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An Investigation of Broadcast Radiation Intensities at Mt. Wilson, California

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AN INVESTIGATION OF BROADCAST RADIATION INTENSITIES AT MT. WILSON, CALIFORNIA

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PREFACE

The Office of Radiation Programs of the U.S. Environmental Protection Agency carries out a national program designed to evaluate population exposure to ionizing and nonionizing radiation, and to promote development of controls necessary to protect the public health and safety. This report describes a survey conducted at Mt. Wilson in the Los Angeles area to evaluate ambient radio frequency and microwave radiation intensities. Readers of this report are encouraged to inform the Office of Radiation Programs of any omissions or errors. Comments or requests for further information are also invited.

Floyd L. Galpin, Director
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ACKNOWLEDGMENTS

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INTRODUCTION

This report describes an investigation of electromagnetic field intensities at the multistation broadcast installation located at the top of Mt. Wilson near Los Angeles, California. Mt Wilson supports transmitting antennas for a total of 27 broadcast stations (12 FM radio stations and 15 television stations). In June 1975, a gross hazard survey was performed by the Los Angeles County Department of Health Services using a Narda Microwave Corporation electric field probe. The results of this survey indicated that exposures of 6 mW/cm^2 were found near the Mt. Wilson Post Office. Based on this finding a preliminary analysis was performed to estimate the potential broadcast radiation levels at Mt. Wilson [1]. The analysis concluded that ground level radiofrequency exposures would lie within the 1 28 mW/cm^2 range with the exact exposure level being dependent upon the particular vertical radiation patterns of the transmitting antennas which were involved. The vertical radiation pattern is a measure of the transmitting antenna's ability to focus the power in the vertical plane with the main beam aimed generally at the horizon [2]. Past experience by EPA has shown that some FM radio transmitters emit a radiation lobe almost straight down with an intensity equal to or greater than that emitted in the main beam. This finding supported the conclusion that ground level exposures exceeding 1 mW/cm^2 could exist on Mt. Wilson, but due to an insufficiency of data pertaining to vertical radiation patterns of VHF and UHF TV stations the upper limit was estimated, conservatively, to be as high as 28 mW/cm^2.

Exposures of this magnitude (28 mW/cm^2) are unquestionably considered hazardous, and since it was unclear as to what exposure levels exist on Mt. Wilson, a field investigation was performed in November of 1975 to conduct measurements of actual radiation levels. In addition to determining the exposure, it was considered important to evaluate different measurement techniques and instrumentation; this was partially accomplished by making use of a number of different microwave survey probes and a spectrum analyzer and sets of calibrated dipole antennas. It was hoped that the results of this field study could also help to evaluate other high intensity broadcast source locations throughout the country and aid EPA in evaluating population exposure to radiofrequency and microwave fields.

The Mt. Wilson site is probably unique to the entire nation in terms of source density and total number of stations. It was even considered that the Mt. Wilson complex might produce an upper limit nationally for public exposure to electromagnetic radiation.

Figure 1 depicts part of the extensive Mt. Wilson broadcast complex. A station listing is given in Tables 1 and 2 giving pertinent technical parameters of all FM and TV stations atop Mt. Wilson. There are no AM standard broadcast stations on Mt. Wilson. All of the stations together account for a total of 10.2 MW of effective radiated power (ERP); 586 kW of this total is due to the FM radio stations. FM station antennas vary in height above ground from 100 to 492 feet while TV antenna heights vary from 82 to 490 feet. Figure 2 is a map of the major tower complex on Mt. Wilson. It was produced by copying an aerial photograph and then reducing the size. Cross references for purposes of station identification and location were made with a number of information sources [3,4] and personal inspection and discussion with station personnel on the mountain. There exists a lower density antenna complex, principally KNXT-TV (channel 2) and KNX-FM, to the west of the area shown on the map. The Post Office is seen to be situated within several hundred feet of the major concentration of broadcast towers on Mt. Wilson.

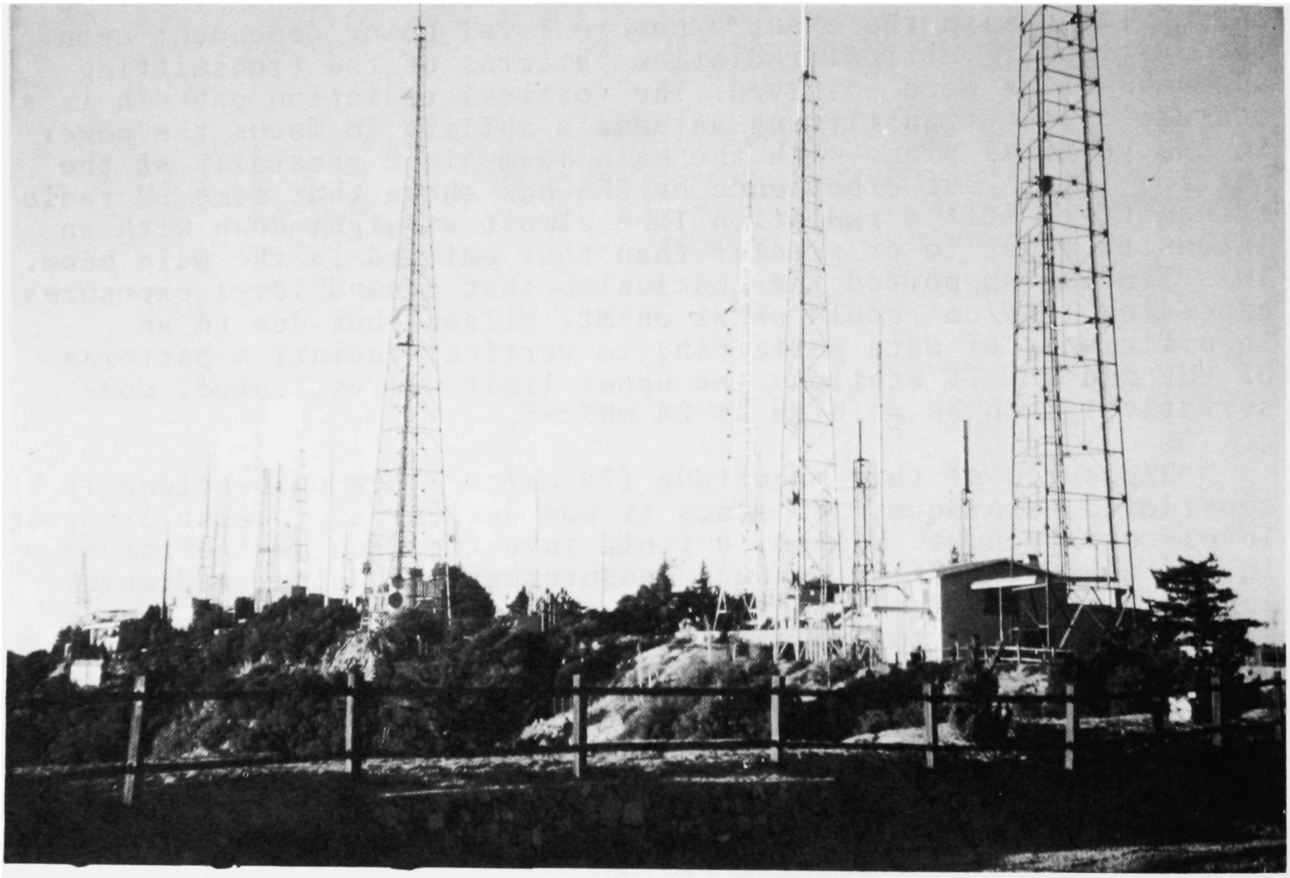

FIGURE 1. MT. WILSON BROADCAST COMPLEX
AS SEEN FROM PAVILION PARKING LOT

TABLE 1. TV STATIONS ON MT. WILSON[4]

	Power Visual	Power Aural	Latitude	Longitude	Ant. Ht. Above Ground (Ft)	Total Power
KNXT-TV (2)	46.8	9.33	34-13-57	118-04-18	466	56.1
KNBC-TV (4)	42.7	7.41	34-13-33	118-03-55	490	50.1
KTLA-TV (5)	50.1	10	34-13-35	118-03-56	240	60.1
KABC-TV (7)	166	25.7	34-13-36	118-03-59	234	191.7
KHJ-TV (9)	162	22.9	34-13-38	118-04-00	199	184.9
KTTV-TV (11)	166	20	34-13-29	118-03-47.1	237	186.0
KCOP-TV (13)	170	32.4	34-13-42	118-04-02	200	202.4
KWHY-TV (22)	64.6	9.12	34-13-36	118-03-59	132	73.7
KCET-TV (28)	1200	240	34-13-27	118-03-47	363	1440.0
KMEX-TV (34)	500	100	34-13-35	118-03-56	170	600.0
KLXA-TV (40)	622	123	34-13-42.5	118-04-01	200	745.0
KBSA-TV (46)	219	138	34-13-35	118-03-58	138	357.0
KBSC-TV (52)	800	120	34-13-27	118-03-45	82	920.0
KLCS-TV (58)	1906	380	34-14-26	118-03-45	180	2286.0
KVST-TV (68)	1925	385	34-13-36	118-03-59	126	2310.0

These data pertain to the stations at the time of the field study, November 1975.

TABLE 2. FM STATIONS ON MT. WILSON

Call	Freq. (MHz)	Power (kW)	Ant. Ht. (Ft)	Latitude	Longitude
KPFK-FM	90.7	110	170	34-13-45	118-04-03
KFAC-FM	92.3	59	142	34-13-29	118-03-46
KNX-FM	93.1	54	466	34-13-29	118-04-18
KMET-FM	94.7	58	237	34-13-29	118-03-47
KLOS-FM	95.5	68	234	34-13-36	118-03-59
KRTH-FM	101.1	58.8	199	34-13-38	118-04-00
KUTE-FM	101.9	0.7	110	34-13-35	118-03-59
KKDJ-FM	102.7	8	200	34-13-36	118-03-57
KOST-FM	103.5	12.5	492	34-13-34	118-03-55
KBIG-FM	104.3	105	120		
KBCA-FM	105.1	18	100	34-13-47	118-04-03
KLVE-FM	107.5	34			
	Total Power = 586				

These data pertain to the stations at the time of the field study, November 1975.

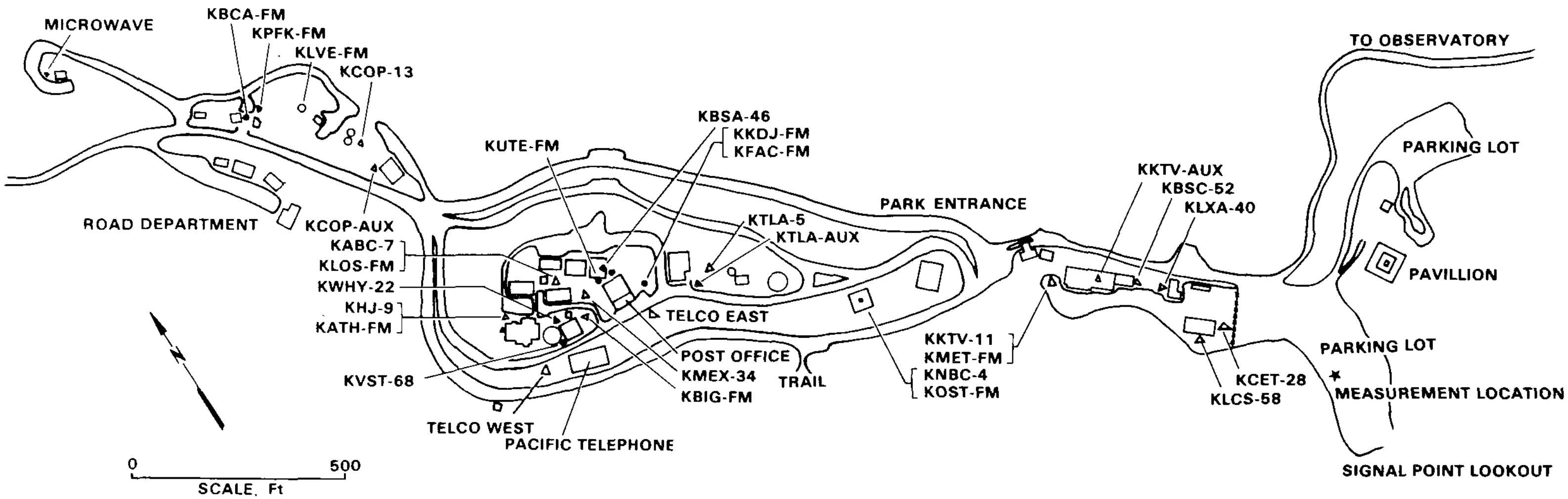

FIGURE 2. MAP OF MT. WILSON BROADCAST COMPLEX

EQUIPMENT USED IN THE STUDY

Several different types of survey instruments were taken to Mt. Wilson for the purpose of determining actual radiation levels and instrument intercomparison. Two survey type monitors manufactured by Narda Microwave Corporation were used: a model 8321 electric field probe with a model 8310 readout unit and a model 8316 B readout unit; a model 8616 readout unit with a model 8631 magnetic field probe. Pertinent technical specifications for these instruments are given in Table 3. The major features of these instruments are: a) all instruments are isotropic in response; i.e., they are independent of orientation in a field; b) the electric field responding instruments are designed for radiation detection in the 300 MHz to 18 GHz frequency range; c) the magnetic field instrument is designed to measure radiation levels in the 10 to 300 MHz frequency range; d) all instruments provide a readout in units of mW/cm^2 power density. A detailed description of the development of these probes, which utilize thermocouple techniques to measure power absorption, can be found in the literature [5].

Another survey instrument, developed by the National Bureau of Standards, was utilized during the investigation. This device, the model EDM-3, uses an orthogonal array of very short dipole elements which contain diodes for immediate detection of the incident electric fields and conversion to a dc voltage. This voltage is fed to the readout instrument via extremely high resistance leads which give the probe a non-perturbing feature with respect to the field. The predecessor developments to this particular instrument have been described in the literature [6]. Table 4 lists pertinent technical specifications for the NBS EDM-3. The unique feature of this device is its flat response to incident fields from 10-1000 MHz and its readout in units of $\mu J/m^3$ electric field energy density.

Yet another device used in the study consisted of the Instruments for Industry E-field sensor, model EFS-1. This device responds to the electric field and provides a readout directly in terms of the electric field strength (Volts/meter). A single rod type of antenna is used as the pickup and consequently the instrument can only be used for measurement of one spatial field component at a time. Each of the three orthogonal components are measured by re-orienting the instrument. The EFS-1 has a flat response from 10 kHz to 200 MHz. Table 5 provides technical specifications for the EFS-1.

TABLE 3. TECHNICAL SPECIFICATIONS FOR NARDA ELECTRIC AND MAGNETIC FIELD MONITORS

Instrument/Probe Characteristics	Readout Instrument		
	8310	8316B	8616
Response Time (sec)	1.2	1.0, 3.0	
Dynamic Range	.1-20 mW/cm^2	0.02 -20 mW/cm^2	
Probe Responds to	Electric Field		Magnetic Field
Accuracy at Calibration Frequencies	± 0.5dB		
Frequency Sensitivity 1-12 GHz	± 0.5dB		
0.85-18 GHz	± 0.5-1 dB		
0.30-18 GHz	± 0.5-3 dB		
10-200 MHz			± 0.5 dB
10-300			- 0.5, +2 dB
Isotropic Response	+ 0.5 dB maximum deviation from energy incident is any direction except from and through handle		
Probe Overload	100 mW/cm^2 CW 60 W/cm^2 Peak		60 mW/cm^2 CW 60 W/cm^2 Peak

TABLE 4. TECHNICAL SPECIFICATIONS FOR NBS MODEL EDM-3 ELECTRIC ENERGY DENSITY METER

Frequency Range	3-3,000 MHz
Electric Energy Density Range	full scale ranges of 3, 1, 0.3, 0.1, 0.03, 0.01, 0.003, 0.001, 0.003 $\mu J/m^3$
Dynamic Range	50 dB (0.00003-3.0 $\mu J/m^3$)
Overall Accuracy	
10 MHz-1 GHz	±1 dB
Isotropic Response	±1 dB

TABLE 5. TECHNICAL SPECIFICATIONS FOR IFI MODEL EFS-1 E-FIELD SENSOR

Frequency Range	10 kHz to 200 MHz
Accuracy	better than 5% of full scale
Meter Calibration	direct reading in volts per meter
Field Strength Ranges	1-3 V/m
	3-10 V/m
	10-30 V/m
	30-100 V/m
	100-300 V/m

Because more conventional methods of measuring electric field strength revolve around the use of a frequency selective receiver coupled to a calibrated antenna, a Tektronix spectrum analyzer, model 7L13, was used in the study. A set of calibrated, tuned dipole antennas were used in conjunction with the spectrum analyzer. Table 6 provides a specification summary for the spectrum analyzer and Figure 3 is a graph of the calibration factor for the dipole antennas. The dipole antennas were cali brated by EPA by referencing them to a set of standard dipole antennas constructed by the National Bureau of Standards. The antenna factor shown in Figure 3 includes the effect of the 20 foot connecting cable between the antenna and the spectrum analyzer. The spectrum analyzer produces a display on a CRT which appears as a graph of signal amplitude in terms of power vs. frequency. With knowledge of the antenna calibration factor, the received signal powers can be corrected to yield the incident electric field strength. In order to obtain a measure of the total power density at a given point, measurements in at least two orientations 90 degrees with respect to each other, must be made. In general, three orthogonal measurements will be required. The equivalent power density then can be computed using the relations which follow.

In free space the plane wave rms electric and magnetic fields are related through the impedance of space by

$$\frac{E}{H} = Z_o \text{ where } Z_o \text{ is typically taken to be } 377\ \Omega$$

$$Z_o = \sqrt{\frac{\mu_o}{\varepsilon_o}} \text{ where}$$

μ_o = permeability of free space = 1.257×10^{-6} H/m

ε_o = permittivity of free space = 8.854×10^{-12} F/m

The time average of the energy flow, S, or power density is given by

$$S = \frac{E^2}{Z_o} = Z_o H^2$$

The total energy density U for an electromagnetic wave is

$$U = \frac{1}{2} (\varepsilon_o E^2 + \mu_o H^2) = U_E + U_H) \text{ and}$$

$$\frac{U_E}{U_H} = 1$$

where $U_E \equiv$ electric field energy density
$U_H \equiv$ magnetic field energy density

TABLE 6. TECHNICAL SPECIFICATIONS FOR TEKTRONIX SPECTRUM ANALYZER MODEL 7L-13

Tuning Range	1 kHz-1.8 GHz
Display Flatness	+1, -2 dB over any selected frequency span with respect to 50 MHz
Reference Level	Calibrated in decade steps from -100 dBm to +30 dBm

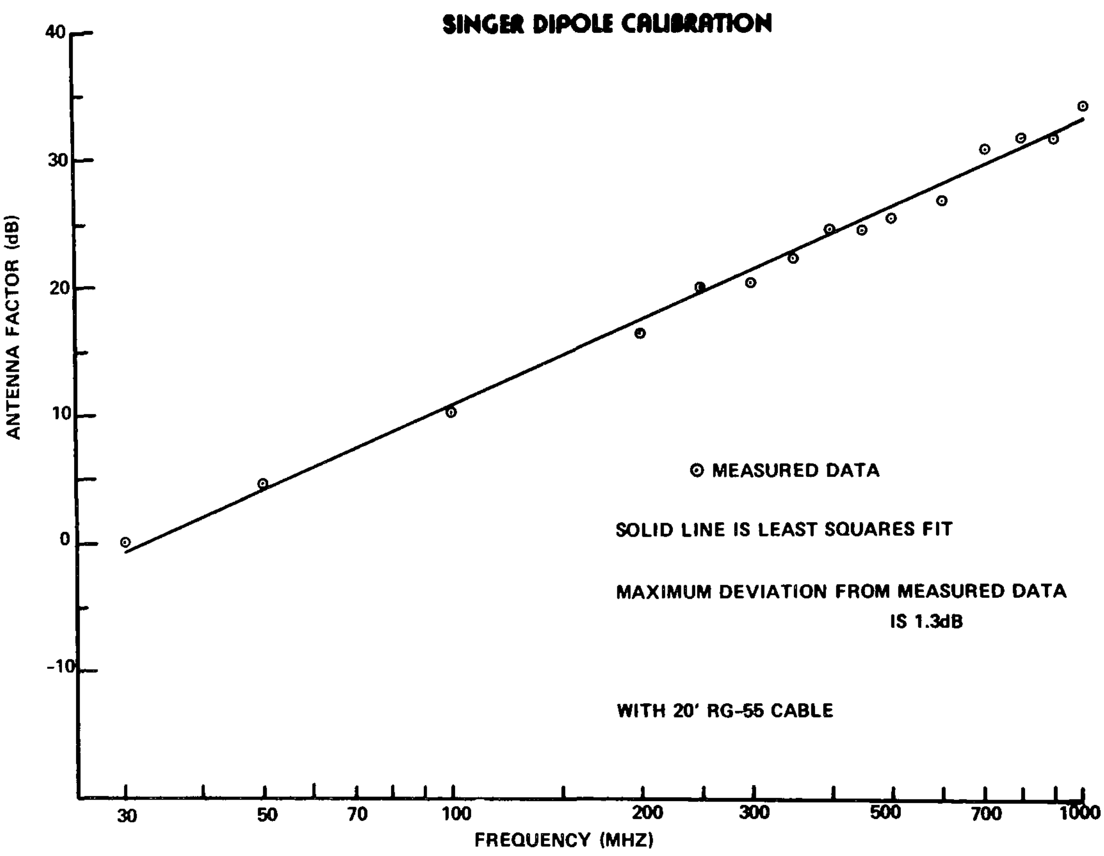

FIGURE 3. ANTENNA FACTOR GRAPH FOR THE DIPOLE ANTENNA WITH 20 FT OF CABLE

Based on these relations, the following result for plane waves:

$$S\ (\mathrm{mW/cm^2}) = \frac{[E(\mathrm{V/m})]^2}{3770}$$

and

$$S\ (\mathrm{mW/cm^2}) = 60.0\ U_E\ \ (\mu\mathrm{J/m^3}).$$

Thus, measurements of electric field energy density may be converted into far field (plane wave) equivalent power density [7]. Electric field energy density measurements made in the near field of an antenna (where E and H are not related as in plane waves) can not be simply converted into power density, but the expression $S = 60\ U_E$ will give an upper limit for the actual power density.

RESULTS

The approach used to measure radiation levels on Mt. Wilson consisted of surveying the general area using the various types of survey instruments available. This allowed a determination of the specific areas where relatively intense radiation levels exist, determination of the magnitude of these levels, and provided insight to some of the deficiencies of the instruments. The Narda electric field monitors are not designed for frequencies below 300 MHz. Thus these measurements were used to evaluate their performance in an environment where they would not necessarily be expected to respond reliably. In general, maximum field intensities were observed beneath FM broadcast transmitting antennas. Typical exposure levels were found to lie in the range of 1-7 mW/cm^2; exposures in open areas, i.e., not close to conducting structures, did not exceed about 2 mW/cm^2 equivalent power density. During the course of the measurements it was determined that the Narda electric field monitors yielded inconsistent readings of power density. The responses were characterized by significant changes in meter reading due to probe lead stretching and orientation. This phenomenon was first observed when an exposure reading at one point could not be reproduced at a later time. As an example, at one location the Narda electric field instruments could be made to read anywhere between 1 and 13 mW/cm^2, depending on probe lead and readout meter orientation. Another factor of considerable significance was an apparent pickup of 60 Hz ac power line electric fields from the nearby commercial power transformers. Though it was not conclusively proved, there was suspicion that the lower frequency fields, i.e., approximately 100 MHz, of the FM stations, were permeating the readout enclosure and possibly producing undesirable currents on the probe lead causing the observed interference effect. The Narda electric field monitors are designed for broadband response from 300 MHz to 18 GHz. It is not clear what effect the presence of a relatively intense field at 100 MHz will have. Because of the presence of significant fields below 300 MHz and the inconsistencies of the readings the Narda electric field monitors were not used to collect data.

In contrast to the Narda electric field monitors, the new Narda magnetic field instrument seemed to exhibit far superior performance in the Mt. Wilson environment. This instrument was essentially independent of probe lead stretch effects and was far less dependent on 60 Hz ac field pickup. This is probably due to two major reasons; (a) the monitor has a self contained preamplifier within the probe handle and, (b) the probe is designed to respond to fields from 10 to 300 MHz, which is the frequency range for the most intense ground level fields measured. However, it is not clear just what effect would be seen if there are present relatively intense UHF fields, e.g., from UHF TV stations. It is possible that the orthogonal loop array in the probe may exhibit a resonance response at some high frequency causing an erroneous reading on the meter. Thus, when used in a multiple frequency environment, where signals span the 54-800 MHz range, there is still a degree of uncertainty in the readings.

The NBS probe, designed for uniform sensitivity over the 10-1,000 MHz region, proved very consistent in readings, from one location to another. The availability of a peak or average detector function provided a means of identifying the presence of 60 Hz pickup and, for the types of sources present at Mt. Wilson, allowed the determination of actual RF field density. A number of comparisons were performed with the NBS electric field and Narda magnetic field meters. The findings are to a degree not completely clear. At certain locations, the two instruments provided almost an identical response when the meter indications were converted to the same units. This occurred in fairly clear locations i.e., not immediately next to a reflecting object. Nevertheless, even under such conditions, at other locations, the instruments did not correspond in reading. This was particularly true when measuring the fields in a clump of trees next to an ac transformer and near the KBIG-FM radio tower. Here, we observed that the fields were relatively more intense, up to about 5 mW/cm^2, near the surface of the tree trunks using the NBS meter. Such a conclusion was not as evident using the Narda magnetic field meter. On the basis of the limited tests performed during this study, it is presumed that any differences seen in the two meters are principally due to the fact that one responds to the electric field while the other responds to the magnetic field. Furthermore, in situations which are not considered far field, the two field parameters, electric and magnetic field strength, will not have a fixed and known relationship. This phenomenon should be further and more rigorously defined. It became apparent that field comparisons of different meters can be difficult, due to exact spatial relocation problems.

A maximum observed electric field energy density of 0.12μJ/m^3 or 7.2 mW/cm^2 equivalent was measured on the ground beneath KLVE-FM. This measurement was near the steel pole supporting the antenna and is not representative for distances beyond several feet from the tower. KLVE-FM uses an unguyed steel pole type of tower rather than a conventional triangular self-supporting or guyed type of arrangement.

On a driveway near the base of KBIG-FM, a measurement of the field strength of KBIG-FM was made using the spectrum analyzer and a tuned, half-wave dipole. Figure 4 illustrates the dipole antenna arrangement and a measurement of the radiation at the

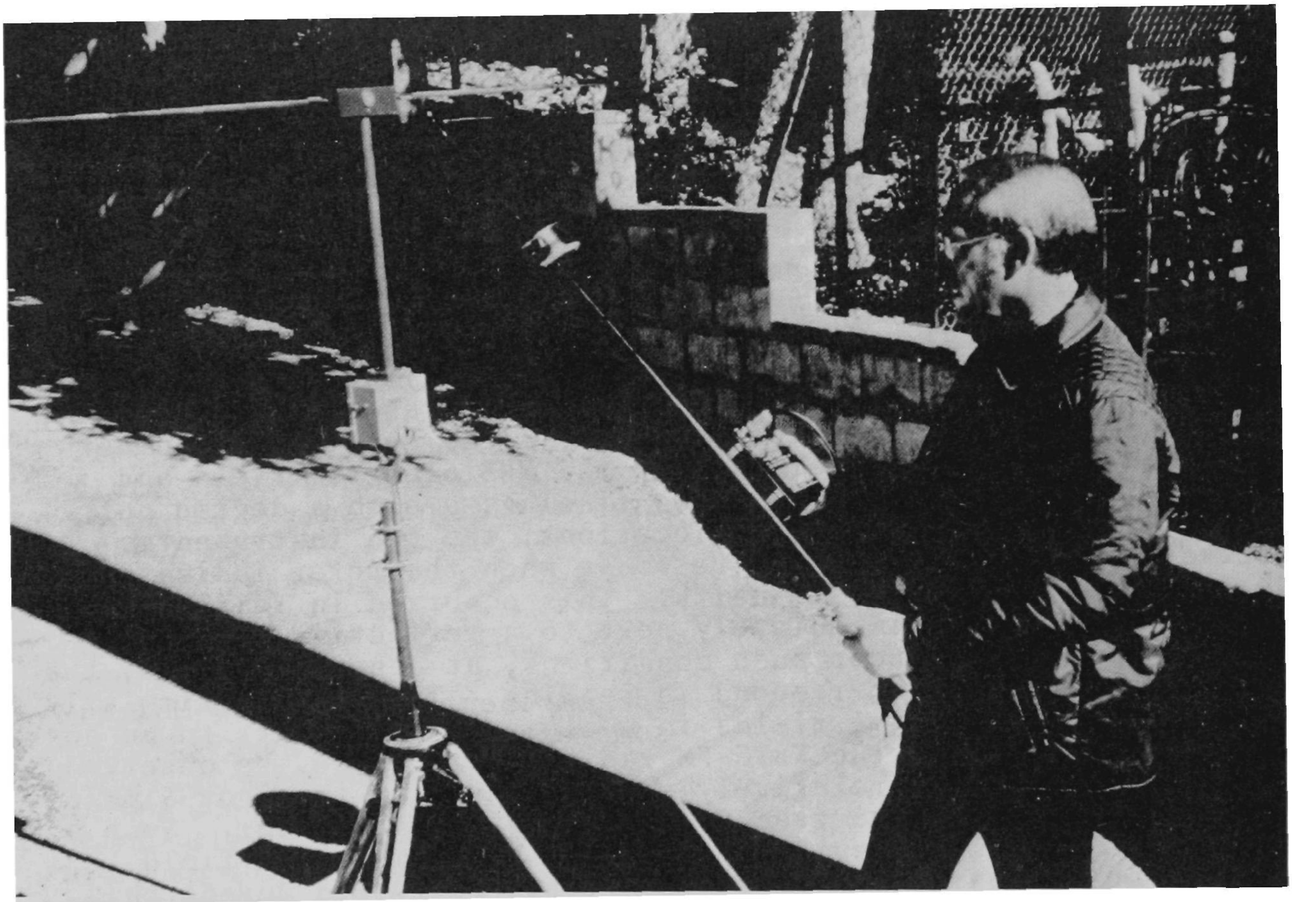

FIGURE 4. DIPOLE ANTENNA ARRANGEMENT; MEASUREMENT OF RADIATION INTENSITY AT ANTENNA WITH NBS PROBE

antenna with the NBS probe. The results of the measurement showed that the FM station field was predominant in terms of other field components produced by other nearby stations. With the spectrum analyzer the field was measured as equivalent to 2.30 mW/cm^2 including vertical and horizontal field components. Using the NBS meter to measure the field at the center of the dipole antenna a reading of 0.032 $\mu J/m^3$ equivalent to 1.92 mW/cm^2 was obtained. This is equivalent to a 0.8 dB difference and represents excellent agreement.

An estimate of the expected power density at ground level was performed for KBIG-FM. The distance to the center of radiation of the antenna was taken as 90 feet (27.4 m) and the power density was calculated by assuming that the total ERP in both horizontal and vertical planes was effective at this steep vertical angle (not usually valid). In this case the computed value was 2.2 mW/cm^2 appearing to be in good agreement with the measured values. This agreement is probably fortuitous since the vertically polarized component of the field will normally be very low at a steep depression angle and since the presence of reflections can cause the resultant power density to vary by a factor of four over calculated free space values.

An attempt was made to correlate the findings obtained with the NBS meter and the spectrum analyzer with the IFI probe. Experience with the IFI showed that the readings were difficult to make in that the orientation of the IFI was so critical for finding the maximum value that one could not easily reproduce the readings. The best that could be done with the IFI was a reading of 39 V/m equivalent to 0.40 mW/cm^2 on the driveway near the base of KBIG-FM. The IFI is apparently very significantly affected by the presence of a ground plane and thus the readings obtained are of questionable value. A block of polyetyrene foam was used to support the instrument during the measurements but further investigation is desirable to fully define the usefulness of this device in field situations similar to the Mt. Wilson site. It is possible that higher frequency field components, above 200 MHz may have disturbed the readings to some extent.

A detailed survey, using the NBS probe, was made of the interior of the Post Office and attached residence. Figure 5 is a diagram of the Post Office and residence showing measured field intensities in terms of μJ/m^3 and mW/cm^2. Typical maximums were 0.12 mW/cm^2 equivalent except very near some conducting objects such as the light switch where a reading of 0.48 mW/cm^2 was encountered. Outside the Post Office in the backyard was a rabbit hutch for a pet rabbit. At this location the measured field was equivalent to 1.2 mW/cm^2.

A value of 0.003 mW/cm^2 was observed in a tree house in the backyard of the residence. Measurements were made in the tree house because of its elevated location and minimum shielding.

Measurements were also conducted in the large parking lot near the Pavillion using the spectrum analyzer and tuned dipole arrangement. From this location almost the entire broadcast complex could be viewed. A sequence of measurements were made for each FM and TV station operating at the time of measurement from Mt. Wilson. These results are tabulated in Table 7 for the VHF TV stations, Table 8 for the UHF TV stations, and in Table 10 for the FM stations.

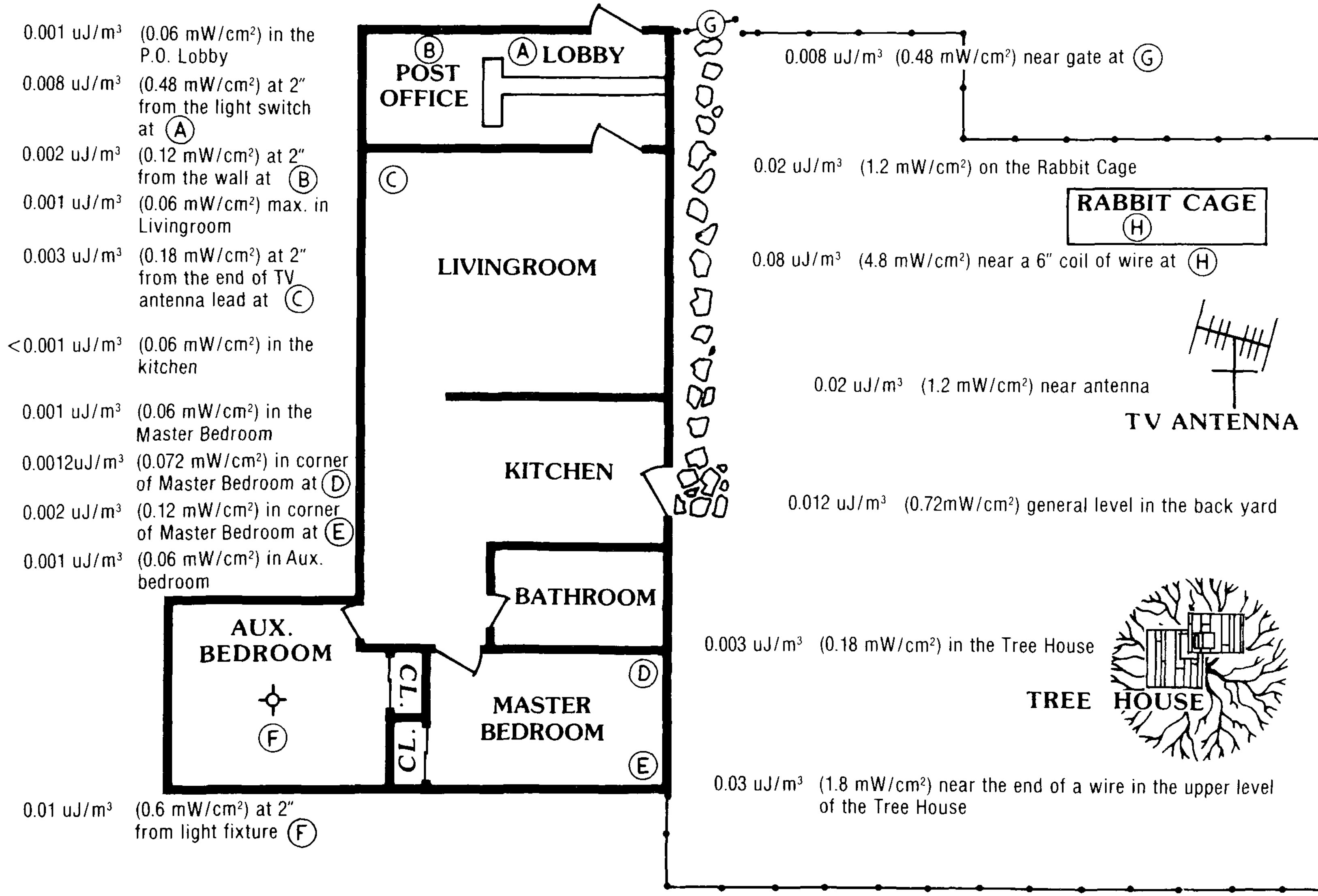

FIGURE 5. FIELD INTENSITIES IN POST OFFICE, RESIDENCE AND YARD AS MEASURED WITH NBS PROBE

TABLE 7. VHF TV EXPOSURE MEASUREMENTS IN PARKING LOT

Channel	Call	Freq (MHz)	E (V/m)	S (μW/cm²)
2	KNXT-TV	55.25*	0.279	0.0207
		59.75**	0.110	0.0032
4	KNBC-TV	67.25	0.507	0.0683
		71.75	0.181	0.0086
5	KTLA-TV	77.25	0.415	0.0456
		81.75	0.158	0.0066
7	KABC-TV	175.25	3.71	3.64
		179.75	1.48	0.58
9	KHJ-TV	187.25	2.76	2.02
		191.75	1.13	0.336
11	KTTV-TV	199.25	4.15	4.57
		203.75	1.52	0.611
13	KCOP-TV	211.25	1.77	0.832
		215.75	2.32	1.43
			Total	14.18

* Visual carrier.
** Aural carrier.

TABLE 8. UHF TV EXPOSURE MEASUREMENTS IN PARKING LOT

Channel	Call	Freq (MHz)	E (V/m)	S (μW/cm²)
22	KWHY-TV	519.25	0.09	0.0021
		523.75	0.09	0.0021
28	KCET-TV	555.25	2.56	1.74
		559.75	0.92	0.225
34	KMEX-TV	591.25	0.97	0.250
		595.75	0.87	0.201
40	KXLA-TV	627.25	0.41	0.0446
		631.75	0.33	0.0289
58	KLCS-58	735.25	5.52	8.08
		739.75	2.48	1.63
			Total	12.21

TABLE 9. FM RADIO EXPOSURE MEASUREMENTS IN PARKING LOT

Call	Freq (MHz)	E (V/m)	S ($\mu W/cm^2$)
KPFK-FM	90.7	0.287	0.0219
KFAC-FM	92.3	4.36	5.04
KNX-FM	93.1	0.257	0.0175
KMET-FM	94.7	2.35	1.47
KLOS-FM	95.5	2.35	1.47
KRTH-FM	101.1	4.50	5.37
KUTE-FM	101.9	0.306	0.0248
KKDJ-FM	102.7	1.808	0.867
KOST-FM	103.5	0.577	0.0882
KBIG-FM	104.3	7.68	15.65
KBCA-FM	105.1	0.118	0.0037
KLVE-FM	107.5	0.408	0.0442
		Total	29.54

Exposure from VHF TV = 14.18 $\mu W/cm^2$
Exposure from UHF TV = 12.21 $\mu W/cm^2$
Exposure from FM radio = 29.54 $\mu W/cm^2$

Total exposure 55.93 $\mu W/cm^2$

Thus we see that the major proportion of total exposure is due to the presence of the FM broadcast stations, it being greater than the VHF and UHF TV combined. This observation is due to the broader radiation pattern of FM station antennas in the vertical plane when compared to TV type transmitting antennas.

CONCLUSIONS

Measurements of electric field intensity in the unique environment of broadcast emitters at Mt. Wilson indicate that maximum radiation levels lie in the range of 1-7 mW/cm^2 and are very dependent on location. Small distance changes can result in very large changes in exposure and as such introduce significant uncertainties in predictive modeling. The higher end of this range will be encountered near conducting objects and usually encompass only relatively small areas of concern. Levels near 1 mW/cm^2 may be more common and are likely to be present in areas near the base of FM broadcast towers. Ground level values of field intensity are typically far less for VHF and UHF TV emissions, even though the TV stations have higher ERP.

Care must be used when making surveys of radiation levels in a multiple frequency environment such as at Mt. Wilson with emissions as low as 54 MHz since commonly used survey instruments may exhibit frequency dependencies or interference susceptibili ties which lead to erroneous indications of exposures.

Localized hotspots, resulting from reflections in a multiple source environment, are most easily identified with a broadband survey probe. While the broadband probe is most efficient in determining the existence of a relatively intense field, a tunable device, such as a spectrum analyzer, is required to isolate the field components. Exposure levels reported here do not exceed the OSHA guide of 10 mW/cm^2 established for the working environment [8], however the maximum values are several orders of magnitude greater than median environmental levels found in certain urban environments [9]. Radiation levels encountered while working on the broadcast towers themselves can be much higher and are the subject of separate consideration [10].

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16. ABSTRACT

This report describes a series of measurements made to determine radio frequency exposure from television and FM broadcast stations located on Mt. Wilson to areas near the tower bases and within about 2,000 feet. Portable broadband survey instruments and a spectrum analyzer with dipole antennas were employed in these measurements and used in a comparison of indicated radiation levels and assess difficulties or peculiarities of the specific types of equipment. Maximum ground level exposure values were in the 1-7 mW/cm^2 range. Intensities of about 0.1 mW/cm^2 were measured inside the Mt. Wilson Post Office which is located in the immediate vicinity of a large number of towers. Ground level intensities were predominantly due to the presence of FM broadcast installations even though the FM stations used much lower effective radiated powers. This phenomenon is due to the much broader vertical plane pattern of FM stations and the presence of grating lobes associated with some FM antennas. It was found that wide ranges in exposure could occur over very small geographic areas revealing the potential for significant uncertainties in predictive modeling.

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