*, a Prince William County, VA, newspaper. This comes despite preliminary findings by Dr. Samuel Milham Jr. of the Washington state Department of Health that Boeing employees who worked with EMP suffered leukemia and lymphomas at ten times the expected rate (see p.1 and *MWN*, N/D88). The Army has also declined to look into potential effects on residents in the surrounding area—denying requests from state and county officials—claiming that the responsibility lies with the state health department. However, one state health official said that he does not have the necessary staff for such a study. In April, the *Potomac News* featured a five-part investigative series on the Army's record on EMP safety at the Woodbridge facility (see *MWN*, M/J90). The Army shut down the Woodbridge EMP simulators in 1988—as part of a legal settlement—after 17 years of operation (see *MWN*, M/J88).

LITIGATION

Some Legal Advice..."Injuries from NIER are classic examples of the results of a love affair carried on in ignorance of the risks," writes Bruce DeBoskey in the August 1990 issue of *Trial*, the magazine of the Association of Trial Lawyers of America; he goes on to suggest that, "Creative plaintiffs' lawyers can help remedy this alarming situation by representing the victims of the electronic age." DeBoskey, of Silver & DeBoskey in Denver, CO, recently won an undisclosed sum in settling a case of RF radiation exposure. DeBoskey's two clients claimed that living next to an FM radio tower had caused one to develop non-Hodgkin's lymphoma and had exposed the other to an increased risk of cancer (see *MWN*, S/O89 and M/J90). DeBoskey believes that industry faces "serious punitive damage problems" from its long-standing knowledge of the potential hazards of NIER. Moreover, for those industries that have been "funding research designed to show the absence of harm to workers or....[that] have taken affirmative steps to prevent the institution and enforcement of exposure limits....potential liability is even greater."...An article in the *Columbia Journal of Environmental Law, 15*, No.2, pp.359-388, 1990, warns that the EMF health effects issue is here to stay. "As water and air pollution were to the 1970s, and hazardous waste and toxic chemicals to the 1980s, electromagnetic fields will be an environmental issue of the 1990s," writes law student John Weiss.

MEDICAL APPLICATIONS

MRI Safety... Drs. Emanuel Kanal and Frank Shellock, two physicians who have long been concerned with the possible risks associated with magnetic resonance imaging (MRI), together with Dr. Lalith Talagala have published a detailed review, "Safety Considerations in MR Imaging," in the September 1990 issue of *Radiology* (*176*, pp.593-606). Kanal and Talagala are at the Pittsburgh (PA) NMR Institute; Shellock is at the Cedars-Sinai Medical Center in Los Angeles, CA. Their paper includes 155 references. The last major review was by Dr. Jerome Beers in *Magnetic Resonance Imaging, 7*, pp.309-331, 1989 (see *MWN*, J/A89)....Shellock also published a review last year: "Biological Effects and Safety Aspects of Magnetic Resonance Imaging," *Magnetic Resonance Quarterly, 5*, pp.243-261, 1989. See also his recent study, with two associates at Cedars-Sinai, "Heating of the Scrotum by High-Field Strength MR Imaging," *American Journal of Roentgenology, 154*, pp.1229-1232, June 1990....The FDA's Dr. Whit Athey has also been doing research on MRI; see "A Model of the Temperature Rise in the Head Due to Magnetic Resonance Imaging Procedures," *Magnetic Resonance in Medicine, 9*, pp.174-184, 1989. During the summer, the FDA released a report it commissioned from Dr. J. Patrick Reilly on *Peripheral Nerve and Cardiac Excitation by Time-Varying Magnetic Fields: A Comparison of Thresholds* (No.MT90-100). Specifically, Reilly was asked to investigate the potential health risks from the on-and-off switching of the magnetic fields used in MRIs. Single copies are available from Athey at: Office of Science and Technology (HFZ-133), CDRH, 5600 Fishers Lane, Rockville, MD 20857, (301) 443-3840....Dr. Jeffrey Gold and coworkers at the Cornell Medical Center in New York City have published "Safety of Metallic Surgical Clips in Patients Undergoing High-Field Strength Magnetic Resonance Imaging" in *Annals of Thoracic*

Surgery, 48, pp.643-645, 1989....And a group at Baylor College of Medicine in Houston, TX, led by Dr. Naresh Prasad, has found that "immune response may be enhanced following MRI exposure." See their abstract, "Delayed Tumor Onset Following MR Imaging Exposure," presented at the *9th Annual Scientific Meeting of the Society of Magnetic Resonance in Medicine*, held in New York City, August 18-24, 1990.

Hyperthermia Consensus... In May 1989, an *International Consensus Meeting on Hyperthermia* was held in Trento, Italy, to assess the current status of hyperthermia for the treatment of cancer. The consensus statement, complete with copious references, appears in the *International Journal of Hyperthermia, 6*, pp.837-877, September/October 1990.

PEOPLE

Dr. **Howard Wachtel** has taken a one-year sabbatical from the University of Colorado in Boulder to be a visiting scientist at EPRI. Wachtel will be investigating the neurological effects of EMFs....Dr. **Dan Lyle** has joined Dr. **Mays Swicord**'s lab at the FDA's Center for Devices and Radiological Health. He will be continuing his studies on the effects of EMFs on calcium metabolism, which he was working on when he was a member of Dr. **Ross Adey**'s research group at the VA Hospital in Loma Linda, CA. Swicord told *Microwave News* that Lyle's appointment "indicates a growing emphasis on ELF issues at the center."...Dr. **Jerome Beers** has joined the Radiology Department at Columbia-Presbyterian Hospital in New York City.

VDTs

FDA To Test VDT EMFs... The FDA's Center for Devices and Radiological Health has announced that it will measure emissions of X-rays, ultrasound, VLF and ELF EMFs from television sets and VDTs at its Winchester, MA, lab—the first comprehensive government testing program since 1981 (see *MWN*, Mr81 and My81). The FDA began devising test protocols on October 1 and expects measurements to be completed within 18 months. The agency plans to evaluate more than 100 TVs and VDTs....With concern over possible health effects mounting, several magazines have attempted to do their own tests of ELF EMFs from VDTs—with conflicting results. For example, in the December 12, 1989 *PC Magazine*, Winn Rosch reported fields of more than 60 mG 24 inches in front of an NEC monitor—a much higher level than expected. Rosch next told readers of the February 1990 *MacUser* that they could expect similarly high EMFs from a Macintosh Plus. In contrast, *Macworld* reported much lower levels in its own measurements of ten Macintosh-compatible monitors as part of its July 1990 special report on VDT EMFs. *Macworld* nevertheless called these levels "worrisome." *U.S. News & World Report* published readings taken from 30 different monitors in its September 10, 1990 issue. The magazine averaged the results among three different categories: VDTs, black-and-white PCs and color PCs (the distinction between a VDT and a PC is not clear), and though the levels were similar to those reported in *Macworld*, *U.S. News* concluded that they gave a "message of comfort." *Infoworld* is reportedly planning its own tests.

U.S. Air Force Dismisses VDT EMFs...VDT radiation poses no health hazard, according to a new report from the USAF. The report concludes that, "While research continues on low level ELF effects, results of studies so far have proven no link between ELF and detrimental effects on humans....no reassignment of pregnant VDT workers is warranted," and that, "No basis exists for recommending radiation control measures for VDTs." A copy of *Ergonomics and Radiation Effects from Video Display Terminals and Workstations* (AFOEHL Report 90-043EH00542DXX) is available from: Occupational and Environmental Health Laboratory, Human Systems Division, Brooks AFB, TX 78235.

ETC...

Microwave Month... October is "International Microwave Month," according to the Campbell Microwave Institute in Camden, NJ. The institute reports that its research shows that 86% of children 6-17 years old use MW ovens and that "only" 10% of children under the age of six use them. As for their mothers, most said that their kids liked using MW ovens "a lot" and that "only 10% indicated that they were 'very concerned.'"

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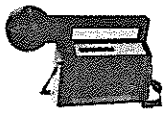

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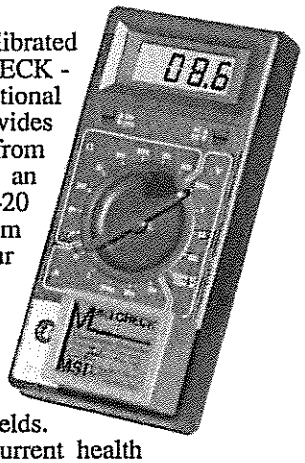

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MICRO WAVE NEWS

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Microwaves Cause Persistent Eye Damage Below 4 W/Kg

U.S.–U.S.S.R. Epi Study Planned

Low-level, pulsed microwave radiation can cause persistent injury to the eye. Laboratory experiments with monkeys and clinical studies of accidentally exposed workers show that the eye's cone photoreceptors can be damaged by weak radiation, according to Henry Kues of the Johns Hopkins University (JHU) Applied Physics Laboratory (APL) in Laurel, MD, and Jack Monahan of the Food and Drug Administration's (FDA) Center for Devices and Radiological Health in Rockville, MD.

"This is the first time we have primate research data that parallel human exposure data," Kues told *Microwave News*. "It is highly unlikely that the changes in cone vision are artifacts." Kues and Monahan are now setting up an epidemiological study of selected microwave-exposed military and civilian personnel in the Soviet Union to further test their findings.

This summer, Kues and Monahan, accompanied by APL's Terry Pfenning, spent three weeks in the U.S.S.R. meeting with Soviet scientists. "The negotiations look very promising," Monahan said on his return in late September. It is likely that researchers in Kiev, Odessa and St. Petersburg will work with the JHU–FDA team.

"We arrived in Leningrad but it was St. Petersburg by the time we left," Monahan said, noting that the coup and its aftermath had not hampered their

(continued on p.13)

Congress Picks DOE To Lead Federal EMF Research

The U.S. Congress has assigned the coordination of federal electromagnetic field (EMF) health research to the Department of Energy (DOE) so that "duplication of research efforts [will] be avoided."

The DOE has scheduled a meeting for October 10-11 in Washington, DC, to draft contingency plans for a comprehensive EMF research effort covering basic science, mitigation and public education, according to Dr. Imre Gyuk, who heads DOE's EMF research program.

For fiscal year 1992 (FY92), DOE's EMF budget is $5 million (see *MWN*, J/F91). As we go to press, Washington is abuzz with rumors that the DOE will soon have a substantially larger research budget.

DOE's mandate is contained in Conference Report 102-177, which accompanied the FY92 appropriations bill for energy and water development, dated July 30. The bill was signed into law by President Bush on August 17.

« Power Line Talk »

The steering committee of the National EMF Research Program (**NERP**) postponed its September 12 meeting until October 16-17 (see *MWN*, J/A91). Three new members have joined the committee: **James DuShaw** of the International Brotherhood of Electrical Workers, Dr. **Mark Cooper** of the Consumer Federation of America and Dr. **Molly Coye**, commissioner of the California Department of Health Services. With the addition of Coye, California now has two representatives on the panel—Dr. **Charles Imbrecht**, who chairs the state's Energy Commission, is already a member....The NERP staff has identified three more groups as prospective research administrators. **Health Research, Inc.**, of Albany, NY, an independent organization that ran the New York Power Lines Project, the **Public Health Foundation** of Washington, DC, which was set up by the Association of State and Territorial Health Officers of McLean, VA, and the **Southwest Research Institute** of San Antonio, TX, are scheduled to make presentations at the October meeting.

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"The future looks promising for a major breakthrough" in our understanding of EMFs and cancer, concluded Dr. **Gilles Thériault** of McGill University in Montreal, Canada, in an address to the ***8th International Symposium on Epidemiology in Occupational Health***, held in Paris, France, on September 10-12. Thériault called the spate of recent male breast cancer studies "most intriguing" and asked, "What about breast cancer in women?" In another presentation, Dr. **Tore Tynes** of the Cancer Registry of Norway in Oslo reported a statistically significant 45% increase in leukemia among electrical workers who had been on the job at least ten years. There was essentially no excess of brain tumors among these workers, however. Tynes previously found an excess of male breast cancer among EMF-exposed workers (see *MWN*, J/F91), but, in Paris, he noted that railway and tram drivers, who had the largest increase in breast cancer—a fourfold excess—are known to be shift workers, and therefore may have abnormal melatonin cycles. This could be part of the problem, he said. Tynes told *Microwave News* that he is also working on epidemiological studies of residentially and occupationally exposed Norwegians.

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University of Maryland Professor **Robert Park**'s op-ed article, "With Alarming Frequency," which appeared in the September 1 *New York Times*—and in the September 12 *Evening Sun* of Baltimore, MD, under the title "America's Hysteria Over Health Risks"—contends that it is a "scientist's obligation to try to put the [EMF] risk in proper perspective for the public." Park then writes that people concerned about EMFs should know that "from 1930 to 1980 the per capita consumption of electric power in the U.S. increased tenfold—yet the incidence of childhood leukemia...showed no change." The article prompted *The New Yorker*'s **Paul Brodeur** to challenge Park's claims in a letter to the *Times*. Brodeur cites National Cancer Institute statistics, detailed in a June 26 *Times* article, that show nearly an 11% increase in acute lymphocytic leukemia (ALL) and more than a 30% rise in brain cancer rates from 1973 to 1988 (see *MWN*, J/F91 and J/A91). ALL and brain cancer are, respectively, the first and second most common types of childhood cancer, Brodeur notes. In an angry letter to the *Evening Sun*, Baltimore attorney **Kieron Quinn** also objects to Park's piece, charging that he and other physicists who share his view are "intellectual successors to the physicists who established to their own satisfaction that the sun revolves around the earth." Quinn is a member of EMRCET—a group of lawyers working on EMF cases (see *MWN*, M/A91). Neither response was published.

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Rhode Island's **Narragansett Electric Co.** has indefinitely postponed construction of a new 44-mile, 345 kV transmission line. The decision had nothing to do with widespread concern over potential EMF health effects from the line, or with last year's **East Greenwich** town council move to block the project by placing a three-year moratorium on new lines above 60 kV, company spokesman Bud Moran told *Microwave News*. Appealing the East Greenwich action last October, Narragansett Electric argued that the new 345 kV line "is needed to provide reliable electric service," and that without it, western Rhode Island "will be at risk of significant service interruptions" (see *MWN*, N/D90). The company now contends that the line will probably not be necessary for at least another decade. Meanwhile, the fate of two 115 kV lines still slated to run through East Greenwich rests with the state Supreme Court, which is scheduled to rule on the legality of the moratorium sometime this winter. The nearby towns of Coventry and Foster followed East Greenwich's lead by passing moratoriums of their own, and a statewide ban on high voltage power lines was proposed during the 1991 legislative session (see *MWN*, J/F91 and M/J91). Governor Bruce Sundlun subsequently appointed an EMF task force to evaluate the proposed ban (see *MWN*, J/A91).

At EPRI: Sussman Replaces Sagan, Research Budget Up

Dr. Leonard Sagan has turned over the management of the Electric Power Research Institute's (EPRI) EMF health studies program to Dr. Stan Sussman. Sagan is now a senior medical scientist in EPRI's environment division.

"I will now be free to do things I like better, such as writing and speaking—people need information on EMFs," Sagan told *Microwave News*. "This is not a sign of a change in my involvement with EMFs," he added. "I'm still heavily involved."

EPRI's EMF budget will grow by $3 million to $10 million in 1992, Sagan said. The new budget figure includes the costs of administering the program, however.

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Consumers Union (CU) has tested **electric blankets** made by Sunbeam-Home Comfort, which claims that it has now reduced their EMFs by approximately 95%. (Sunbeam also makes electric blankets for Montgomery Ward, J.C. Penney and Sears, among others.) In the October issue of *Consumer Reports*, CU confirms that the magnetic fields have indeed been reduced—no word about the electric fields, however. Nevertheless, CU still advises that "children and pregnant women avoid sleeping with electric blankets and heating pads." CU first issued this recommendation in November 1989 (see *MWN*, N/D89 and M/J90).

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Yet another **cancer cluster** has been reported (see *MWN*, S/O90 and M/J91). In the village of Dalmally, **Scotland, U.K.**, at least eight people have died of cancer in the last five years, according to reports in the British newspapers *The Observer* (July 21) and *The Guardian* (August 9). All the victims lived on two streets in the 36-home community, which is divided by a 275 kV transmission line. In addition, there reportedly have been at least two nonfatal cases of breast cancer and three deaths from motor neuron disease. Local residents are fearful. Scottish Power, which owns the line, "insists that no link between power lines and ill health has been substantiated," *The Observer* reported.

Breast Cancer and EMFs: Recent Papers

No Consistent Link with Electric Blanket Use

Postmenopausal women who used electric blankets through the night on a regular basis for ten years had a slightly increased chance of developing breast cancer, according to a new study by Dr. John Vena and colleagues at the State University of New York (SUNY), Buffalo. The 25-36% increase was not statistically significant, however, and the researchers observed neither an increased risk from general long-term electric blanket use nor a dose–response trend with years of blanket use.

"These findings do not support the hypothesis that electric blanket use is associated with an increased risk for breast cancer," the researchers concluded, but added that, "The slightly elevated estimate of risk for the most frequent electric blanket users and the potential public health significance of electromagnetic field [EMF] exposure suggest that further inquiries be undertaken."

"Our study was prompted by Dr. Richard Stevens's theory that the high rates of female breast cancer in industrialized countries are due to light-at-night or EMFs," Vena told *Microwave News*. Stevens, of Battelle Pacific Northwest Lab in Richland, WA, was the first to suggest that breast cancer may be linked to the effects of light and EMFs on the pineal gland's production of melatonin (see *MWN*, J/F87, M/J88 and J/A90).

In an interview, Stevens said that the Vena study was not a good test of his hypothesis because the pineal gland's exposure to EMFs from electric blankets is slight. And according to Dr. Keith Florig of Resources for the Future in Washington, DC, "The field levels in the head when the current is on range from 1 to 4 mG—depending on how far the blanket is pulled up."

The exposure of different parts of the body is a "critical issue that has to be resolved," Vena acknowledged, pointing out that the pineal effect is only one of a number of potential mechanisms, including direct cancer promotion in breast tissue.

In their paper, the SUNY researchers noted that the study was limited because of its focus on postmenopausal women, who experience relatively small variations in estrogen levels. "Premenopausal women might be a better test of what is actually happening," Vena said in an interview, adding, "We plan to investigate that group." The researchers also wrote that the study had low "power" and could only detect a significant effect above a 2.1-fold risk.

The SUNY study included 382 women diagnosed with breast cancer between 1987 and 1989 and 439 controls. See John Vena et al., "Use of Electric Blankets and Risk of Postmenopausal Breast Cancer," *American Journal of Epidemiology, 134*, pp.180-185, 1991.

Demers Male Breast Cancer Study Published

Researchers at the University of Washington and at the Fred Hutchinson Cancer Research Center, both in Seattle, have published their study showing that electricians, telephone linemen and electric power workers had six times the expected rate of male breast cancer, a statistically significant finding (see *MWN*, J/A90). For radio and communications workers, the risk was almost tripled; and for workers with presumed EMF exposure, the risk increased 80%, which is of only borderline statistical significance.

"These results lend support to the theory that [EMFs] may be related to breast cancer in men. The hypothesis warrants evaluation in women," concluded Dr. Paul Demers and coworkers. Male and female breast cancer may be the same disease, they noted, but, "The implications of this study for breast cancer in women are uncertain and are dependent upon the carcinogenic mechanisms involved."

They found that the risk was highest—a statistically significant, more-than-threefold increase—among those who were first exposed before age 30 and at least 30 years prior to diagnosis. In certain occupations, the risks were twice as high. The researchers did not observe a significant trend of increasing risk with increasing length of employment.

The team studied 227 workers diagnosed between 1983 and 1987 and 300 controls. Exposures were categorized by occupation. Since Demers first reported his results in June 1990, two other research teams have published findings of an association between EMF occupational exposures and male breast cancer (see *MWN*, J/F91 and M/A91). See Paul Demers et al., "Occupational Exposure to [EMFs] and Breast Cancer in Men," *American Journal of Epidemiology, 134*, pp.340-347, 1991.

Low Breast Cancer Risk Among Blind Women

Dr. Robert Hahn of the Centers for Disease Control (CDC) in Atlanta, GA, has found that profoundly blind women had half the expected rate of breast cancer as compared to controls with at least some vision. The effect diminished substantially with increasing age.

This finding appears to support the important role of light in suppressing melatonin and increasing the risk of breast cancer. See Robert Hahn, "Profound Bilateral Blindness and the Incidence of Breast Cancer," *Epidemiology, 2*, pp.208-210, 1991.

USC EMF–Childhood Leukemia Study Due in November

The University of Southern California (USC) electromagnetic field (EMF)–childhood leukemia study, which supports the findings of the Wertheimer-Leeper and Savitz studies, will appear in the November 1, 1991 issue of the *American Journal of Epidemiology*. The EMF community has been waiting for the paper since USC's Dr. John Peters announced preliminary results last February at an Electric Power Research Institute (EPRI) workshop (see *MWN*, J/F91 and M/A91).

As originally reported, the USC team found a statistically significant 115% increased risk of childhood leukemia associated with high current wire codes, but did not observe a consistently elevated risk with 24-hour or spot magnetic field measurements. There was no cancer risk associated with measured electric fields.

The paper provides more details on the team's findings of statistically significant associations between leukemia and the use of certain household appliances: a 49% increased risk from use of black-and-white TVs (there was no link to color TVs) and a 182% increased risk associated with electric hair dryer use.

Epidemiology in Print

• A team at the University of Southern California, Los Angeles, has published a study showing that men working for more than ten years in jobs involving low frequency EMF exposures had a tenfold increased risk of developing astrocytomas, a statistically significant finding. Drs. Wendy Mack, Susan Preston-Martin and John Peters observed a significant trend of greater tumor risk with longer employment. "Our results confirm the findings of a positive association between employment in jobs involving presumed [EMF] exposure and brain tumor risk....These results indicate that [EMF] exposure may be an important factor in the etiology of astrocytoma," they conclude. Preston-Martin first reported these findings at the November 1990 Department of Energy contractors review (see *MWN*, N/D90). This study was originally part of a larger project on risk factors for brain tumors (see *MWN*, M/A90). See Wendy Mack, Susan Preston-Martin and John Peters, "Astrocytoma Risk Related to Job Exposure to [EMFs]," *Bioelectromagnetics, 12*, pp.57-66, 1991.

• Children of Scottish women who worked at electrical jobs were 50% more likely to be born prematurely and/or with a low birthweight, according to a group of French and U.K. researchers led by Dr. Silvia Sanjose of the ICRF Cancer Epidemiology Unit in Oxford. Among the electrical workers, electronics wirers had the highest risk—a 74% greater chance—of delivering premature babies and/or babies with low birthweights. The other occupational groups at risk were metal and leather workers. The group did not observe a similar risk among the children whose fathers were electrical workers. See Silvia Sanjose, Eve Roman and Valerie Beral, "Low Birthweight and Preterm Delivery, Scotland, 1981-1984: Effect of Parents' Occupation," *The Lancet, 338*, pp.428-431, August 17, 1991.

• Three recent papers by researchers at the U.K.'s National Radiological Protection Board (NRPB) survey the current EMF bioeffects literature. On epidemiological studies of general health and reproduction, Dr. J.A. Dennis and colleagues conclude that "the bulk of the evidence suggests that there are no effects at exposures below the limits advised by NRPB and [the International Radiation Protection Association]." In a second paper on cancer studies, they note that the evidence "is not sufficient to justify an excessive concern about magnetic field levels in the U.K. from domestic wiring, electrical appliances, power lines, etc., but neither, on the other hand, is there any justification for complacency." The third paper is a brief overview of studies of the bioeffects of extremely low frequency EMFs, radiofrequency and microwave radiation and static magnetic fields. Dr. R.D. Saunders and coworkers conclude that, "The possibility of a health risk cannot be ignored and should be further investigated. If there are such effects, then the evidence suggests that they are subtle and may well be masked by normal biological variation." See J.A. Dennis, C.R. Muirhead and J.R. Ennis, "Epidemiological Studies of Exposures to [EMFs]: I. General Health and Birth Outcome; II. Cancer," *Journal of Radiological Protection, 11*, pp.3-12, 13-25, 1991, and R.D. Saunders, Z.J. Sienkiewicz and C.I. Kowalczuk, "Biological Effects of [EMFs] and Radiation," *ibid*, pp.27-42, 1991.

• In a review of residential EMF studies, Dr. Sol Michaelson of the University of Rochester, NY, concludes that, "In general, the reports to date do not support a definite cause/effect relation between exposure of individuals to 60 Hz electric or magnetic fields and the relative risk of contracting leukemia or other forms of cancer." See Sol Michaelson, "Household Magnetic Fields and Childhood Leukemia: A Critical Analysis," *Pediatrics, 88*, pp.630-635, September 1991.

• In a survey of epidemiological EMF–cancer studies, Dr. Gilles Thériault of McGill University in Montreal, Canada, provides new occupational exposure data. Using an IREQ dosimeter, Thériault and coworkers found that: generating station operators had the highest mean exposures to high frequency transients (7.965 parts per million), splicers had the highest mean exposures to magnetic fields (21 mG) and linemen had the highest mean exposures to electric fields (419 V/m). Comparing EMF-exposed utility workers to non-utility workers, Thériault notes that the utility workers had 65 times greater exposure to transients, 8.1 times higher average magnetic field exposures and 7.6 times higher electric field exposures (see *MWN*, M/A89)—all were statistically significant at the $p<0.001$ level. Thériault points out that the availability of the IREQ dosimeter, developed by Hydro-Québec and marketed by Positron Industries (see *MWN*, J/F90), "opens a new field of research to test the hypothesis of a relationship between EMFs and cancer in environmental as well as in occupational settings." See Gilles Thériault, "Cancer Risks Due to Exposure to [EMFs]," *Recent Results in Cancer Research, 120*, pp.166-180, 1990.

There was a 600% increased risk from use of electric blankets, but it was not significant due to the small number of cases.

The finding of an association with wire codes but not with direct measurements "suggests two fundamentally different interpretations," according to the USC team: First, there *is* a true link between EMFs and childhood leukemia which was not observed because of measurement errors or because of the failure to measure the biologically relevant field parameters. Or second, there is *no* true association and the wire code link is spurious.

With regard to the possibility of an unknown confounder being responsible for the wire code association, the USC team noted that the missing variable would have to be "strongly associated with risk or extremely tightly correlated with wiring configuration classification to have produced the odds ratios" in this and other studies.

The team investigated 232 cases of leukemia among children age 10 and under between the years 1980 and 1987 and matched them with an equal number of controls. Further analysis of the data is under way. The researchers plan future papers.

USC's Dr. Stephanie London is the lead author of the study, "Exposure to Residential Electric and Magnetic Fields and Risk of Childhood Leukemia." It was funded by EPRI.

Congress Awards NAS-NRC $600,000 for ELF Health Review

The U.S. Congress has appropriated $600,000 for a National Academy of Sciences (NAS)-National Research Council (NRC) review of the possible health effects from exposure to extremely low frequency (ELF) electromagnetic fields (EMFs). The project is scheduled to begin in early 1992 and is expected to take more than two years to complete.

An NRC panel will initially conduct a short feasibility study to determine whether there is in fact a need for a full-scale effort, Dennis Mahlum, the project officer for NAS-NRC's Board on Radiation Effects Research, told *Microwave News*. In a telephone interview from his office in Washington, DC, Mahlum said that the project will focus on the carcinogenic, reproductive and behavioral effects of ELF EMFs, but will also include research at other frequencies, where appropriate. No panel members have yet been appointed.

The final study plan is still in preparation; when completed, it will be submitted to the Department of Energy (DOE), which will serve as the conduit for the $600,000. The final product is likely to be an ELF EMF research agenda, Mahlum said. In July, the Environmental Protection Agency (EPA) released its own research strategy document (see *MWN*, J/A91).

Congress set aside the funding for the NAS-NRC review in the appropriations bill for energy and water development for fiscal year 1992, Public Law 102-104, which President Bush signed on August 17. In addition, the joint House–Senate conference report accompanying the law designates the DOE as the lead federal agency for EMF research (see p.1).

Rep. Joseph McDade (R-PA), the top-ranking Republican on the House of Representatives' Appropriations Committee, added the NRC project to the bill. His district includes Scranton, PA, where residents fear that a transmission line may be responsible for a cluster of cancer cases (see *MWN*, J/F91 and M/J91).

In a February 21 letter to NAS President Dr. Frank Press, McDade asked the NAS-NRC to undertake "an independent evaluation" of EMFs and health. On March 8, Press responded that the NAS-NRC staff was "enthusiastic" about doing the study. "As now envisioned," Press wrote, "a committee of approximately 15 experts, representing a broad range of expertise, would perform the study." He estimated that the study would take 24-30 months at a cost of approximately $600,000.

Earlier this year, the NRC circulated a proposal among federal agencies for a study of EMFs from video display terminals (VDTs) but was unable to attract support (see *MWN*, M/A91). The NAS-NRC has an ongoing review of the potential health effects of very low frequency (VLF) radiation from the U.S. Air Force's Ground Wave Emergency Network (GWEN) (see *MWN*, M/J90 and N/D90).

There now are four federally supported reviews of EMF health effects in progress. In addition to the two NAS-NRC projects, EPA is continuing its assessment of EMF cancer risks (see p.12) and the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) is doing its own review in association with the Oak Ridge Associated Universities (see p.12). The Health Effects Institute is conducting a feasibility study, partly with EPA funding, for a possible EMF research program (see *MWN*, M/A91, M/J91, J/A91 and p.8).

On September 11, Rep. Joe Kolter (D-PA) introduced H.R. 3293, which would authorize the NAS to undertake an EMF research review. The bill was moot upon introduction.

Other Congressional Action

• Michigan Senators Donald Riegle and Carl Levin, both Democrats, have jointly introduced a bill which would allot $2 million to study stray voltage from electrical power transmission systems. The Electrical Transmission Research Act of 1991, S.1685, would require the DOE to direct the NAS to conduct an additional two-year investigation into "the sources of, the damages caused by and the possible means of preventing" stray voltage. The bill would start research on stray voltage exposure mitigation "before the biological scientific studies are completed," according to Riegle, who added that, "If we do not begin to solve these problems soon, it will be 15 years before those who live

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near power lines can sleep peacefully knowing they are not suffering any ill health effects from the lines above their heads." The legislation has been assigned to the Senate Committee on Energy and Natural Resources.

- A plan by Senator Frank Lautenberg (D-NJ) to introduce a bill that would provide $45 million over four years for power frequency EMF research, first floated in June, has been put on hold. In August, Lautenberg spokesman Steven Schlein told *Microwave News* that attempts to draft the legislation failed and that there may never be a bill. EMF legislation is not a priority item for the senator, he conceded.
- Rep. Frank Pallone's (D-NJ) legislation to provide $34 million over five years to the DOE for EMF research will not make it out of the House of Representatives' Committee on Science, Space and Technology this year. In May, the committee authorized $2.2 million for EMF research by EPA for fiscal year 1992—$1.5 million of which was to be used to support a joint public–private research initiative (see *MWN*, M/J91). As we go to press, Congress has not yet completed work on the EPA appropriations bill.

Michigan Hearing Spurs Congressman To Oppose Line

Michigan Rep. Howard Wolpe (D) has asked Consumers Power Co. (CPC) of Jackson, MI, to suspend construction of a controversial 115-mile, 345 kV transmission line, citing concerns about electromagnetic field (EMF) exposures. In an August 13 letter, Wolpe urged the utility to "announce a moratorium on this project."

Wolpe is the chairman of the House Committee on Science, Space and Technology's Subcommittee on Investigations and Oversight, which held a hearing on August 6 in Battle Creek, MI, on the power line and EMFs.

"It is clear that exposure to [EMFs] poses a potential risk of adverse health effects," Wolpe wrote to CPC Chairman William McCormick, adding that, "It is incumbent upon [CPC]...to demonstrate that it has taken all prudent actions to avoid unnecessary public exposure" to EMFs. He also wrote that the testimony presented at the hearing "raised serious questions" about the need for the line and he criticized the utility for not considering "cost-effective alternatives."

CPC's McCormick responded in a September 6 letter that the utility has taken numerous steps to ensure that EMFs from the line are not hazardous. "Despite the lack of any definitive evidence of health problems caused by [EMFs], we incorporated a design that would produce an EMF level at the boundary of the transmission line right-of-way that is *ten times* lower than the most rigorous current safety standard adopted by any state in the U.S.," he wrote, though he did not identify specific levels. He added that, should the state of Michigan or the federal government set stricter standards, CPC will comply with them. McCormick also said that continuing growth in electricity demand makes the line necessary.

In his letter to CPC, Wolpe also paraphrased Dr. Leonard Sagan of the Electric Power Research Institute (EPRI), a witness at the hearing, as "begrudgingly" agreeing that "it would be prudent to avoid potential health risks" associated with new lines if electricity demand could otherwise be met at a lower cost. Sagan responded angrily in an interview with *The Energy Daily* (August 22), a Washington, DC, newsletter, stating that, "My scientific reputation is being used to further someone's political aim." He said that he does not know the specifics of the proposed line and that Wolpe had misrepresented his comments. He told the panel that "the evidence [on EMFs and health] is inconclusive, but deserves further research."

In addition to Sagan, others testifying at the hearing included: Dr. William Farland of the Environmental Protection Agency (EPA); Dr. Abraham Liboff of Oakland University, Rochester, MI; Michael Morris of CPC; State Reps. Michael Nye and Glenn Oxender, both Republicans; and Cathy Smith of Michigan Residents Against Giant Electric (Michigan RAGE).

Liboff summarized his research on EMF effects and told the subcommittee that he believes that extremely low frequency (ELF) EMFs pose "a hazard to humans." He urged that universities be given a more substantial role in EMF research. "The future of the research on ELF effects on health will be most efficiently accomplished using traditional competitive university science settings—laboratories, graduate students and freedom from political interference," Liboff said in his prepared statement.

CPC's Michael Morris said that the utility routed the 345 kV line using "an ultraconservative approach that is head and shoulders better than all existing [EMF] standards, so that any impact will be minimal."

Cathy Smith testified that there is no need for the line. She and Alan Barak, a Lansing attorney representing Michigan RAGE, argued that CPC falsely contends that the demand for electricity will outgrow current transmission and distribution capacity. The Michigan Municipal Cooperative Group Utilities, made up of municipally owned and cooperative electric utilities, backed RAGE's argument that the line is not needed.

The 345 kV CPC line is slated to run from Battle Creek, MI, to Akron, IN (see *MWN*, M/J91).

California Legislature Approves $7 Million EMF Fund

A bill to establish an electromagnetic field (EMF) research and education fund of up to $7 million has passed both houses of the California legislature and is awaiting Governor Pete Wilson's signature.

The legislation, SB920, was sponsored by Senator Herschel Rosenthal, chairman of the Senate Energy and Public Utilities Committee. On September 12, in a 54-24 vote, the General Assembly sent the bill to the Senate floor, where it was approved 31-0 the next day.

If it becomes law, the measure will require California electric utilities to finance the EMF study fund through a onetime fee; an "urgency" provision will immediately send $4,390,000

to the state Public Utilities Commission (PUC) and the Department of Health Services (DHS) for a two-year EMF initiative; and the rest of the fund will be allocated by the legislature for follow-up research.

The California effort is intended to complement the joint public–private National EMF Research Program (see *MWN*, J/A91 and p.2), and has widespread support among utilities as well as among labor and environmental groups, Michael Shapiro, a Rosenthal aide, told *Microwave News*. "None of the major players among California utilities has voiced opposition to the bill," Jack Sahl of Southern California Edison said in a telephone interview, adding that state utilities do not want "to wait around for other entities" to implement EMF research.

At least 80% of the initial allotment is earmarked for DHS research, which would include cellular and epidemiological studies, investigations of EMF health risks among children attending schools near power lines and the development of possible mitigation techniques. A research status report would have to be submitted to the legislature by December 1, 1993.

The rest of the money would be appropriated to the PUC, which would be required to outline an interim prudent avoidance policy by June 30, 1992. The PUC would also oversee the work of a recently formed, 17-member "consensus" group made up of scientists, government officials, consumers and utility representatives. The group—which will help to identify and develop regulatory measures—will hold its first meeting October 10-11.

The bill also directs state utilities to develop employee education programs, provide EMF measurements to customers upon request and distribute written EMF health risk information at least once a year.

The legislation was prompted by "current EMF uncertainty and controversy," and allows for "the longer-term possibility that we may be faced with a serious EMF health problem," Rosenthal remarked at an American Law Firm Association EMF seminar, *Developing a Corporate Strategy*, on September 26 in Los Angeles, CA. The new effort is a follow-up to a $2 million EMF initiative, also sponsored by Rosenthal, passed in 1988 (see *MWN*, S/O88 and N/D88).

BPA Now Reports No Melatonin Effect in Sheep

Sheep living directly under a high voltage transmission line did not show depressed levels of melatonin, according to researchers from the Bonneville Power Administration (BPA), based in Portland, OR, and from Oregon State University (OSU) in Corvallis.

OSU's Dr. Fred Stormshak reported preliminary results showing a 20-25% reduction in serum melatonin at last November's annual Department of Energy (DOE) EMF meeting (see *MWN*, N/D90). Stormshak will present the updated results at this year's DOE review, to be held November 3-7 in Milwaukee, WI.

The researchers compared a group of ten sheep penned under a 500 kV BPA transmission line with a control group of ten sheep penned away from the line. The sheep under the line were exposed to magnetic fields ranging from 15-60 mG and electric fields of 4.5-7.5 kV/m, while the control group was exposed only to background EMF levels.

Over 6,000 blood samples were taken from the sheep over a ten-month period. Initially, sheep under the line had lowered melatonin levels, but later results showed a great deal of "random variation," with no statistically significant difference between the two groups, Jack Lee, a BPA environmental health specialist, told *Microwave News*.

The study is now being repeated using groups of 15 sheep. The replication, in which larger pens will be used to insure that the sheep do not shield each other from the electric field, as they might have in the first study, will also investigate immunological effects. Some of the sheep have EMDEX meters strapped to their bodies to gauge actual EMF exposures, Lee said in a telephone interview.

Melatonin is a hormone secreted by the pineal gland which regulates biological cycles and inhibits cancer. Other studies have shown lowered melatonin levels in animals exposed to EMFs (see *MWN*, M/J88 and J/A90).

Litigation Update

• On July 15, a jury in the Superior Court of Fulton County, GA, ordered Georgia Power Co. to pay Jimmy and Marilyn Barrett $22,000 for one-third of an acre of property condemned for a transmission line right-of-way (ROW). The Barretts, of Buford, GA, had challenged Georgia Power's initial $4,800 property valuation in a condemnation proceeding, arguing that the utility should compensate them for land beyond the ROW where increased EMF levels are detectable. They also asked for compensation for the loss of use of the property and for loss of privacy. The Barretts sought $207,000. A court-appointed Special Master awarded them $13,821—which included $5,013 for EMF-related "consequential damages"—but the Barretts appealed that ruling, leading to the jury trial. According to the Barretts' attorney, John Blandford of Blandford & Werbin in Chamblee, GA, the Barretts feared EMFs from the line might cause them to develop cancer and claimed that the EMFs "contaminated an area as much as 200 feet" from the line. The attorney for Georgia Power, Donald Janney of Troutman, Sanders, Lockerman & Ashmore in Atlanta, GA, said that the utility had offered to settle with the Barretts for $23,000 one week before the case went to trial.

• In a case filed on July 24 against Georgia Power Co. and Oglethorpe Power Co., Larry and Nancy Jordan and their children of Douglasville, GA, charge that Nancy's non-Hodgkin's lymphoma was due to exposure to EMFs from a power line that crosses their property. They are seeking $5 million for negligence, fraud and punitive damages, among other claims. The suit, filed in the Superior Court for Douglas County, GA, alleges that the utilities failed to disclose the potential health risks of power frequency EMFs. The Jordans are being represented by Eugene Brooks of Middleton & Anderson in Savannah, GA, Bruce DeBoskey of Silver & DeBoskey in Denver, CO, and Paul Carroll of Hine, Carroll & Niedrach in Rome, GA. DeBoskey is a founding member of the Electromagnetic Radiation Case Evaluation Team (EMR-CET), a group of plaintiffs' lawyers involved in EMF litigation (see *MWN*, M/A91).

NCI Weighs an EMF Initiative

The National Cancer Institute (NCI) is considering sponsoring a well-defined project on electromagnetic field (EMF)–cancer research. A two-day NCI workshop, *Molecular Mechanisms of Potential EMF-Induced Transformation*, was held September 12-13 in Bethesda, MD, to assess the need, and justification, for such an initiative.

The EMF workshop was only the first step in a "highly competitive" decision-making process, Dr. Richard Pelroy of NCI's Radiation Effects Branch told *Microwave News*. He stressed that the process was still in its early stages; if approved by internal and external reviewers, a formal decision would be announced in about a year, he said.

"There is enormous political pressure for the NCI to become involved" in the EMF issue, according to a knowledgeable source who has been following developments at the NCI. Last May, three branches of the National Institutes of Health (NIH), led by the National Institute of Environmental Health Sciences (NIEHS), published a joint request for EMF proposals (see *MWN*, M/J91).

The NCI and NIH efforts are "complementary," NIEHS's Dr. Michael Galvin, a participant at the NCI workshop, said in a telephone interview. NIEHS is undertaking a multifaceted approach to EMF research, while NCI is interested in addressing specific questions, Galvin explained. He said that the May call for proposals had prompted a "good response."

Other participants at the workshop included: Drs. James Felton (Chair), Larry Anderson, Roswell Boutwell, Kelly Clifton, Marvin Frazier, Reba Goodman, Robert Liburdy, Martha Linet, Richard Luben, J.R. McLean, Martin Misakian and Thomas Tenforde.

HEI Scales Down Plans for EMF Research Program

The Health Effects Institute (HEI) is scaling down its plans for a public–private electromagnetic field (EMF) research program. At the second meeting of the HEI feasibility study committee on August 26-27 in Cambridge, MA, HEI President Dr. Andrew Sivak asked the committee to consider a smaller research program with a $2.5 million budget, as well as the original $20-30 million effort (see *MWN*, M/A91, M/J91 and J/A91).

HEI's funding sources are uncertain—and have become more so by the recent designation of the Department of Energy (DOE) as the lead agency for EMF research (see p.1).

HEI had requested a three-year funding commitment from the Environmental Protection Agency (EPA), but, according to Sivak, EPA will now have to consult with the DOE before it can commit any money to EMF research from its 1992 budget. "If the money isn't forthcoming, I'm not sure the institute is excited about going ahead with the project," he said.

At the August meeting, the committee members focused on the reduced research effort. Most favored a few simple in vitro experiments that could yield definitive, repeatable results. Sivak told *Microwave News* that HEI could fund about five to ten projects in a few areas of research—for example, effects on calcium ion transport, melatonin production and cell division.

Dr. Richard Setlow of Brookhaven National Lab, the chairman of the feasibility committee, indicated that it is unlikely that HEI will sponsor human studies.

Although some committee members want HEI to address public education, EPA's Dr. Doreen Hill, an invited observer, said that she was not sure that risk information is "appropriate" for HEI. Dr. David Savitz of the University of North Carolina, Chapel Hill, agreed: "I see HEI as having a unique niche: It should take advantage of [its] well-established tradition in elegant, biologically-driven lab research."

The committee heard presentations from Dr. Joseph Bowman of the National Institute for Occupational Safety and Health (NIOSH) in Cincinnati, OH, on the University of Southern California EMF–childhood leukemia study (see p.4) and from Dr. Walter Rogers of the Southwest Research Institute in San Antonio, TX, on melatonin studies of baboons exposed to fields of 30 kV/m and 1.0 G (see *MWN*, N/D90).

Sivak, Setlow and Dr. Peter Valberg of Gradient Corp.—which is coordinating the feasibility study for HEI—have drafted a research plan incorporating the committee's suggestions. Sivak said, "We're going to present several areas of research that are not completely constrained by money." The committee will meet again on October 11 to review the plan before Sivak presents it to the HEI board on October 24. If the board gives its approval, Sivak hopes to issue a request for proposals by early 1992 and to sign contracts by May or June.

HEI's Asbestos Record

At the August meeeting, Dr. Asher Sheppard of the VA Hospital in Loma Linda, CA, asked Dr. Andrew Sivak how he would answer the charges that HEI's credibility had been undermined by its work on asbestos. Sheppard, a member of the EMF feasibility committee, cited a resolution by the National Association of Attorneys General (NAAG) which expressed a "deep concern" about HEI-AR's—HEI's project on asbestos research—ability to produce unbiased results (see *MWN*, M/J91 and J/A91).

Sivak responded that HEI had earned a great deal of credibility during 11 years of administering research and that there is nothing that HEI can do to satisfy certain factions of the EMF community.

In an interview with *Microwave News*, Sheppard said that Sivak's response was "unsatisfactory—he totally skimmed over the issue. I'd be surprised if HEI got any more money until Sivak can assure a credible EMF program."

The HEI-AR final report on asbestos was released on September 25 and is available at no cost from: HEI-AR, 141 Portland St., Suite 7100, Cambridge, MA 02139, (617) 225-0866.

NEMA Review Cautious on EMF–Cancer Link

Current scientific data are "insufficient" to confirm an electromagnetic field (EMF)–cancer link, and regulating EMF exposures would be "premature," according to an analysis sponsored by the National Electrical Manufacturers Association (NEMA), a trade group based in Washington, DC.

The 125-page literature review, *Extremely Low Frequency Electromagnetic Fields and Cancer: Focus on Tumor Initiation, Promotion and Cancer*, was written by biochemist Dr. Earl F. Walborg Jr., who, together with well-known cancer researcher Dr. Thomas Slaga of the University of Texas, founded Dermigen, Inc., a Smithville, TX-based consulting firm, in 1988.

Though epidemiological studies "have produced evidence suggesting an association between residential [EMF] exposure" and childhood cancer, Walborg argues that the data do not confirm a causal link and stresses the need to determine critical parameters of exposure. Most animal studies have not demonstrated an EMF–cancer relationship, he writes, acknowledging that "an appropriate animal model may not have been utilized." In vitro research has "shown that power frequency [EMFs] can modulate several biological processes" that may be involved in tumor development, including DNA synthesis, RNA transcription, cell proliferation, immune response, enzymatic reactions and pineal gland function, Walborg states.

On November 12, NEMA will sponsor a workshop titled *EMF: Science, Regulation and Law* as part of its annual meeting. NEMA also has published a short brochure, *Biological Effects of Electric and Magnetic Fields*, which presents nontechnical answers to EMF health effects questions. Earlier this year NEMA endorsed the National Electromagnetic Research Program (NERP), a joint public–private research project (see *MWN*, J/A91). The report and the brochure are available at no cost from: NEMA Public Affairs, 2101 L St., NW, Washington, DC 20037, (202) 457-8455.

FROM THE FIELD

Seattle's Concerns Over ANSI 1991 RF/MW Safety Standard

Excerpted below is a letter from Sue Donaldson, a member of the Seattle, WA, City Council to Dr. Tom Budinger of the Lawrence Berkeley Lab in Berkeley, CA, the chairman of the IEEE's Standards Coordinating Committee (SCC) 28, which is responsible for revising the 1982 American National Standards Institute's (ANSI) safety limits for occupational and public exposures to radiofrequency and microwave (RF/MW) radiation. For many years, the city of Seattle has been developing an RF/MW exposure standard (see MWN, *J/A88, J/A89 and S/O89). *In addition, King County, WA, which includes Seattle, is considering adopting its own RF/MW standard.*

In mid-September, Dr. Don Justesen, a member of SCC-28, sent a "provisional response" to Donaldson on behalf of Budinger. In a telephone interview, Budinger told Microwave News *that he and the cochairs of the subcommittee that revised the standard—Drs. Eleanor Adair of the John Pierce Foundation in New Haven, CT, and Om Gandhi of the University of Utah, Salt Lake City—will prepare a written response prior to SCC-28's next meeting on November 2.*

August 12, 1991

Dear Dr. Budinger:

The city of Seattle has been following the progress of SCC-28 in developing guidance for protecting humans from non-ionizing radiation hazards. Revision of the American National Standards Institute (ANSI) C95.1 guidance pertaining to safety levels for human exposure to radiofrequency [RF] electromagnetic fields of 3 kHz to 300 GHz is extremely important to local agencies that have responsibility for issuance of land use permits for telecommunications facilities. This is especially true in light of the absence of federally promulgated standards.

With the inclusion of safety guidance for "uncontrolled environments" as presented in the final draft of ANSI C95.1-1991, the standard is directly applicable to public exposure to non-ionizing electromagnetic radiation (NIER). For this reason, and in consideration of concerns about RF fields expressed by citizens residing in the city of Seattle, we look to you for further explanation of the content of C95.1-1991 and the rationale by which SCC-28 accepted particular guidance levels, safety factors, measures and exclusions. This is very important to us in determining what, if any, local actions are appropriate to enforce the ANSI guidance, and/or further address health concerns in Seattle.

I chair the Seattle City Council Land Use Committee and also an advisory committee concerned with telecommunications facilities in Seattle. On behalf of the Seattle Telecommunications Facilities Advisory Committee, I ask for your response to a number of questions that have come up in reviewing the ANSI C95.1-1991 final draft and the biological literature....

We have five general areas of concern:

- Selection of 4 W/Kg as the level for adverse effects on the basis of data on altered animal behavior, and use of 4 W/Kg as the platform upon which all subsequent components of the standards are set;
- Inadequate explanations of the rationales for a two-tiered standard (other than for induced currents considerations), and the particular safety factors selected;
- Dismissal of non-thermal effects as stated in the conclusion that, "Research on the effects of chronic exposure and speculations on the biological significance of non-thermal interactions have not yet resulted in *any meaningful basis* for alteration of the standard" (emphasis added);
- Lack of the justification for exclusion of portable devices operating at 7 watts and below; and
- Broad assurances provided in the recommended guidelines about avoidance of risk convey the impression that all health issues have been thoroughly and completely addressed, yet there is no acknowledgment of legitimate concerns about cancer which still need thorough investigation.

Questions pertaining to these areas of concern follow:

A. *4 W/Kg Threshold and Biological Endpoint:* What justification is there for disregarding the evidence indicating the existence of health effects below 4 W/Kg, when within the body of scientific studies available to SCC-28, there is evidence supporting the existence of deleterious effects occurring below 4 W/Kg?

The Environmental Protection Agency's (EPA) 1984 review of the literature reached the conclusion that: "...biological effects occur

at an SAR of about 1 W/Kg; some of them may be significant under certain environmental conditions." EPA's publication in the *Federal Register* (July 30, 1986) regarding federal radiation protection guidance states: ..."The evidence indicates that exposure of human beings at frequencies in the resonant region at an SAR of approximately 1 W/Kg produces significant changes in body temperature under some environmental conditions." I understand this conclusion is based in part upon the results of modeling analyses showing whole-body average SARs of 1-4 W/Kg for relatively short durations (1 hour) produce significant increases of about 1°C in human body temperature at ambient temperatures of 25-30°C (77-86°F). The EPA *Federal Register* notice advises that a 1°C rise in the core temperature of humans exposed to RF radiation should be considered hazardous to relatively healthy individuals. In addition, it seems reasonable to conclude that increases in body temperature are likely to occur at SARs lower than 1-4 W/Kg if exposures occur under more thermally stressful conditions, e.g., higher ambient temperature and/or higher relative humidity.

Why did the committee reject the scientific evidence indicating death will occur in some laboratory animals at a dose rate of 4 W/Kg? Why is behavioral disruption identified as the critical biological endpoint in the final draft guideline when it has been demonstrated that prolonged exposures at 4 W/Kg may cause death?...

The final draft of the revised C95.1 guideline indicates (pp.6-1–6-2): "The literature review was followed by extensive deliberations of a Working Group on Risk Assessment that was charged to reach agreement on an SAR at which potentially deleterious health effects *are likely* to occur in human beings" (emphasis added). What precisely does the committee mean by "are likely"? What probability factor and dose–response function are being conveyed here, i.e., are we to assume a 1% probability; or, say 50% or 90%? Is there evidence for the shape of a curve representing the probability of deleterious effects as a function of SAR and thereby evidence for the setting of such probabilities? Is there a quantitative basis for the slope of such a curve in the range near 4 W/Kg?

Use of 4 W/Kg as a threshold suggests it is entirely unlikely that any deleterious effects will occur under 4 W/Kg and conversely, at 4 W/Kg and above, chronic exposure may constitute a health hazard. Is such a sharp distinction, i.e., threshold, realistic on the basis of data for deleterious effects as a function of SAR?

B. *Rationale for the Two-Tiered Standard and Specific Safety Factors:* In the interest of reaching an understanding of the degree of conservatism present in C95.1-1991, we need more specific information related to the rationale for the two-tiered standard and the specific safety factors applied to each tier....

What exactly does the committee mean by "safety factor"? What model is being employed—a probabilistic model where the standards are based on an extrapolation process to determine a level of exposure at which there is a low probability of effect, or a threshold model for which significant effects occur only above a specific threshold value? What is the basis for the specific numerical values (10 and 50) selected by SCC-28 as safety factors?

C. *Relevancy of Non-Thermal Interactions to Modification of the Standard:* The final draft ANSI C95.1-1991 document states on p.6-4: "Research on the effects of chronic exposure and speculation on the biological significance of non-thermal interactions have not yet resulted *in any meaningful* basis for alteration of the standard" (emphasis added) and on p.6-11: "Studies such as those indicating effects, in vitro, on cell function were considered transient and reversible with no detrimental health effects."

Since 1986, a number of research articles have been published concerning thermal or low-level exposures and effects on tissues on the eye (Kues et al., 1987, 1989), effects on cholinergic activity of rat brains (Lai et al., 1987), effects suggesting microwave action on endogenous brain opiods (Lai et al., 1986a, 1986b), effects of short pulses on integrity of the blood–brain barrier (Neubauer et al., 1990), effects on fetal development (Tofani et al., 1986) and effects on the incidence of tumors in chronically exposed rats (Kunz et al., 1985). In addition, a number of in vitro areas have been investigated, including cancer-promoting changes in cultured cells (Balcer-Kubiczek and Harrison, 1986, 1989, 1991). Of the topics on animal exposures, only experimental data on the blood–brain barrier were considered by SCC-28 as a result of the time window set for the literature reviewed.

These recent research results emphasize the existence of biological effects at exposures below 4 W/Kg that may result in deleterious health effects. The recent findings together with older work demonstrating nonbehavioral effects at thermal levels of exposure further weaken the arguments that establish the standard on a behaviorally determined threshold of 4 W/Kg, and the premise that the standard is based upon a conservative view of the existing data.

In light of the work cited above, is there not a biological basis for reexamination of the basic premise that established the standard on a behaviorally determined threshold of 4 W/Kg?

Even if it were more firmly established that in vitro effects referred to in the statement from p.6-11 are indeed "transient and reversible," how can it be assumed that no future health impact may result? Given modern concepts of cell biology and the latency for onset of some diseases, this seems questionable.

D. *Exclusion Clause for Portable Devices:* The exclusion for low-power devices runs contrary to the whole philosophy of the rest of the standard. What is the detailed basis for the exclusion? Are there biological data that support the inherent assumption that if the input power of the radiating device is 7 watts or less, or 1.4 watts or less, the energy deposited in the body is harmless regardless of proximity to the body or duration of exposure? What consideration has been given to hot spots and different kinds of antennas? The recently revised language of C95.1-1991 that indicates the exclusion "...does not apply to devices with the radiating structures maintained within 2.5 cm of the body" needs clarification. What is meant by "maintained"? Also, §4.4, p.4-14 indicates the relaxation of power density limits is allowed for exposure of all parts of the body except for the eyes and testes, yet §4.2.3 and §6 make no mention of the exclusion being disallowed when applied to these parts of the body. How are we to interpret the recommended guidance when hand-held radios may be used with the antenna in close proximity to the eyes?...

E. *Possible Cancer Effects and Definitive Statements of Risk:* A number of statements in the C95.1-1991 final draft suggest an absence of health risks from NIER associated with allowable exposures, yet there has been very little experimentation related to possible elevated risks of cancer.

Would you agree that the issue of cancer and RF exposures has been given far too little attention experimentally for definitive statements about risk of either a positive or negative nature?

I want to thank the SCC-28 committee members for the long hours and intensive efforts undertaken to address this important area. Undoubtedly, the job has been a difficult one. I am not an advocate of the creation of a patchwork of local NIER standards.

I am hopeful that a better understanding of SCC-28's perspective on the above will satisfy the concerns I have presented. Your response is very important to Seattle's decision on whether to embrace the recommended guidance of ANSI C95.1-1991, and as such will be greatly appreciated.

Sincerely,
Sue Donaldson
Councilmember, Seattle City Council

CIRRPC Sharply Critical of EPA EMF–Cancer Report

The Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), which is managed by the White House Office of Science and Technology Policy (OSTP), has urged the Environmental Protection Agency (EPA) to overhaul its draft report on electromagnetic fields (EMFs) and cancer.

In an August 5 letter to EPA Assistant Administrator Erich Bretthauer, CIRRPC Chairman Dr. Alvin Young wrote that the committee believes the report should be "substantially revised, if not rewritten." That conclusion echoes the recommendation of EPA's Scientific Advisory Board's (SAB) Non-Ionizing EMF Subcommittee that the document has "serious deficiencies and should be rewritten" (see *MWN*, J/A91).

Young cautioned that "the evidence presented...does not provide a scientifically sound basis for linking cancer to exposures to electric and magnetic fields." He called the document's executive summary "unnecessarily alarming" and emphasized the importance of rewriting it. "The interpretation of the data is biased towards accentuating a positive correlation," he argued.

Young's letter was accompanied by comments from seven federal departments and agencies that had been asked to review the EPA draft report (see box below). Of the seven, the National Cancer Institute (NCI) and the Department of Defense (DOD) criticized the document as sharply as CIRRPC, emphasizing many of the same points.

NCI's Dr. John Boice stated that "the conclusions presented remain scientifically unsound and unnecessarily alarming." Robert Barker, assistant secretary of defense, urged that, "This report should not be published. Alternatively, the scope of the report could be expanded to incorporate the volumes of research which document a lack of EMF effects, and its conclusions modified accordingly." Late last year, a U.S. Air Force review was similarly critical (see *MWN*, N/D90).

Dr. Imre Gyuk of the Department of Energy found the report improved over an earlier draft but said that the executive summary "suffers from a severe case of overgeneralizations, speculations and unjustifiable conclusions." Reviewers from the Center for Devices and Radiological Health and from the National Institute of Standards and Technology were generally positive in their comments.

Comments Submitted to CIRRPC on EPA EMF–Cancer Report

Seven federal departments and agencies submitted comments to CIRRPC on EPA's draft review document on EMFs and cancer. Compiled below are excerpts from some of the comments.

• **Department of Defense** (Robert Barker, assistant secretary): "...[T]he document does not support a scientific assessment that [EMFs] are possible carcinogens. The document is inconsistent and seriously deficient in not presenting a balanced and comprehensive review of the literature. In addition, it appears to gloss over or ignore studies showing negative results....The overall weight of the epidemiologic evidence is so slight as to be almost nonexistent—certainly not sufficient to justify the alarmist nature of this document....This report should not be published."

• **Department of Energy** (Dr. Imre Gyuk, program manager for electromagnetic research): "[C]larity and understanding of the important issues are still hampered due to treatment of disparate frequency ranges [ELF and RF] in the same chapters....The document would be less subject to attack if it were simply stated that studies of carcinogenesis in animals exposed to ELF have not been done....[The] Executive Summary suffers from a severe case of overgeneralizations, speculations and unjustifiable conclusions."

• **Department of Energy** (Harry Pettengill, deputy assistant secretary for health): "[The] conclusions regarding the risk of cancer in children and adults seem appropriate. While the risks are low, there does seem to be a consistent trend for certain type-specific cancers. There certainly is the need for continued health research in this area and the development of better indicators of exposure."

• **Department of Transportation** (Dr. Aviva Brecher, project manager, maglev EMF health effects): "The EPA draft report is a useful compendium, and a fairly balanced critique of research results to date. I concur with Dr. Imre Gyuk of DOE that lumping ELF fields effects with those of RF and higher (MW) frequencies [of] electromagnetic radiation is technically incorrect and unwarranted....The incomplete, uncertain and internally inconsistent current state of knowledge on EMF and cancer must be more forcefully stated...."

• **Food and Drug Administration's Center for Devices and Radiological Health** (Walter Gundaker, acting director): "This is a well-researched document which presents a reasonable and balanced examination of the evidence available to date. It prudently refrains from rejecting the large body of evidence out-of-hand because of perceived weaknesses of individual studies, yet acknowledges that the aggregate picture has many questions yet to be answered...."

• **National Cancer Institute** (Dr. John Boice, head of the radiation epidemiology branch): "All [NCI] reviewers agreed that the human epidemiologic data to date did not support the sweeping conclusions made in the EPA document. In our judgment the conclusions presented remain scientifically unsound and unnecessarily alarming....There appeared to be a tendency throughout the report to dismiss negative or inconclusive findings rather than weighing these inconsistencies in the overall interpretation....Missing throughout is a clear statement that we cannot conclude at this time whether [EMFs] pose a cancer hazard."

• **National Institute of Standards and Technology** (Paul Todd, biostatistician): "I see no serious problem with issuing the book as it stands. Experimenters who have been quoted may not feel the same way, but the report treats all of the research fairly, and, if anything, is too noncritical."

• **Occupational Safety and Health Administration** (Sheldon Weiner, director, office of standards analysis and promulgation): "[O]ur reviewer of the epidemiological sections of the report feels that EPA has implied an unsupportable degree of confidence in the positive studies relative to carcinogenesis both in children and adults. On the other hand, our reviewer of the animal and in vitro studies feels that EPA has understated the strength of the evidence supporting a carcinogenic link."

CIRRPC Begins Its Own Health Review

An independent review panel on EMF health effects under the direction of CIRRPC met for the first time on September 5-6 in Washington, DC. CIRRPC initiated the review late last year after the White House Office of Science and Technology Policy opposed release of EPA's draft review of EMFs and cancer.

The panel plans to meet monthly and to complete its work within six months. The review was scheduled to start early this year but was delayed for undisclosed reasons (see *MWN*, N/D90, J/F91 and J/A91).

Oak Ridge Associated Universities (ORAU) of Oak Ridge, TN, and Washington, DC, is coordinating the review under contract to CIRRPC. According to a statement issued by ORAU, the review panel will evaluate reported carcinogenic, reproductive and neurophysiological effects. It will consider both power frequencies (15-180 Hz) and very low frequencies (VLF) (10-30 kHz) from video display terminals (VDTs), though they will be addressed separately.

Dr. Glenn Davis, chairman of ORAU's Medical Sciences Division, is chairman of the review panel. The other ten members are: Drs. William Bennett, Yale University, New Haven, CT; Joseph Brady, Johns Hopkins University School of Medicine, Baltimore, MD; Robert Brent, Jefferson Medical College, Philadelphia, PA; Leon Gordis, Johns Hopkins University School of Medicine; William Gordon, Rice University, Houston, TX; Samuel Greenhouse, George Washington University, Washington, DC; Russel Reiter, University of Texas, San Antonio; Gary Stein, University of Massachusetts Medical Center, Worcester; Charles Susskind, University of California, Berkeley; and Dimitrios Trichopoulos, Harvard University School of Public Health, Boston, MA. (Susskind was originally named to head the panel.)

RAC Approves SAB Report on EPA Cancer Assessment

At a September 20 meeting, the Science Advisory Board's (SAB) Radiation Advisory Committee (RAC) unanimously approved the Non-Ionizing EMF Subcommittee's report on the Environmental Protection Agency (EPA) draft EMF–cancer assessment. Four of the seven RAC members were present at the Washington, DC, meeting.

The subcommittee report asks EPA to rewrite its EMF–cancer assessment, citing "serious deficiencies," and cautions that there are insufficient data to classify EMFs as carcinogenic (see *MWN*, J/F91, M/J91 and J/A91).

The SAB's Executive Committee will now review the subcommittee's report at an October 29-30 meeting. Kathleen Conway, an SAB staff member, told *Microwave News* that she expects the executive committee will also approve it. If so, the report will then be sent to EPA Administrator William Reilly.

Five More Cancer–Police Radar Claims Filed

The number of legal claims alleging that police officers developed cancer as a result of operating speed radar units has increased by five, bringing the total to eight. Three Connecticut officers with cancer have filed workers' compensation claims. And the widow of a Wisconsin state trooper who died of cancer and a California police officer who has cancer have filed lawsuits against radar manufacturers. All five of the officers used radar units manufactured by Kustom Signals, Inc., of Overland Park, KS.

In Connecticut, Thomas Malcolm, 42, of the Windsor Locks Police Department (WLPD), charges that he developed testicular cancer from operating a Kustom radar since 1977. Ricardo Rachele, 33, also of the WLPD, used a Kustom unit since 1979 and has cancer in his shoulder and collarbone. A third officer, Vincent Casertano, 56, of the Shelton Police Department, has thyroid cancer—he began operating a Kustom radar in 1971. All three are represented by attorney Stuart Rothenberg of Rothenberg, Rothenberg & Rothenberg in Manchester, CT.

William Gifford, Windsor Locks' police chief, told the Manchester, CT, *Journal Inquirer* that he will continue using the Kustom radar units but that he plans to investigate whether they can cause cancer. Gifford did not respond to a request for comment from *Microwave News*.

In Wisconsin, Naomi Sudbrink of Augusta is suing Kustom, which manufactured the radar units her late husband Arnold had used for more than three years as a Wisconsin state trooper, and five insurance companies. Arnold Sudbrink died last September from cancer that first developed in his eye. The suit was filed on September 13 in Wisconsin Circuit Court for Eau Claire County, where Arnold Sudbrink lived.

Officer Steven Cottini of the Concord (CA) Police Department and his wife, Christine, are seeking $12.5 million from Kustom and MPD, Inc., of Owensboro, KY, for Steven's testicular cancer. From 1977 to 1979, while working for the San Bruno (CA) Police Department, Cottini used the MPD units. From 1979 to 1987, he used the Kustom radar devices while at the Concord Police Department. The suit was filed September 10 in U.S. District Court for Northern California in San Francisco.

John Sweeney of Agoura Hills, CA, is the attorney for both Sudbrink and the Cottinis. Earlier this year, Sweeney sued Kustom on behalf of three plaintiffs (see *MWN*, M/A91 and J/A91).

William Ruppert, a partner in Kustom, told *Microwave News* in a telephone interview that he had no comment on the claims made against the company.

FDA Police Radar Hot Line

The Food and Drug Administration's (FDA) "Problem Reporting Hot Line" is now responding to inquiries about police radar health effects. Data collected from callers may be used to develop an epidemiological survey, according to agency officials.

The hot line, which is regularly used for problems with medical devices, is referring calls to the television, acoustics and microwaves products branch of the Office of Compliance at the agency's Center for Devices and Radiological Health. The hot line number is: (800) 638-6725.

NIOSH VDT Epi Study Revisited

Two letters published in the September 12 *New England Journal of Medicine* question the conclusions of the National Institute for Occupational Safety and Health (NIOSH) study of VDT workers and spontaneous abortions (see *MWN*, M/A91).

In one letter, Dr. Robert Newcombe and Edward Coles of the University of Wales College of Medicine, U.K., cite "considerable" differences between the study population and the controls in the mean number of pregnancies per woman, cautioning that, "The results presented could conceal a potentially serious hazard associated with the use of VDTs, if the difference in the rates of pregnancy resulted from excess early, undetected fetal loss in the exposed group."

The second letter, written by editors of *Microwave News* and *VDT News*, argues that NIOSH's conclusion—that exposure to VDT electromagnetic fields (EMFs) was not associated with an increased risk of spontaneous abortion—was not justified since both the case and the control groups were equally exposed to extremely low frequency EMFs.

In their response, NIOSH's Dr. Teresa Schnorr and colleagues said that the apparent differences in pregnancies went away when adjustments were made for the women who had worked as both directory assistance operators (the case group) and general operators (the control group) during the study period. With respect to EMFs, they pointed out that the crucial difference between cases and controls was that the VDT operators were exposed to higher very low frequency (VLF) EMFs.

Microwave Eye Damage *(continued from p.1)*

mission.

In a presentation at the June meeting of the Bioelectromagnetics Society (BEMS), Kues described how the eyes of monkeys exposed to 3.5-4 W/Kg of 1.25 GHz radiation (0.5 μsec pulses at 16 Hz) for four hours a day, three times a week for three weeks lost most of their cone function and half of their rod function. One week after exposure, the rod photoreceptors returned to approximately 80% of their pre-exposure level, but the cones remained damaged. Cone damage is manifested by a loss of color discrimination and some decrease in visual acuity, Kues explained. Impaired rods result in reduction in night vision.

Four monkeys were exposed and all suffered similar damage, leading Kues and Monahan to conclude that the threshold for the effect is below 3.5 W/Kg. Examination of the eye tissue confirmed the degeneration of cones and suggested that a specific population of cones is more vulnerable than others—different types of cones are responsible for detecting different colors.

Kues and colleagues at JHU medical school's Wilmer Institute—Kues divides his time between the APL and Wilmer—examined two workers who were accidentally exposed to 6 GHz microwaves while operating an illegal satellite uplink. The 30-watt transmitter exposed their retinas to an estimated 5 mW/cm^2 of continuous wave radiation for two 15-minute periods. Both men suffered a 50% loss in cone response as measured by changes in electroretinograms (ERGs). Seven months later, there was no improvement.

Based on these results, Kues and Monahan recommend diagnostic tests for those occupationally or accidentally exposed to microwaves, including: specular microscopy, retinal and iris fluorescein angiography and ERGs. If referred by an ophthalmologist, the Wilmer Institute will examine anyone who has been accidentally exposed to microwave levels in excess of existing safety guidelines as part of its research program, Kues said.

Researchers at JHU-APL have been investigating the effects of microwave radiation on the eye since the early 1980s. In a series of studies, a team led by Kues and Monahan has shown that low-level, pulsed radiation can injure the endothelial layer of the cornea and cause leakage in the blood–aqueous barrier. The effect occurs at a specific absorption rate (SAR) of 2.6 W/Kg or less (see *MWN*, J/A83, S/O86 and J/A87). In addition, the team found that eyes treated with glaucoma drugs are much more sensitive to microwaves—at levels as low as 0.26 W/Kg (see *MWN*, J/A88).

Both the old and the new results challenge the specifics of the current (1991) revision of the 1982 American National Standards Institute (ANSI) guidelines for human exposure to radiofrequency and microwave radiation. The SCC-28 committee rewriting the standard concluded that "whole-body SARs below 4 W/Kg were not associated with effects that demonstrably constitute a hazard for humans." The SCC-28 committee has been criticized for ignoring the previous Kues-Monahan findings (see p.9).

At the BEMS meeting, Kues was asked why the epidemiological study would be done in the U.S.S.R. instead of in the U.S. He replied that U.S. military officials had been "very reluctant" to provide any data. In an interview, Kues said that the Department of Defense is concerned about privacy issues.

A paper describing both the monkey and human results has been submitted for publication to *Archives of Ophthalmology*.

UPDATES

COMPATIBILITY & INTERFERENCE

Black Hawk Helicopter Accidents...EMI has never caused a Black Hawk helicopter accident, according to Secretary of the Army Michael Stone. In an unpublished, August 6 letter to the *New York Times*, obtained by *Microwave News* through the Freedom of Information Act, Stone contends that reports of seri-

ous EMI problems "wrongly discredit an Army helicopter that has proven itself to be a safe, highly effective piece of equipment." One such report, a November 1987 piece from Knight–Ridder Newspapers, blamed EMI for the crashes of five Black Hawk helicopters and the deaths of 22 servicemen since 1982 (see *MWN*, N/D87). A June 1988 investigation by the DOD concluded that the Black Hawk is indeed susceptible to EMI, and in a September 1988 memo to the DOD Inspector General, Stone, then under secretary of the Army, acknowledged that "EMI does raise safety of flight concerns with respect to the Black Hawk" (see *MWN*, S/O88 and N/D88). In his letter to the *Times*, Stone calls the Black Hawk "one of the safest helicopters in the Army's inventory," and points out that, "Since 1987, the accident rate has fallen by 47%." Stone does not mention that in 1987 the Army issued warnings to Black Hawk pilots to stay away from high-power radio transmitters and instituted a program to shield the helicopter from EMI.

INTERNATIONAL

Trip to China... Study Mission International (SMI), a division of W/L Associates, and the Bioelectromagnetics Society are organizing a 19-day, five-city tour of China for September 1993. Participants will meet with Chinese researchers working on the biological effects of 50 Hz EMFs, RF/MW radiation and millimeter waves, as well as their medical and agricultural applications. Dr. C.K. Chou of the City of Hope National Medical Center in Duarte, CA, who will lead the delegation, told *Microwave News* that the trip will be a "mixture of business and pleasure—we intend to explore bioelectromagnetic research and see the sights." Space is limited to 35 scientists and their spouses at a cost of less than $3,000 per person. For more information, contact: Dr. William Wisecup, W/L Associates, 120 W. Church St., Frederick, MD 21701, (301) 663-1915.

MEDICAL APPLICATIONS

RF for a Racing Heart...RF radiation can be used as an effective treatment for paroxysmal supraventricular tachycardia (PSVT)—a rapid heartbeat condition which afflicts roughly one in every 200 people in the U.S.—according to several recent studies. In the past, drug therapy or surgery was required to prevent natural electrical impulses in the heart from triggering up to 300 beats per minute. Now researchers are using RF radiation to insure that these impulses, typically occurring 60 times per minute, stimulate only one beat each. The June 6 *New England Journal of Medicine* includes two papers on this new treatment: Dr. Warren Jackman and coworkers at the University of Oklahoma Health Sciences Center in Oklahoma City report that the treatment is "highly effective," and a team headed by Dr. Hugh Calkins of the University of Michigan Medical Center in Ann Arbor asserts that the new method is "feasible and practical" and has "a favorable risk–benefit ratio." In an accompanying editorial, Dr. Jeremy Ruskin of the Massachusetts General Hospital in Boston predicts that, if the early data are confirmed, the technique will become the "treatment of choice" for PSVT patients. In a paper published in the June 29 issue of *The Lancet*, German researchers led by Dr. Karl-Heinz Kuck of the University Hospital Eppendorf in Hamburg state that the RF treatment "has none of the disadvantages of direct-current shock therapy," and that initial reports on its use are "promising." Despite these optimistic conclusions, the researchers do note some adverse reactions to the treatment. For a popular account of the new research, see the July 20 issue of *Science News*.

MRI Safety... The safety of magnetic resonance imagers (MRIs) is again being questioned. Participants at a May conference on MRI safety held in Bethesda, MD, heard several reports that the intense static magnetic fields, RF EMFs and gradient EMFs from new high-speed MRIs have occasionally produced biological responses ranging from vertigo to a metallic taste in patients' mouths at strengths as low as 1.5 T, according to the July/August issue of *The Institute*, a publication of the Institute of Electrical and Electronics Engineers. Dr. Jeffrey Weinreb of the New York University Medical Center's MRI Department stated in a presentation at the conference that, "We've been saying [that MRIs are safe] for so long, we almost believe it. We now know there are many potential safety hazards with MRI." *Science* also reported on the meeting, which was sponsored by the New York Academy of Sciences. "For the moment...the main task seems to be to find out what effect these high-tech medical wonders actually have on living tissue," it reported in its May 31 issue.

MEETINGS

T&D on EMFs... Excerpts from presentations at a conference held in February are the heart of a 16-page article, "EMF: How Dangerous?" in the June issue of *Transmission & Distribution* magazine, which sponsored the meeting (see *MWN*, M/A91). Among the speakers were: Paul Brodeur of *The New Yorker;* Arthur Bryant of Trial Lawyers for Public Justice, Washington, DC; Dr. Granger Morgan of Carnegie Mellon University, Pittsburgh, PA; U.S. Rep. Frank Pallone (D-NJ); James Sanford of PSE&G of New Jersey; and Thomas Watson of Crowell & Moring, Washington, DC. A copy of the June issue can be obtained for $5.00 from: Intertech Publications, PO Box 12901, Overland Park, KS 66212, (913) 541-6628.

PEOPLE

Dr. **Alicia Dustira** is the EMF contact in the White House Office of Science and Technology Policy (OSTP), reporting to Dr. **Allan Bromley**, the President's science advisor, who has criticized EPA's draft EMF–cancer assessment (see *MWN*, N/D90 and M/J91)....The IEEE has recognized Dr. **Eleanor Adair** of the John Pierce Foundation in New Haven, CT, and **Richard Harris** of National Public Radio for their "literary contributions furthering public understanding of the engineering profession." At a September 1 awards ceremony, the IEEE's U.S. Activities unit praised Adair for "her scholarly and balanced paper titled *Currents of Death Rectified*," a response to Paul Brodeur's book on EMFs which first appeared as a series of articles in *The New Yorker*. Harris was honored for "his balanced five-part series" on EMFs, which ran April 15-19, 1991. Harris

is continuing to follow the EMF debate; he aired an update on the EPA cancer report on September 17....Dr. **Jan Walleczek** has joined Dr. **Ross Adey**'s laboratory at the VA Hospital in Loma Linda, CA. His work is being supported by a grant from the John Fetzer Institute in Kalamazoo, MI....Dr. **Maria Stuchly**, who will soon leave Health and Welfare Canada for the University of Victoria in British Columbia, has been named chair of the International Union of Radio Science's (URSI) newly formed Commission K on Electromagnetics in Biology and Medicine. Dr. **Paola Bernardi** of the University of Rome is the vice-chair. Commission K was set up at URSI's August 1990 meeting in Prague, Czechoslovakia. Stuchly plans to have the first meeting of the more than 20 members of her committee at the *1st World Congress for Electricity and Magnetism in Biology and Medicine* in Orlando, FL, in June 1992 (see *MWN*, M/A91).

STANDARDS

NRPB Updates MRI Standards... The U.K.'s NRPB's revised standards for exposures to MRI systems, outlined by Dr. R.D. Saunders in the July 1991 *Radiological Protection Bulletin*, are generally two-tiered, with a lower limit which may be exceeded under controlled conditions and an upper limit which should not be exceeded. For *static magnetic fields*, the lower limit is 2.5 T and the maximum is 4 T. For *gradient magnetic fields*, the board specifies a maximum induced current density of 400 mA/m² (or 20 T/s) when the magnetic fields are changing for longer than 120 μsec. This limit can be relaxed for shorter exposures. For RF radiation, the board recommends lower and upper limits for whole body SARs of 1 W/Kg and 2 W/Kg, respectively, for exposures of more than 30 minutes. Progressively higher SARs can be applied for shorter exposures up to maximum limits of 2 W/Kg and 4 W/Kg, respectively, averaged over a 15-minute period. Separate limits are specified for the head, trunk and limbs. The board also advises that women should not have an MRI exam during the first three months of pregnancy. A copy of the "Board Statement on Clinical Magnetic Resonance Diagnostic Procedures," *Documents of the NRPB*, 2, No.1, is available for £5.00 from: Her Majesty's Stationery Office Publications Center, PO Box 276, London SW8 5DT, U.K., (44+071) 873-9090.

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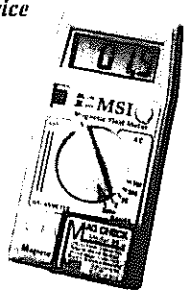

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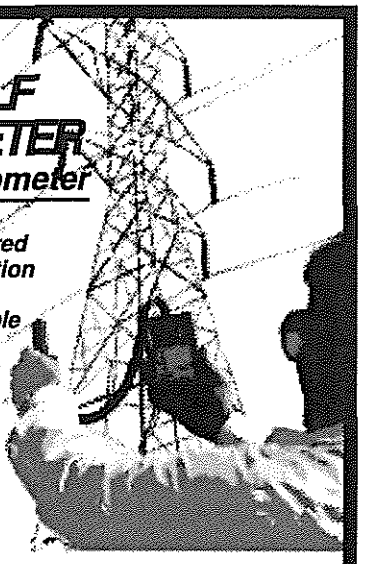

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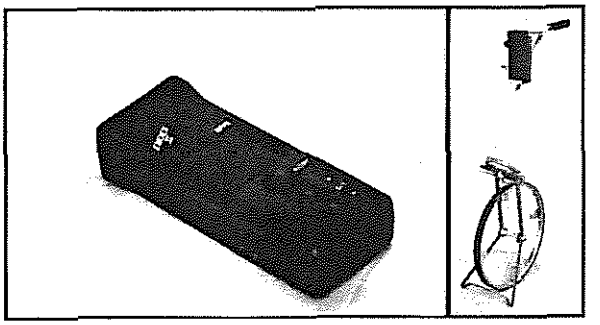

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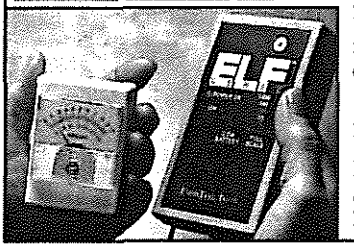

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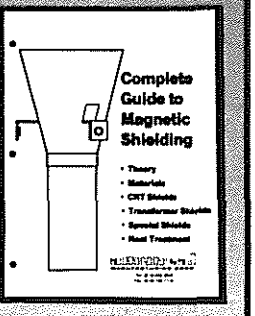

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MICRO WAVE NEWS

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Swedish Officials Acknowledge EMF–Cancer Connection

New Epi Studies Prompt Policy Shift

Mitigation Strategies Being Adopted

On September 30, Sweden's National Board for Industrial and Technical Development, NUTEK, formally announced that from now on it "will act on the assumption that there is a connection between exposure to power frequency magnetic fields and cancer, in particular childhood cancer."

The new policy was prompted by two major epidemiological studies, released the same day, which add support to the proposition that exposures to weak electromagnetic fields (EMFs) at home and on the job contribute to the development of cancer. This is the first time a national government has recognized the EMF–cancer link.

Jaak Nöu, the director of NUTEK's Department of Electrical Safety, told *Microwave News* that the new policy will apply primarily to children. "We don't yet consider the link proven for adults—this will have to wait for detailed investigations from around the world."

In the residential study, Dr. Anders Ahlbom and Maria Feychting of the Institute of Environmental Medicine at the Karolinska Institute in Stockholm found that children exposed to average fields of 3 mG or more in their homes

U.S. Congress Okays $65 Million EMF Research Plan, see p.2.

had close to four times the expected rate of leukemia. The link to cancer among adults was weaker than for children. "The results provide support for the hypothesis that exposure to magnetic fields increases the risk of cancer," they concluded.

The occupational study by Dr. Birgitta Floderus and coworkers at the Department of Neuromedicine at the National Institute of Occupational Health (NIOH) in Solna, a suburb of Stockholm, showed that men exposed to similar levels of magnetic fields at work had three times the expected incidence of chronic lymphocytic leukemia (CLL).

The studies, which used sophisticated exposure assessments, go a long way toward resolving some of the ambiguities that have prompted doubts about the EMF–cancer link. Most notably, they identify dose–response relationships between cancer and EMF exposure and may explain why previous childhood cancer studies failed to establish a link with measured magnetic fields.

NUTEK will soon begin work on EMF exposure regulations for new homes near power lines and for all new electrical facilities, which Nöu predicted would take about six months to complete. He said that the standard

(continued on p.12)

« Power Line Talk »

The **Health Effects Institute**'s much-delayed EMF research plan will be released by the end of the year, according to Acting President Dr. **Charles Powers**. "HEI is never going to step into a scientific area until its board and its scientific advisers have determined that they have something to contribute," Powers told *Microwave News*, adding that HEI had not promised the plan by a certain date. Dr. Andrew Sivak, who resigned last spring from his position as president of HEI, had originally predicted that the report would be completed by November 1991. After HEI's board reviewed a draft, however, an extensive rewrite was undertaken (see *MWN*, N/D91). "HEI is managing the creation of the report directly now," Powers explained, and Cambridge-based Gradient Corp., which coordinated the work under Sivak, is no longer involved. Dr. **Joe Brain** of Harvard University's School of Public Health now heads the Electric and Magnetic Fields Research Planning Committee; the former chair, Dr. **Richard Setlow** of Brookhaven National Lab, remains a member of the committee. HEI began its work on EMFs in 1991 with funding from **EPA**, which has been considering the creation of a public–private research program (see *MWN*, M/A91, J/A91 and S/O91). The assessment of possible research directions "will be useful irrespective of any additional role HEI may play," Powers said.

«« »»

A 230 kV Philadelphia Electric Co. (**PECO**) power line should not be energized until the Pennsylvania Public Utility Commission (**PUC**) sets EMF exposure standards, PUC administrative law judge **Herbert Smolen** ruled on August 19. Smolen said he made the decision in spite of the fact that "no causal connection between biological effects of EMFs and harm to human health has been scientifically proven or disproven." The PUC had originally approved the utility's plan to upgrade the line from 138 kV in 1990 (see *MWN*, M/J91). Residents and citizens groups later petitioned to have the case reviewed. The PUC has no plans to regulate exposures, according to spokesman John Frazier. On September 14, PECO filed an exception to Smolen's decision—a move that will force the full commission to review and vote on the case, Frazier said. "Smolen couldn't find any adverse health effects, and then he turned around and said the line shouldn't be energized," argued PECO spokesman Bill Jones. "Why endanger service to so many people when we are well within Florida and New York standards?" Jones further criticized Smolen's decision for being "disastrous to economic development" in the state and said that it would set "an extremely dangerous precedent." Even though the commission may decide to reverse Smolen's ruling, nearby residents have claimed a victory. "It's a terrific decision," Dorothy English of Parents Against an Unsafe Environment (**PAUSE**) told *Microwave News*. "We have no EMF exposure standards in Pennsylvania and it's great that the PUC recognizes that maybe it's time for a change." According to Jones, EMFs would measure about 40 mG at the edge of the right-of-way along the 12.8 mile line, which runs between two towns in Bucks and Montgomery Counties. Florida and New York have set right-of-way magnetic field limits for 230 kV lines at 150 mG and 200 mG, respectively (see *MWN*, M/A88, M/A89, J/F90, M/A90 and S/O90). Interestingly, the Florida standard was set after the state's Siting Board denied the Florida Power Corporation a permit to build a 500 kV line, pending the development of magnetic field exposure limits (see *MWN*, M/A86). The Pennsylvania PUC will probably meet to vote on the case at the end of the fall, Frazier said.

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A subsidiary of the **Irish Electricity Supply Board** (ESB) and Dick Roche, a member of the Irish parliament, have engaged in a stinging exchange over whether the subsidiary is fit to investigate a possible EMF–cancer link in North Dublin, since the ESB is involved in long-standing disputes over the siting of its power lines (see *MWN*, S/O87 and M/A89). "There is a well-accepted principle that one cannot be the judge in one's own case," quipped Roche in a July 10 letter to Gerry Breen, managing director of ESBI Engineering Ltd.—a subsidiary of the ESB, Ireland's Dublin-based national utility. Breen had written to Roche saying that he took "grave exception" to remarks Roche had made that appeared in the *Irish Independent*, because they implied that his company lacked "professionalism

Congress Approves $65 Million EMF Research Program

On October 8, Congress passed a far-reaching national energy bill that, among many other provisions, authorizes a $65 million electromagnetic field (EMF) research and public information program. As we went to press, the President was expected to sign the bill.

When the legislation emerged from a House–Senate conference committee, the Department of Energy (DOE) had again been put in charge of the program and been given specific responsibility for engineering research. The National Institute of Environmental Health Sciences (NIEHS) retained responsibility for all health effects research and the communications component of the program. The original version of the legislation gave the entire effort to the DOE, but it was transferred to NIEHS in the bill the House passed last May (see *MWN*, J/F92, M/A92 and M/J92).

The measure provides for $13 million in each of the next five years, of which up to $1 million is for communications. Half of the funds are to come from nonfederal sources.

A full report on the legislation will appear in our next issue.

and ethical standards." He refuted Roche's claim that it would be difficult for an ESB subsidiary to give an "objective appraisal" of its parent company. ESBI Engineering has been asked by a state medical officer to assist in measuring EMFs from power lines in North Dublin. Roche represents County Wicklow, which includes North Dublin, in parliament.

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The **California Energy Commission** (CEC) should take steps to ensure that public exposures to power line EMFs do not grow in the future, according to a report by CEC Staff Toxicologist Dr. Obed Odoemelam—but Odoemelam also recommends that no action be taken to lower EMFs from their present levels. Reducing magnetic fields "would mark a major departure from the existing electric field-based approaches to field control," the report states. Odoemelam reasons that there is not enough scientific evidence to warrant further mitigation policies. "Changes in field control should be instituted only after establishing the cancer-causing effects of magnetic field exposure with a high level of certainty," he writes. The 27-page report provides a brief overview of laboratory, cellular and epidemiological studies on the effects of EMFs and concludes that they are often unreliable or contradictory and permit only "uncertain interpretations." The report is careful to note, however, that the possibility of "significant biological effects cannot be discounted," and recommends that the CEC continue to support related research. The commission has not yet taken a position on the issue, nor has it announced plans to do so, CEC Executive Director B.B. Blevins told *Microwave News*. To order a copy of *High-Voltage Transmission Lines: Summary of Health Effects Studies*, send $2.10 and a self-addressed mailing label to: California Energy Commission, Publication Unit, 1516 Ninth St., MS-13, Sacramento, CA 95814. Refer to publication No. P700-92-002.

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Dr. **Charles Polk** of the University of Rhode Island is organizing a mini-symposium, "Where Are the Thresholds for Biological Effects of Non-Endogenous Low Frequency, Low Intensity EMFs," at the *14th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, to be held in Paris, France, on October 29-November 1. Among the scheduled speakers are Drs. **Friedemann Kaiser, Ken McLeod, Jerry Phillips** and **Bill Pickard**....And Dr. **Morando Soffritti** of the Institute of Oncology in Bologna, Italy, is planning a half-day conference, *ELF EMFs and Cancer: A Priority for Research* on November 23 in Carpi, which is near Bologna. Dr. **Anders Ahlbom**, Dr. **Gary Boorman, Paul Brodeur**, Dr. **Cesare Maltoni** and Dr. **Sam Milham** have been invited to give presentations.

NIEHS Awards IITRI $8 Million for Animal Studies

The National Institute of Environmental Health Sciences (NIEHS) has signed an $8,292,397 contract with the Chicago-based IIT Research Institute (IITRI) for a study of the possible carcinogenic and reproductive effects of 60 Hz magnetic fields on laboratory animals. The effort marks the largest set of studies ever attempted by a health agency in the U.S.

In the cancer study—which will use more than 2,000 rats and mice—animals will be exposed to continuous 20 mG, 2 G or 10 G magnetic fields, or to intermittent 10 G magnetic fields for up to two years. Researchers will use 100 animals in each exposure group, instead of the usual 50, to "give greater sensitivity in detecting marginal effects of exposure," said Dr. Gary Boorman, project officer for the study and chief of NIEHS' pathology branch.

Three generations of animals will be monitored in the reproductive study. Number of litters, number and percent of live pups per litter and mean body weight of live offspring of exposed parents will be checked. The offspring will then be bred, and their offspring will be similarly observed.

The 56-month contract, signed on August 10, will be administered by the National Toxicology Program (NTP), which coordinates research for the Department of Health and Human Services (DHHS); NIEHS is a part of the DHHS. Construction of a $2 million animal exposure system began in September, and the experiments will begin next spring, Boorman said. The National Institute of Standards and Technology (NIST) will confirm that the exposure setup is correct, Boorman said, noting that NIST's validation "will add to the credibility of the study."

For a copy of the *Statement of Work for the Conduct of Studies to Evaluate the Toxic and Carcinogenic Potential of 60 Hz Magnetic Fields in Laboratory Animals for the National Toxicology Program*, contact: Thomas Hardee, NIEHS, Contracts and Procurements Management Branch, PO Box 12874, Research Triangle Park, NC 27709, (919) 541-0429. Refer to contract No. N01-ES-25351. For more on the study, see *MWN*, S/O90.

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Utility Group Develops Home Measurement Protocol

In an effort to help utilities respond to customers' requests, a task force of utility engineers is developing a protocol for EMF measurements. "Power companies all over the country are taking readings in different ways," said Peter Jump, a spokesman for the Edison Electric Institute, a member of the task force. "We wanted a standard way of doing them."

The protocol will help small utilities that might not have the resources to develop expertise in measuring EMFs, as well as the larger companies that are confronted with growing numbers of requests for information, explained Kate Maracas, director of the task force, formally known as the National EMF Measurement Protocol Group (NEMPG). Maracas is an environmental engineer at the Salt River Project, a publicly owned utility based in Phoenix. She said the group also plans to produce a training video to accompany the protocol, which should be completed by the spring of 1993.

The Institute of Electrical and Electronics Engineers (IEEE) Magnetic Fields Task Force—a subcommittee of IEEE's AC Fields Working Group—has been working closely with NEMPG in developing the standard, Maracas said. The IEEE group will publish its own protocol for power frequency fields in January.

NEMPG was formed last September. Its members include utility representatives and three utility trade organizations: the American Public Power Association, the Edison Electric Institute and the National Rural Electric Cooperative Association.

EMF Measurement Guides

Dr. Granger Morgan of Carnegie Mellon University has written a new booklet, *Measuring Power Frequency Fields*, which offers advice on EMF surveys in the home and workplace. The guide is for individuals who ask experts to take readings for them or who plan to take measurements themselves. Morgan and his colleagues, including Drs. Jack Adams, Baruch Fischhoff and Indira Nair, are also working on a second booklet, which is meant to be consulted after a survey has been done. *Making Sense out of Measurements of Electric and Magnetic Fields* offers ways of interpreting the findings and reviews EMF health risks. The second booklet will be available in a couple of months.

Carnegie Mellon has distributed more than 100,000 copies of its original booklet, *Electric and Magnetic Fields from 60 Hertz Electric Power: What Do We Know About Possible Health Risks?* since it was first published in 1989.

To order the measurement guides, contact: Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, PA 15213. Prices were not available as we went to press.

Legal Notebook

PG&E Worker's Family Files EMF Claim

The family of a former Pacific Gas & Electric (PG&E) maintenance worker filed a wrongful death claim against the northern California utility on August 10, charging that the electrician's fatal leukemia was caused by his on-the-job exposure to EMFs. John Lacey, who died in February at the age of 40, had worked at various substations in the San Francisco Bay area from 1971 to 1981; his leukemia was diagnosed in 1990, according to his attorney, Flora Chu of the San Francisco firm of Hawes & Chu. Chu said that she might also bring a personal injury suit on the family's behalf.

Lacey's duties for PG&E included inspecting and reading meters on electrical equipment and checking devices in underground vaults, according to a stipulation of facts signed by Chu and PG&E's lawyer, Carl Allen. EMFs from switching devices in such vaults can reach 37 G, according to measurements commissioned by the International Brotherhood of Electrical Workers (IBEW) Local 1245, based in Walnut Creek, CA. IBEW's Landis Martula told *Microwave News* that union members are concerned about EMFs and that they are considering assembling a cancer registry for utility workers.

PG&E is reviewing Lacey's job records and medical history, according to PG&E spokesman Scott Blakey. It is too early in the investigation to say "anything meaningful" about the case, Blakey said. In March, a Washington State agency rejected a claim that a Seattle City Light electrical worker's death from leukemia was caused by his exposure to EMFs (see *MWN*, M/J92). That decision has been appealed.

A Change in the Course of EMF Litigation?

Mounting evidence of a potential link between EMFs and health hazards is likely to change the course of EMF personal injury litigation, writes Kristopher Brown in the March 1992 issue of the *Boston University Law Review*.

Owners and manufacturers of equipment that generates EMFs will find it increasingly difficult to argue that they were unaware of the risks associated with EMFs and, as a result, they will face a greater threat of liability under negligence and strict product liability laws, Brown predicts.

Meanwhile, plaintiffs will continue to face the difficult task of proving causation—the connection between exposure to EMFs and injury—as scientific evidence on the subject remains inconclusive and courts may decide not to admit EMF expert testimony, further hindering plaintiffs' efforts, according to Brown. Judges have rejected such testimony in the past due to a lack of scientific evidence (see, for example, *MWN*, J/A92).

"The EMF debate is not likely to be resolved in the near future," Brown concludes, "[but] unless serious consideration is soon given to these complex questions, EMF personal injury litigation is destined to become a legal quagmire."

Are Navy Communications Towers Responsible for Hawaiian Childhood Leukemia Cluster?

A cluster of childhood leukemia cases near a Navy submarine communications facility in the Waianae Coast section of the island of Oahu, HI continues to defy attempts to pinpoint a cause. But recent reports by the Hawaii Department of Health (DOH) and by the U.S. Environmental Protection Agency (EPA) add evidence that the cluster, first investigated in the mid-1980s, was not due to chance and might be related to radiofrequency (RF) radiation emissions from the Navy facility, which is known as Lualualei.

The DOH investigation, a case–control study of 14 children who were diagnosed with leukemia between 1977 and 1990, found that the incidence of the disease was higher among children who lived closer to Lualualei. This finding was not statistically significant, but elevated odds ratios were identified for all six variables the researchers used to assess proximity to Lualualei. The DOH report concluded that there may be a "weak association" between proximity to the transmitters and the incidence of leukemia but cautioned that, "We do not have enough knowledge to link the two causally."

"I don't think the cluster is a chance event," Dr. Gertraud Maskarinec, coauthor of the DOH report, told *Microwave News*. She added that childhood leukemia rates in the area have been normal in recent years.

Overall, the 14 cases constitute a statistically significant doubling of the expected number, based on childhood leukemia rates for the state. But the researchers found that the greatest cause for concern was in a three-year period: seven children were diagnosed with leukemia from 1982 to 1984. "These...cases are unusual in several respects," the report explains, because:

- Five of [the seven] were acute non-lymphocytic leukemias, while three out of four childhood leukemias statewide are of the lymphocytic type.
- Six of the cases were girls, while childhood leukemia is usually somewhat more common in boys than in girls.
- Four of these girls were between nine and twelve years old at diagnosis, [while the] peak age of onset for childhood leukemias is around three years.

A number of possible causes for this cluster have been raised: RF radiation from Lualualei; benzene from used motor oil; pesticide-contaminated milk; some other, unknown carcinogenic chemical; or exposure to a carcinogen in combination with RF emissions from Lualualei.

Dr. Bruce Anderson, DOH's deputy director for environmental health administration, said in an interview that he is less concerned about the Lualualei transmitters than he is about possible exposure to carcinogenic chemicals, such as benzene. "There was a lot of used motor oil being brought to that community," he said, explaining that a waste-oil hauler had operations there. Rather than disposing of the oil, the hauler sprayed it on roads to keep dust down and gave large amounts to area residents, some of whom used it on their farms. The waste oil, found in 55-gallon drums on property throughout the area, is the object of a DOH-led cleanup effort begun in 1991.

DOH researchers considered the waste oil problem but did not analyze it in the case–control study. "I cannot think of a practical way to assess exposure," Maskarinec said.

The possibility that emissions from Lualualei could be harmful has worried nearby residents for more than a decade. In 1982, reacting to their concerns, the Navy measured radiation within the boundaries of its facility and declared that there was no health risk (see *MWN*, J/A82). By 1985, however, the unusual occurrence of childhood leukemia had been noticed and was brought to the attention of the Cancer Research Center of Hawaii, which ran a preliminary investigation; the center recommended further study, including measurements of RF exposures (see *MWN*, M/J87). In the summer of 1990, U.S. Sen. Daniel Akaka (D-HI) and a state legislator held separate hearings that addressed Lualualei. Shortly thereafter, the DOH

Similar Cluster Near U.S. Navy Transmitters in Scotland

A cluster of childhood leukemia has also been documented in Thurso, on the north coast of Scotland, near a U.S. Navy communications facility. This cluster has prompted several studies—primarily examining ionizing radiation—which have yielded few answers. No detailed investigation of RF radiation from the Navy complex, in Forss, has yet been done.

An extensive analysis of a possible connection with ionizing radiation from a nearby nuclear fuel reprocessing plant at Dounreay was completed in 1988 by the Committee on Medical Aspects of Radiation in the Environment (COMARE), a government-sponsored panel. The report concluded that the elevated cancer rates could not be linked to radiation from the nuclear facility: "Conventional dose and risk estimates suggest that neither authorised nor accidental [radioactive] discharges could be responsible."

But the report also argued that the cluster was not a chance occurrence. Between 1979 and 1984, six children developed leukemia—a statistically significant increase. The panel noted that, "These are extreme results and this is a remarkable observation."

A follow-up study by the Scottish Health Service, published in 1991, failed to establish a link between the children's leukemia and their fathers' exposure to nuclear radiation at the Dounreay plant.

The Navy's Forss transmitter facility is located about halfway between the Dounreay nuclear station and the town of Thurso.

EPA May Return to RF/MW Limits

The Environmental Protection Agency (EPA) is considering resuming work on setting safety limits for human exposures to radiofrequency and microwave (RF/MW) radiation. EPA stopped developing the limits—commonly known as RF/MW guidance—in 1988.

"We are currently evaluating the need for the guidance," Margo Oge, the director of EPA's Office of Radiation Programs (ORP), announced at a Senate hearing on police radar on August 10 in Washington (see p.7). EPA is also planning to hold a conference on the health effects of RF radiation, she said.

Following the hearing, Sen. Joseph Lieberman (D-CT) urged EPA Administrator William Reilly "to take up the development of [the RF/MW] guidance again." This was the second time this year that EPA was asked to return to the question of RF/MW exposure limits. Accompanying its review of the agency's cancer report, EPA's Science Advisory Board recommended that the agency "complete its efforts with regard to [RF/MW radiation] and issue exposure guidelines independent of present issues pertaining to lower frequencies" (see *MWN*, J/A91 and J/F92).

At the end of September, Marty Halper, the director of ORP's Radiation Studies Division, told *Microwave News* that the EPA conference, which is tentatively scheduled for April, will address RF/MW bioeffects and cost–benefit issues. "If those at the conference perceive a need for the guidance, we'll do it," he said.

In an interview, Oge said, "It will be important for the agency to finalize its work."

EPA began work on the guidance in the late 1970s and was set to propose a 100 $\mu W/cm^2$ limit for 30-300 MHz radiation in 1984 when the agency's policy office forced a delay (see *MWN*, Jun84 and J/A84). EPA continued to work on the standard but abandoned the effort in 1988 (see *MWN*, J/A86 and S/O88).

began its investigation, asking EPA to measure the RF radiation near the Navy facility (see *MWN*, S/O90 and J/F91).

The RF emissions from Lualualei are uncommon, since the Navy transmitters are used for long-distance communications with submarines and are found in only three other U.S. communities, according to EPA. The Navy uses equipment operating in the very low frequency (VLF), low frequency (LF) and high frequency (HF) ranges (see box p.7).

"VLF electric and magnetic fields were studied much more intensively than fields at other frequencies because of the high power of this transmitter," according to the report, which was prepared by Edwin Mantiply of EPA's National Air and Radiation Environmental Laboratory in Montgomery, AL. The VLF transmitter operates continuously at 23.4 kHz, with an output of 512 kW. Mantiply also sampled electromagnetic fields from power lines at several outdoor locations in the community.

Mantiply found electric field strengths as high as 82 V/m from the VLF transmitter, and magnetic field strengths as high as 99 mA/m, in an open area just outside the facility. In a telephone interview, he said that in the adjacent communities "people do get exposed to 80 V/m outdoors," adding that, "you see 60 V/m in wide areas." But the EPA report was not designed to assess typical exposures, and no measurements were taken indoors or near the residences of those who developed leukemia. "The object was to gain some understanding of field levels in the community rather than conduct a detailed exposure assessment," the report states. The results are generally consistent with the measurements the Navy made in 1982.

Some significant questions about this cluster remain unanswered. For example, the DOH investigators noted in their report that four of the children with leukemia lived in Quonset huts—WWII surplus buildings which have corrugated metal roofs in a half-cylinder shape. There are several hundred such buildings used as homes in the area. Maskarinec said she could reach no conclusions about this finding. "I'm tempted to think it's a surrogate for something else," she said—perhaps time spent outdoors, since Quonset huts are presumably less comfortable than other homes, or exposure to some toxic chemical or metal. She said that she would expect these buildings to shield their occupants against radiation from Lualualei but added that, "It would be a good idea to measure there."

EPA's Mantiply said the Quonset huts would affect RF exposures. "They could be your best shield or your worst nightmare," he said. "It all depends on how they are built." If the metal roof is well grounded, it will function as a shield. If it is not, he explained, it will work much like an antenna and could "be a strong source of VLF current" for someone who came in direct contact with it. He emphasized that he had not investigated these buildings.

The DOH investigators also explored the possibility that something unusual had happened at the Lualualei facility to trigger the leukemia outbreak that occurred from 1982 to 1984. They searched a newspaper index and found that maintenance problems and disrepair led to the firing of the maintenance contractor at Lualualei in early 1981, but they were hesitant to draw any conclusions from this. "One hypothesis about the effects of electromagnetic radiation suggests intermittent or irregular exposures may be more harmful than continuous exposures," the report states. "However, a real association between the leukemia cluster and the events in 1981 appears unlikely because of the short incubation period."

Another episode from the early 1980s was not addressed by the DOH. In January 1982, milk supplies on the island of Oahu were found to have been accidentally contaminated with heptachlor, a pesticide that had been sprayed on pineapple leaves used as feed for dairy cattle. The tainted milk was sold for at least 57 days before a general recall was begun, according to a report in *Science (217*, pp.137-140, July 9, 1982). Several experts "are concerned that infants in particular will suffer a heightened risk

of leukemia or liver disorders," the article stated.

DOH's Anderson said he does not believe that the heptachlor contamination could be associated with the cluster since "the milk problem was an island-wide problem" and the cluster just appeared in the Waianae Coast section.

Several recent studies have suggested that electromagnetic radiation can act synergistically with known chemical tumor promoters to accelerate the development of cancer (see *MWN*, J/A89, N/D90 and J/A91). None of these studies has specifically addressed VLF radiation, however, nor did the DOH look into such combined effects. In the mid-1980s, the DOH found that people living next to radio and TV broadcast towers in Honolulu had elevated rates of cancer (see *MWN*, M/J87).

If a child had ever lived within 2.2 miles of the Lualualei facility, or lived within 2.6 miles just before diagnosis or at birth, the leukemia risk was more than double that of the controls. Residence within 2.6 miles of the transmitters in 1981 yielded a risk more than three times that of the controls, as did a summary index used to assess proximity to Lualualei. A history of cancer in the family also showed an association with the incidence of leukemia. None of the findings in the case–control study achieved statistical significance.

The DOH report, *Investigation of Childhood Leukemia on the Waianae Coast 1977-1990*, is available from: Hawaii DOH, Communication Office, 1250 Punchbowl Street, Honolulu, HI 96813, (808) 586-4442. The EPA report, *Measurements of Electric and Magnetic Fields in the Waianae, Hawaii Area* (400R-92-009, July 1992), is available from: EPA, National Air and Radiation Environmental Laboratory, 1504 Avenue A, Montgomery, AL 36115, (205) 270-3400.

RF Radiation from Lualualei

The following are the maximum field strengths as measured by EPA outside the boundaries of the Lualualei Naval Radio Transmission Facility:

	Electric Field	Magnetic Field
VLF (23.4 kHz)	82 V/m	99 mA/m
LF (146.1 kHz)	0.5 V/m	0.9 mA/m
HF (3-30 MHz*)	8.8 V/m	22 mA/m

From: EPA, *Measurements of Electric and Magnetic Fields in the Waianae, Hawaii Area*, 1992.

* Various frequencies.

Congress Directs NIOSH To Study Police Radar–Cancer Link

The U.S. Congress has directed the National Institute for Occupational Safety and Health (NIOSH) to begin an epidemiological study of the possible link between police radar use and cancer.

At a Senate hearing in August, scientists, radar manufacturers, federal health officials and police officers all voiced support for a federal study. Such an effort was first proposed by Sen. Christopher Dodd and strongly promoted by Sen. Joseph Lieberman—both Democrats from Connecticut.

"Senator Dodd and I are going to stick with this until we get some answers," Lieberman said at the August 10 hearing of the Senate Governmental Affairs Committee's ad hoc subcommittee on consumer and environmental affairs, which he chairs.

"There's a patience level of [how much delay] we'll tolerate here, and it's about to run out," Dodd added, after announcing that the National Institute of Environmental Health Sciences had responded to his May request for a study by saying only that it might do a feasibility study (see *MWN*, M/A92).

Sen. John Glenn (D-OH), chairman of the committee, who also participated in the hearing, said that he is "extremely disturbed" about reported links between police radar use and cancer (see *MWN*, J/A91, S/O91 and M/A92).

After the hearing, Lieberman, Dodd, Glenn and Sen. Dennis DeConcini (D-AZ) asked the Senate Appropriations Committee subcommittee on labor, health and human services and education to fund the study. The subcommittee did not earmark funds for a study but added language to appropriations legislation for NIOSH urging the agency to conduct one. An aide to Sen. Tom Harkin (D-IA), who chairs the subcommittee, told *Microwave News* that NIOSH "seems willing to move forward," but added that the legislation does not require the study. Funding would come from the agency's general operating budget, she said.

NIOSH's Dr. Bryan Hardin endorsed the study at the August hearing and said that "caution in the use of radar guns...is prudent" until more research is done. In materials sent to Lieberman in late August, NIOSH estimated that the study would cost $1.7 million and take three to five years.

Lieberman has asked the Environmental Protection Agency

"Wow!"

At one point during the hearing, Sen. Lieberman asked Dr. Ross Adey what other technologies might pose health risks if police radar is indeed a cancer threat.

Adey listed electric blankets, microwave ovens, radio-frequency sealers and cellular phones, which he said can produce "a quite high field in the brain."

"Wow! There's a lot to be worried about here," Lieberman said, acknowledging a moment later that his response was "non-senatorial."

Adey's point was reinforced by a letter Lieberman received following the hearing from Dr. Eleanor Adair of the John Pierce Laboratory in New Haven, CT, who is skeptical of police radar hazards. She wrote: "If you accept the indictment that radar guns produce cancer, then you must so indict every similar device."

(EPA) to transfer to NIOSH some of the $1.8 million in unspent funds that EPA received last year for electromagnetic field (EMF) research (see *MWN*, J/A92). On August 13, Lieberman wrote to EPA Administrator William Reilly urging the agency to transfer the money "so that NIOSH can initiate this needed study at the earliest possible time." In a September 21 response, EPA's assistant administrator for R&D, Dr. Erich Bretthauer, declined, for the present, to release any funds.

The study was backed by John Kusek, a vice president of Kustom Signals Inc., one of the nation's largest manufacturers of police radar devices, though he maintained that police radar is not hazardous. In his testimony, Kusek explained that, "We feel research would substantiate our view of the risk." He defended the safety of Kustom's radar units on the basis of the 1991 Institute of Electrical and Electronics Engineers (IEEE) exposure guidelines, which he said were designed to be "as conservative as possible" (see *MWN*, N/D91).

Kusek also disclosed that his company has sued Connecticut to block the ban on hand-held radar units that the state enacted earlier this year (see below). About 30% of all police radar units are hand-held, he estimated.

Dr. Ross Adey of the Veterans Administration Hospital in Loma Linda, CA testified that low-power radar sources could be harmful. Citing recent findings by Germany's Drs. Werner Grundler and Friedemann Kaiser, Adey suggested that it may not be possible to define a threshold below which radar emissions are safe. "Clear responses occurred at incident field levels of 5 picowatts/cm^2, about one million times below field levels permitted" under the IEEE guideline, Adey said, concluding that the standard, which permits exposures to 5 mW/cm^2 at police radar frequencies, is too lenient.

Asked by Lieberman whether police officers have "a legitimate cause to worry," Adey responded that police radar "may carry a significant biological and biomedical risk based on both the physical evidence and the biological evidence."

Henry Kues of the Johns Hopkins University Applied Physics Lab (JHU-APL) in Laurel, MD described his research on the effects of microwaves on the eye (see *MWN*, S/O91). He noted that, under certain circumstances, police officers using hand-held radar are exposed to levels higher than those allowed under the 100 μW/cm^2 JHU-APL exposure standard (see *MWN*, D84).

John Rankine, a member of the IEEE's standards board, said he doubts police radar is harmful. But he added that he views anecdotal reports of an association between police radar and cancer "with concern" and supports a study. Rankine said the 1991 IEEE standard was written by "the most open, best attended and best qualified committee" among the hundreds that have developed IEEE standards.

Police officers testifying at the hearing urged Lieberman and Dodd to make sure the federal study gets done. "Senators, you are our last best hope," Ohio State Trooper Gary Poynter testified. Poynter's compilation of cancer incidence among police officers first brought the police radar issue to national attention. He noted that the total number of cancer cases he has cataloged is now 168, up from the 89 cases he had identified as of last spring (see *MWN*, M/A91 and M/A92).

Windsor Locks, CT policeman Thomas Malcolm, whose testicular cancer is in remission, showed the senators at the hearing how he had rested the radar unit near his groin without turning it off (see *MWN*, S/O91). He also urged Lieberman and Dodd to act. "If I can save one more police officer, then I've done my job. If you can force a study, then you've done your job," he said.

Sam Franzo, representing the International Brotherhood of Police Officers in Rocky Hill, CT, said that his union supports a national ban on the use of police radar transmitters inside cars. "We just want the antenna outside the car and a national study. What's the big deal?" he asked.

Radar Manufacturer Sues Connecticut

Kustom Signals Inc. of Lenexa, KS has filed suit against Connecticut Governor Lowell Weicker and other state officials, challenging the state's ban on hand-held radar. In its August 7 complaint, Kustom said that the law violates the company's constitutional rights and was passed "without credible scientific support."

Connecticut enacted the law on June 1 to "protect police officers from the risk of cancer caused by the use of hand-held radar devices," according to Sen. Joseph Lieberman (see *MWN*, M/A92 and M/J92). The senator told *Microwave News* that he is confident the ban will be upheld, adding that it is a "moderate, reasonable response" to the threat police officers face when they use hand-held radar.

Kustom Signals, a leading manufacturer of traffic radar, argued in its claim that "non-ionizing emissions from hand-held radar devices are very low, and exposure even at the closest possible distance to them does not constitute a hazard to human health....It is not reasonable to conclude from the existing data that radiofrequency exposure from hand-held radar devices is a cause of cancer."

The defendants in the suit have not yet been served. Kustom has 120 days from the time the claim was filed in U.S. District Court in Hartford to notify Weicker and others formally about the complaint; otherwise, it could be dismissed. William Ruppert, chairman and CEO of Kustom Signals, did not respond to repeated telephone calls from *Microwave News*.

VDT Foundation Establishes Health Research Center at JHU

The Johns Hopkins University (JHU) School of Hygiene and Public Health in Baltimore has been selected to run the Center for VDT and Health Research on behalf of the VDT Health Research Foundation (HRF). Dr. Ronald Gray, a physician and epidemiologist with a background in reproductive health issues, was named director, and Dr. Patrick Breysse, a well-known EMF researcher, was named associate director.

Gray told *Microwave News* that a high priority will be an examination of what parameters of video display terminal (VDT) EMFs are important for studies of human health. The

center may host a workshop on this topic next year. Gray noted, however, that it is too early to say precisely what mix of studies the center will pursue.

An advisory board with ten to twelve members will select the center's projects, he explained. The board should be complete soon and will hold its first meeting later this year or early next year. It will include "some outstanding people" on exposure assessment, as well as experts on epidemiology, ergonomics and stress, Gray said.

The JHU School of Hygiene and Public Health has, in the past, been involved in research on cancer and occupational exposure to EMFs. Breysse has worked with Dr. Genevieve Matanoski on a major study of cancer among telephone workers (see *MWN*, N/D89 and J/A91). JHU researchers will be allowed to compete for funding from the center, Breysse said.

Launched last winter by IBM Corp., Apple Computer Inc. and Compaq Computer Corp. (see *MWN*, M/A92), the VDT HRF has so far failed to enlist support from other corporations to expand its research funding base—a goal of the organization. Some computer makers may be apprehensive about pointing to a problem, said Philip Shellhaas, director of public policy programs for IBM and executive director of the foundation. In an interview at the *Work With Display Units '92* conference in Berlin in early September, Shellhaas said there may also be a concern "that any research that is sponsored by industry would be seen as less credible than work done by a government agency like NIOSH." He said that the foundation is presently talking to a "short list" of six or eight interested companies, and that he hopes to attract international support.

To date, the foundation has committed to providing the research center with about $2.25 million over three years.

Columbia University, Harvard University, the University of California and the University of Texas had also been considered for the center.

FROM THE FIELD

BPA Updates EMF Guidelines

Following the recommendations of its EMF task force, the Bonneville Power Administration (BPA) has updated its EMF guidelines, last revised in 1988. "Where EMF[s] had been one of the many considerations in design and location of new BPA facilities, [they are] now a major decision factor," according to a memo that accompanied the new guidelines. The full text of the 1992 Bonneville Interim Guidelines on Electric and Magnetic Fields, *which went into effect in June, appears below. For more information, contact: Dr. Jack Lee, Bonneville Power Administration, PO Box 3621 (EFB), Portland, OR 97208, (503) 230-4530.*

Recognizing

- that public concern is increasing over potential health effects of EMFs and that this concern is important to BPA,
- that a clear course of action cannot be determined from present scientific evidence and
- that defining and addressing any risks associated with EMFs is the responsibility of the entire society, which values both the availability of energy and the well-being of its citizens,

BPA adopts the following revised interim guidelines governing its practices with regard to electric and magnetic fields. As new information becomes available, these guidelines will be reexamined. Such reexamination will occur at least every two years.

1. Because it appears that it will take several more years before sufficient scientific data is available to establish whether EMFs are a threat to public or worker health, it does not appear prudent at this time for BPA to modify existing electrical field standards or establish numerical field strength standards for magnetic fields produced by BPA facilities.

As states in the region review the issue of EMFs and consider limits on these fields, BPA will participate in the process. BPA will adopt practices consistent with EMF standards in such states, to the maximum extent practicable.

2. BPA will continue to support R&D efforts dealing with EMF issues.

3. In arriving at design and location choices for new transmission facilities:

- EMF exposure shall be a major decision factor to be balanced with other major decision factors (such as reliability).
- Accordingly, BPA shall seek to keep EMF exposures as low as are reasonably achievable, considering social, economic and environmental factors.
- BPA will consider both existing mitigation techniques (such as developing alternative facility locations; increasing right-of-way widths; altering line or tower geometry; using higher voltages to reduce current levels; and undergrounding) and developing technology. The practicability of these options will be determined on a case-by-case basis.

4. Where practical alternatives exist, public and employee exposure to EMFs should not be increased by any BPA operations, practices or actions.

5. BPA employees will be kept informed on current research and information.

6. BPA will explore, in conjunction with its employees, ways to reduce exposures in carrying out their jobs.

7. BPA will actively seek to inform and involve affected customers and the public in BPA project development, including evaluation of siting factors such as EMFs. BPA will continue to develop appropriate educational materials and to respond to requests from the public for information or measurement of EMFs associated with the BPA transmission system.

8. BPA will involve its utility customers and the public in its policy deliberations on EMFs.

Radar and Nerve Damage: A WWII Veteran's Case Report

To the Editor:

During World War II, I served in the U.S. Navy as an aviation radar specialist assigned to an airborne antisubmarine branch of the Atlantic Fleet.

For three years, I worked on S-band (2-4 GHz) airborne search radar units that were rated at 50 kW peak power (36 W average power). In a small shop set up for the purpose, I serviced and tested these radars,

often using something known as an echo box—a cylindrical cavity that simulated echoes when placed in the radar beam. The echo box required tuning adjustments during this procedure, forcing me to work directly in front of the radiating antenna.

During training I was never told of any microwave exposure hazards, and in fact I was taught this specific maintenance procedure, which required extensive, direct exposure to microwaves. I would commonly spend an hour or two at a time in the beam of the radiating antenna.

Generally, the right side of my head was nearest the radar antenna—just four feet away. At this distance, the radar had a free-space field intensity of about 32 mW/cm^2. But I believe that numerous field reflections were present to cause even higher exposures. Possibly most important, the radar signals were intensified by a two-inch metal denture I wore on the right side of my mouth—with the result that the adjacent facial nerve tissue was thermally injured.

My nerve injury occurred suddenly in late 1944. After servicing a radar with the echo box procedure, a swelling developed under my right maxillary bone prominence, just above the location of the denture. Soon I found that my face was insensitive to touch around the swelling. I assumed it was an insect bite. After a week or two, the swelling receded but a sense of facial numbness on the right side remained and has persisted to this day.

I began to drool saliva uncontrollably and dribble food out of the right side of my mouth. Feeling at the time that this was a temporary but personal ailment that should be hidden from my peers and my superiors to avoid ridicule and possible discrimination in advancement, I developed ways to hide my injury from others.

When I was discharged from the Navy in 1946, my wife saw my condition and insisted that I consult with the family doctor, who promptly directed me to a neurologist. The neurologist performed extensive nerve tests, X-ray studies and a spinal tap, and he had tissue removed from the right maxillary sinus for examination. He concluded that the fifth, seventh, and, to a lesser degree, third nerves were damaged and said he believed that demyelination had occurred. This doctor found no evidence of a tumor or disease, but he remarked that the onset of the condition and other symptoms reminded him of an X-ray or diathermy exposure injury.

I related the story of my radar exposure but the doctor expressed total ignorance of microwave effects on humans. I dropped the matter though the symptoms remained and, I believe, presented handicaps in my relationships with employers and social contacts.

I developed eye problems that can be connected to my radar exposure as well: bilateral cataracts and retinal detachments. My right eye conjunctiva had no feeling (as a result of the damage to the fifth nerve), and this eye had retinal lesions, seriously restricting the sharpness of my vision and my field of view.

In 1976, 32 years after my microwave exposures, I read a news article by Jack Anderson revealing to the public for the first time evidence of injuries to World War II veterans who worked on radar. Noting similarities with my own neural and visual disorders, I sought and obtained new neurological and eye examinations. This time, the doctors concluded that the wartime exposures were the logical cause. The neural disorder was believed to be the result of a thermal lesion produced by focused microwave radiation in the vicinity of the metal denture that I wore.

I then prepared and presented claims to the Veterans Administration (VA) for both the eye and nerve injuries. After several denials and subsequent appeals over a period of 14 years, the VA agreed to my claim for eye injuries, but flatly disagreed that the neuropathy had anything to do with microwaves. VA officials argued that it was impossible to prove that my exposure could have been "excessive," and they claimed that there is no scientifically or medically recognized link between exposure to microwave radiation and peripheral (facial area) cranial nerve damage.

I am now 75 years of age, and I still live with my neural disorder and still believe that it resulted from being exposed to radar microwaves. I hope to prove it somehow, if only to benefit a fuller scientific and medical understanding of injuries such as mine.

Sincerely,
John McWade
67690 Ontina Rd.
Cathedral City, CA 92234

UPDATES

BROADCAST TOWERS

Expansion Limits... Health concerns are keeping the debate over radio and television towers alive in Seattle. In August, the city enacted a height limit that is designed, according to City Councilwoman Sue Donaldson, to keep new "super towers" from being built and to provide an incentive for broadcasters to move their facilities to nonresidential areas. The ordinance sets an overall height limit of 1,100 feet above sea level, which is about 100 feet higher than the tallest existing towers, and specifies other restrictions on expansion. Donaldson, chair of the city's land-use committee and the sponsor of the measure, told *Microwave News* that the cap would "keep a speculative, very tall tower from coming in." She was referring to a proposed 1,000-foot tower—rising 1,400 feet above sea level—that could have encouraged other broadcasters in the area to increase the height of their existing towers. Don Wilkinson, director of engineering for KOMO television, said that his station has had plans since the mid-1980s to raise its existing tower to 1,350 feet above sea level. With this move now blocked, Wilkinson explained, the station may have difficulties in accommodating new broadcast technologies such as high-definition television. But Wilkinson argued that the new ordinance will not force the station to move its facility to a less-populated location outside the city, stating that the towers for all local TV stations "need to be centrally located and reasonably close together." The ordinance is a compromise "that we're not terribly pleased with," Wilkinson said. The most vehement opponents of Seattle's broadcast towers were also dissatisfied with the new rules, according to Steve Ludwig, president of Citizens Against Tower Expansion (CATE). Members of his organization, who are concerned about reports of elevated cancer rates in their Queen Anne Hill neighborhood, were part of an angry, noisy crowd of protesters that twice forced the city council to adjourn while it voted on the broadcast tower ordinance on August 10. Seattle adopted public exposure guidelines for RF radiation last January (see *MWN*, J/F92).

INTERNATIONAL

Radar and Power Line Fears in Ireland... In the small town of Crossmaglen, Northern Ireland, near the border with the Republic of Ireland, ten people have died from brain hemorrhages and three from brain tumors—out of a population of about 2,400—in the last two years, and residents suspect NIER from a nearby British Army surveillance post, according to an account in the Dublin *Sunday Press* (June 28). A local physician, Dr. Mary Allen, sounded the alarm. "In all the areas I have worked I have never experienced such a high level of general illness," Allen told the *Press*. "This ranges from listlessness and insomnia to cancer and mental illnesses, including anxiety and depression. We need a comprehensive survey of the health of the community...and we need the Army to disclose what type of equipment they're using." The newspaper reported that the British Army has "been using surface movement radar in the area since 1986."...EMFs from power lines are causing concern in the Dublin suburb of Ballymun. The June 8 *Evening Herald* reported that seven women in a 400-house development known as Belclare Estate have died of cancer in the last 14 months. An environmental group, Healthwatch Ireland, has taken EMF measurements, which are in turn being reviewed by a government agency, and the Irish Minister for Health, Dr. John O'Connell, has begun an investigation into the Ballymun cancer cluster. "You cannot start a total scare, but these figures warrant further study...by a team of epidemiologists," Dr. Patricia Sheehan, a radiation researcher, told the *Herald*. "No one knows what causes cancer, but it has been established that when people are exposed to non-ionizing radiation and ionizing radiation there is an increase in cancer."

BBC Tower Sparks Controversy... An environmental health specialist in Birmingham, U.K., Dr. Mark Payne, has identified seven cases of leukemia and lymphoma among residents who live within 1,500 meters of a British Broadcasting Corp. (BBC) radio and television tower, according to reports on March 30 in *The Guardian* and in *The Birmingham Post*. All but one lived in the area for at least 14 years. The 750-foot tower transmits four television and seven radio stations. Payne culled the cancer cases from the medical records of a general practitioner in the area who has about 2,600 patients. He also found that there are 12 area residents currently receiving treatment for mental illness. "Had the Sutton Coldfield transmitter been a new drug, it would have to have passed elaborate tests as to its long-term safety," Payne wrote in an as-yet-unpublished letter to a British medical journal obtained by *Microwave News*. Such tests are not required, he added, "because of the widely held view that, apart from the heating effect, non-ionizing radiation presents no health hazards. We need to reassess this [view]."

MILITARY SYSTEMS

Microwave Weaponry... An article in *Aviation Week & Space Technology* flatly contradicts a report in a competing publication that an EMP weapon was used in the Gulf War. The earlier story, in the April 13-19 issue of *Defense News*, stated that an EMP warhead mounted on the Navy's Tomahawk cruise missile was used in the opening days of Operation Desert Storm (see *MWN*, M/J92). The weapon, also referred to as a high-power microwave (HPM) device, was meant to disrupt electronics in Iraq's air defense systems, wrote coauthors Robert Holzer and Neil Munro. The piece in the April 27 *Aviation Week* confirmed part of the earlier report, quoting unnamed U.S. defense officials who said that a "Tomahawk-size" EMP warhead is being developed in projects at Los Alamos National Laboratory, NM and Eglin Air Force Base, FL. "[B]ut no such weapon was used against Iraq," *Aviation Week* reporter David Fulghum wrote. His story was not primarily about EMP weapons and made no specific reference to *Defense News*. Rather, the three-page article described a secret offensive to disrupt Iraqi air defenses. *Defense News*' Munro said his sources stick by their original story.

TECHNOLOGY

Microwave Dryers... For those who have toyed with the possibility of drying clothes in a microwave oven, just wait. American Micro-Tech Inc. of Lake Oswego, OR is developing a microwave clothes dryer. Tests of the appliance that were sponsored by Southern California Edison have shown a 10% energy savings as compared with a conventional electric dryer. The utility also touts faster drying, fewer wrinkles and less static cling. The dryer is a modified household tumble dryer: microwave generators have been added, along with door locks and shielding; a low-wattage electric heating unit is still needed to help carry moisture out of the dryer....EPRI researchers are also studying this technology and have recently completed a prototype. They are still working out some kinks, however: metal buttons, coins and zippers are not a problem in the microwave dryer, but long, thin metal objects such as bobby pins or nails can heat up and damage clothing. "In a microwave dryer...microwaves 'target' the water molecules clinging to the clothes rather than the molecules constituting the fabrics," EPRI's John Kesselring wrote in the June *EPRI Journal* (pp.34-36). "In experimental testing, dryer temperatures...generally have not exceeded 110°F, an excellent range for drying delicate fabrics." Kesselring, who is with EPRI's Customer Systems Division, predicted that the dryers could be on the market as early as 1994. Past announcements that this technology would soon be available to consumers have proved to be premature, however (see *MWN*, N/D88).

CORRECTION

In our last issue, we misstated the per-mile construction costs of overhead and underground power lines in the article on "The Economics of Mitigation" (p.4). The cost of a 345 kV H-frame configuration is $390,000 per mile and the cost of burying the same line is $1,450,000 per mile, according to a report prepared for Rhode Island's EMF task force by Commonwealth Associates.

might require that average annual exposures be less than 2 mG, noting that peak fields would be less than 4 mG. The average exposure could end up being 3 or 4 mG, Nöu said. "We will have to balance the health of the Swedish population with the economic costs of the standard." NUTEK is responsible for electrical safety regulations in Sweden.

If the 2 mG average limit is adopted, there will be a right-of-way (ROW) of approximately 200 meters—about 300 feet on each side—for a 400 kV power line, according to Nöu. He noted that this ROW could be reduced to 100 meters with low magnetic field transmission designs and the use of other mitigation strategies.

"The most difficult problem is what to do about existing homes and power lines," Nöu said. "The cost of decreasing these magnetic fields will be enormous."

Rolf Lindgren, the EMF manager for the state power company, Vattenfall, and a member of NUTEK's safety standards committee, told *Microwave News* that exposures above 2 mG from existing power lines and substations would be addressed "on a case-by-case basis," adding that, "Changes would have to be weighed against the economic costs."

When asked whether Sweden would adopt a 2 mG occupational standard, Lindgren replied that such a limit "would bring an end to industrial society in Sweden." He predicted that market forces, which will now favor low magnetic field systems, would yield ways of reducing worker and public exposures.

A 2-4 mG population standard would be up to 100 times more stringent than the standards adopted by New York State and Florida—the only two magnetic field limits in the U.S. (see *MWN*, M/A89 and S/O90). It would be up to 500 times stricter than the International Radiation Protection Association (IRPA) guidelines for public exposures to 50/60 Hz magnetic fields and up to 2,500 times stricter than IRPA's occupational standard (see *MWN*, M/J89).

The new epidemiological results are, in the words of NIOH's Dr. Kjell Hansson Mild, "remarkably clear in pointing to a connection between cancer and magnetic field exposures." And Dr. Lars-Erik Paulsson of the Swedish Radiation Protection Institute in Stockholm said that, "The childhood cancer study confirms earlier findings with astonishing precision." Both Mild, who is based in Umeå, and Paulsson were present when the epidemiological results and the NUTEK policy were announced in Stockholm.

Lindgren and Mild both cited the need to design new homes with electrical circuitry that would limit magnetic field exposures. Similarly, in an interview with *Microwave News*, Per Erik Boivie of the Swedish Confederation of Professional Employees, TCO, in Stockholm, argued for low magnetic fields in new office buildings. "We think our strategy to bring down fields as low as possible is a very good strategy," he said.

In its public statement, NUTEK made a commitment to sponsor more research to determine the mechanism of interaction—a move endorsed by many of the Swedish officials interviewed for this report.

The Ahlbom–Feychting and Floderus studies cost more than $2 million and took more than five years to complete (see *MWN*, M/J87). Both groups said that they will soon submit their results for publication. The epidemiological studies are part of a larger Swedish research program, which includes studies on animals and on cellular systems.

Reactions in the U.S. and the U.K.

Few American researchers have yet seen the full reports of the two studies, but summaries have been widely disseminated (see p.14 for the full texts of the abstracts). "The results are very suggestive of a real association with childhood leukemia," said Dr. David Savitz, an epidemiologist at the University of North Carolina, Chapel Hill. Similarly, Dr. Richard Stevens of the Battelle Pacific Northwest Lab in Richland, WA said that, "It is hard to imagine what obvious problem could account for these results other than magnetic fields." With respect to the occupational study, Dr. Sam Milham, who recently retired from the Washington State Department of Health, said, "It's a confirmation that EMF exposures are associated with certain cancers."

"My first thought is that this further evidence, coming from extensive work by well-established scientists, may finally allow scientists who would like to work on the problem to do so without unwarranted put-downs by the 'old boys' of science," Dr. Nancy Wertheimer told *Microwave News* from her office in Boulder, CO. In 1979, Wertheimer, working with physicist Ed Leeper, first identified the link between childhood cancer and high current lines by using a system of wire codes to estimate long-term magnetic field exposures.

Representatives of utilities outside Sweden are reserving final judgment on the new research until they have had a chance to analyze the studies carefully.

The Ahlbom–Feychting study was "rigorously conducted" and "provides important new information," according to the Electric Power Research Institute (EPRI) in Palo Alto, CA. In an interview, Dr. Stanley Sussman, manager of EMF health studies, said, "We're trying to put it into perspective with the rest of the literature. Frankly, we need more information, particularly with respect to the modeling of the historical fields, which is critical to their results." Sussman said that EPRI had not yet completed its review of the Floderus occupational study.

Robert Beck, vice president for environmental affairs at the Edison Electric Institute (EEI) in Washington, called the studies "important contributions to our body of knowledge," adding

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that they "provide us with some more answers, and questions, to the EMF puzzle." He stressed "the need for a coordinated and comprehensive national research program into possible EMF health effects." (Congress has now passed such a plan, see p.2.)

Richard Loughery, EEI's EMF issue manager, said that he looks forward to debating the new results at the Department of Energy's (DOE) annual review of EMF research, which will be held in San Diego on November 9-12. Both Ahlbom and Floderus will present their results at the DOE meeting.

In the U.K., Dr. John Male of the National Grid Co. in Leatherhead, Surrey told *Microwave News* that, "We see this as an important addition to the scientific data base. We await an assessment of its significance by the National Radiological Protection Board (NRPB)." Last spring, the board issued a report which concluded that there is "no firm evidence" of a cancer risk from exposures to power frequency EMFs (see *MWN*, M/A92).

Ahlbom–Feychting Residential Study

Ahlbom and Feychting used the most detailed exposure assessment ever attempted, reconstructing long-term magnetic field exposures for those living next to high voltage power lines. First, they used a computer model to calculate the magnetic fields inside homes next to power lines carrying a known amount of current and confirmed the accuracy of the model with spot measurements. Then, using Vattenfall's historical records of the current loads on the nation's power lines, they estimated the average field exposures for each case and for corresponding controls at the year of diagnosis as well as one, five and ten years before diagnosis; they also estimated exposures for children at the time of birth and at the time of conception.

Based on these estimated long-term exposures, Ahlbom and Feychting found that childhood leukemia rates rose with increasing magnetic field exposures—a clear dose–response relationship. Children exposed to more than 1 mG had twice, those exposed to more than 2 mG had close to three times, and those exposed to more than 3 mG had nearly four times the incidence of leukemia of those exposed to less than 1 mG. Despite a small number of cases, the risk ratios are statistically significant. The researchers found similar results when exposure was defined by proximity to power lines.

Ahlbom and Feychting noted that controlling "for confounding from air pollution or socioeconomic status did not change the results."

In the U.S., Savitz and Dr. John Peters of the University of Southern California (USC) have each shown that children living near high current power lines have higher rates of cancer, but neither found a significant association with measured magnetic fields (see *MWN*, N/D86 and M/A91). Savitz and Peters each confirmed the landmark Wertheimer–Leeper study.

Importantly, like Savitz and Peters, Ahlbom and Feychting did not find a link between childhood cancer and spot magnetic field measurements. In a telephone interview, Feychting explained that, because currents on power lines have increased over the years, spot measurements do not correlate with the historical estimates—and tend to overestimate past exposures.

Norwegian and Danish Studies Also Point to Cancer Risk

Two other Scandinavian epidemiological studies—one on Norwegian workers and one on Danish children—also point to an EMF–cancer risk.

Drs. Tore Tynes, Aage Andersen and Frøydis Langmark of the Cancer Registry of Norway in Oslo report that male electrical workers with a "long duration of employment" had a statistically significant 40% increase in acute and chronic leukemia. The highest risks were among radio and TV repairmen, radio and telegraph operators and power line workers.

The results, which were based on an investigation of approximately 38,000 workers, appear in the July 1 issue of the *American Journal of Epidemiology (136*, pp.81-88, 1992). The researchers did not see an increased risk of brain tumors. Tynes and Andersen previously reported that this group of workers had an abnormally high rate of breast cancer (see *MWN*, J/F91).

And on October 7, as we went to press, Dr. Jørgen Olsen of the Danish Cancer Registry in Copenhagen announced that children living near high voltage power lines with magnetic field exposures of 1 mG or more had a statistically significant fivefold elevated risk of lymphoma, as compared with controls. Although no excess risk of leukemia or brain tumors was observed, the combined risk for these three types of childhood cancer was more than five-and-a-half times greater for exposures of 4 mG or more, as compared with controls.

"It is not possible to use spot measurements to know historical exposures," she said. "Our study provides a possible explanation as to why Savitz and the USC researchers found associations with wire codes and not with spot measurements," she concluded.

Savitz pointed out that the new study "has its own methodological strengths and weaknesses and these are different from the U.S. studies—it's not another Wertheimer–Leeper or Peters study." Battelle's Stevens noted that questions about control selection that have been raised with regard to the American studies—for instance, potential biases due to random digit dialing—do not apply to the Ahlbom–Feychting study.

For adults, Ahlbom and Feychting found a 70% excess of both acute myeloid leukemia (AML) and chronic myeloid leukemia (CML) for those exposed to more than 2 mG, as compared to those exposed to less than 1 mG. Neither of these results is statistically significant, however.

Unlike Wertheimer and Savitz, or Sweden's Dr. Lennart Tomenius (see *MWN*, N82, M/J86 and N/D87), Ahlbom and Feychting did not identify an EMF link to brain tumors in children. (Peters only looked at leukemia.) Nor did they find a link to brain tumors among adults. "We were surprised that we did not see a risk for brain tumors," Feychting said. Savitz

commented that, "Up until this study, the evidence was stronger for brain cancer than for leukemia. This shifts the balance somewhat."

The elevated cancer risk appears to apply only to those children who lived in single-family homes. In their report, Ahlbom and Feychting argued that this lack of an association may be explained by the small number of cases and because the "precision of the calculated fields may be lower for apartment houses than for one-family homes."

Ahlbom and Feychting's case–control study included all children with cancer and all adults with leukemia or brain tumors diagnosed between 1960 and 1985, among the nearly 500,000 people who lived within 300 meters of any of Sweden's 15,000 km of 220 and 400 kV lines. The researchers identified 142 children with cancer—39 with leukemia and 33 with brain tumors—and 558 controls. Among the adults, 325 cases of leukemia and 223 cases of brain tumors were compared with 1,091 controls.

"It would be very difficult to do this kind of study in the U.S.," Savitz pointed out, citing the detailed population, cancer

Abstracts of the Swedish Epidemiological Studies

On September 30, Maria Feychting and Anders Ahlbom of the Institute of Environmental Medicine at the Karolinska Institute, Stockholm, released their study, Magnetic Fields and Cancer in People Residing Near Swedish High Voltage Power Lines. *On the same day, Dr. Birgitta Floderus and coworkers at the Department of Neuromedicine at the National Institute of Occupational Health in Solna released* Occupational Exposure to Electromagnetic Fields in Relation to Leukemia and Brain Tumors: A Case–Control Study. *Reprinted below are the authors' summaries of the studies.*

Ahlbom–Feychting Residential Study

The aim of the present study was to test the hypothesis that exposure to magnetic fields of the type generated by high voltage power lines increases cancer incidence. The study was designed as a case–control study based on the population comprised of everyone who lived on property located within 300 meters from any of the 220 and 400 kV power lines in Sweden during the period from 1960 through 1985. For adults it was required that the duration of residence was at least one year. The corridor was chosen to be wide enough to ensure that it included both exposed and unexposed homes. The cases were all instances of cancer diagnosed between 1960-85. For children, all types of cancer were included, while for adults the study was restricted to leukemia and brain tumors. The cases were identified through a record linkage to the Cancer Registry. The controls were matched to the cases on time of diagnosis, age, sex, parish and power line. Exposure was assessed in several different ways. First, spot measurements were performed in the homes of the subjects. Second, the magnetic fields generated by the power lines were calculated by means of a computer program taking distance, line configuration and load into account. At the same time as a spot measurement was performed, the load on the line was obtained and the magnetic field calculated. Historical loads were obtained from records that were kept by the station managers. By using these in the program, calculated historical fields were obtained for various time periods appropriate from the etiological point of view. These calculated historical fields were the main source for classifying study subjects into different levels of magnetic field exposure. Thus, the main exposure metric was the annual average of the calculated magnetic field generated by the line. Third, for a sample of the subjects, 24-hour measurements were also performed.

For childhood leukemia and with cutoff points at 0.1 and 0.2 μT, the relative risk (RR) increased over the two exposure levels and was estimated at 2.7 (95% c.l.: 1.0-6.3) for 0.2 μT and over. The test for trend gave a p-value of 0.02. When the upper cutoff point was shifted to 0.3 μT the RR was instead 3.8 (1.4-9.3) and the corresponding trend test gave a p-value of 0.005. These results persisted when data were broken down by gender, age, time of diagnosis and area of living. However, it appeared that the relationship was confined to one-family homes. There was some relationship with distance but no relationship with spot measurements. Control for confounding from air pollution or socioeconomic status did not change the results. For brain tumors or for all childhood cancers together there was little support for an association.

In adults and for magnetic fields of 0.2 μT and over, the RRs for acute myeloid leukemia (AML) and chronic myeloid leukemia (CML) were estimated at 1.7 (0.8-3.5) and 1.7 (0.7-3.8), respectively. This result persisted in most analyses. For brain tumors no association was seen.

The finding of an association, in childhood leukemia, with calculated historical fields but not with measurements is consistent with the assumption that historical calculated fields are reasonably good predictors of past fields but that spot measurements are poor predictors of those fields. The confinement of an association to one-family homes might be explained by a limited accuracy in exposure assessments in apartment houses. The results provide support for the hypothesis that exposure to magnetic fields increases the risk of cancer. This is most evident in childhood leukemia. What aspect of the fields might be involved remains unclear.

Floderus Occupational Study

The relationships between occupational EMF exposure and leukemia or brain tumors were analyzed in a case–control study. The exposure assessment was based on measurements, the cancer diagnoses were verified from medical records and the cases and the controls were representative samples of the general male population.

Based on the job held longest during the 10-year period before diagnosis, an association between leukemia risk and EMF exposure was observed. The association was attributed to chronic lymphocytic leukemia (CLL) and in particular to exposure based on EMF mean values; the relative risk increased with increasing level of exposure. No association was found for AML. Ever having had a high-exposure job during lifetime was more common among patients of CLL compared with control subjects. No such relationship was found for AML. It is unlikely that the results for leukemia are explained by confounding from benzene, ionizing radiation, pesticides, solvents or smoking habits.

For brain tumors, some results speak in favor of an association. The relative risk of brain tumors was increased in the highest exposure categories, based on median values for the job held longest during the decade before diagnosis. The occurrence of benzene, ionizing radiation, pesticides, solvents or smoking did not have any decisive influence on the results. The association found was mainly attributed to subjects below the age of 40, with no major difference between the two groups of brain tumors (astrocytoma grade I-II and III-IV). Ever having had a high-exposure job was more common among brain tumor cases than among control subjects in the youngest age group.

The complex relationships between age at first exposure, cumulative exposure and age at diagnosis have to be further explored, as well as the possible interactions of EMF with other factors. Also the inconsistencies between sub-diagnoses have to be evaluated. The results of this study speak in favor of the hypothesis that occupational EMF exposure is a hazard in the development of certain cancers.