TV RADIO FREQUENCY (RF) MEASUREMENTS FOR CITY OF ISPARTA

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ABSTRACT

So many studies on the public healt affected by EM Field have been carried out. Many results and knowledges have been picked up. These results have been estimated electromagnetic field power on current exposure limits. ICNIRP has published a bulletin shows limit values about exposure and results in all body average SAR.(IRPA-INIRC 1988) On the other hand depend on the growing amount of number of radio stations, radiation from stations threat the healt of people. At last some of them were suspicious. There were many requirements and urgent measurements becouse of these suspects.

1. INTRODUCTION

General standarts were formed to prevent from radiation effects. By Federal Communication Commission (FCC) in USA. FCC gained autority to legal control of human exposure limits on entire for radio station types on Agust 1996. Defination of regular measurement were looked over in EU[1]. It is necessoury to inform puplic by such regulation.
Insturementations or measuring methods which determine limits of exposure to prevent from radio emission. Legal controls might hold locally. For these reason, to inform has been recommended who carries mobile phone. On the other hand, new measuring methods have been improved to measure the value of accepted SAR controls of expose of some parts of body. Therefore, such cellular telephone terminals, on mobil radio equipments, legal controls have been made after set up instrumentation methods.
Legal controls can be set up. Depend on the bases about limits of exposure. Electromagnetic field guides have been prepared by ICNIRP (IRPA-INIRC 1988),
1-Three limits have been determined about exposure limits on electromagnetic field strength guides, these are; electric field strength limit, magnetic field stength limit, and electric power density limit.
2-For all types of radio stations, EIRP (Equal Isotropic Radiation Power) must be looked over.
3-Mobile radio emission for controlled environment: in controlled environment, people have enough knowledge about electromagnetic field. They can control the exposure themselves. They need appropriate methods and training about this subject.
4-Safely notice neccesities: it is neccesery to notice contents of preventing from radio wave emission for operators[2].
Rules determine RF exposure levels for people. MPE (Maximum Permisible Exposure) varies with frequency: MPE levels give energy shows where the people exposure field are. Rules define to type of exposure environment with different two MPE levels. Uncontrolled environment is a place where the people unknown how exposure area is. These areas are especially residential areas. Controlled environment is where the people know exposured area and it can be controlled. The more it's MPE levels are permitted in the controlled areas[3].
Table-1shows maximum permitted levels for broadcast band. If the Peak Enveloppe Power (PEP) exceeds these values, RF environmental results must be estimated.

Table-1 Energy levels for bands[3].

BAND	POWER (Watt)
1600 meter	500
80	500
40	500
30	425
20	225
17	125
15	100
12	75
10	50
6	50
2	50
1.25	50
70 cm	70
33	150
23	200
13	250
SHF(all bands)	250
EHF(all bands)	250

Power levels in antenna input are given as PEP in this table. Amators can reach to these limits easily.
We can calculate appropriate values by utilise following items:
-Tables are produced from formulas of power and field density.
-Tables are produced from antenna models

-Antenna modelling softwares (NEC, MININEC, etc.) can be used.
-Softwares produced from formulas of power and field density
-Calibrated field density measurements can be utilized.

2. EQUATIONS FOR RF FIELD PREDICTION

Calculations can be made to predict RF field strength and power density levels around typical RF sources. For example, in the case of a single radiating antenna, a prediction for power density in the antenna can be made by use of the general equations (1) or (2) below. These equations are generally accurate in the far field of an antenna but will over-predict power density in the near field, where they could be used for making a "worst case" or conservative prediction.

$$S = \frac{P.G}{4\pi R^2} \qquad (1)$$

Where: S=Power density (in appropriate units, e.g., mW/cm^2)

P=Power input to the antenna (in appropriate units, e.g., mW)

G=Power gain of the antenna in the direction of interest relative to an isotropic radiator

R=distance to the center of radiation of the antenna (in appropriate units, e.g., cm)

or:

$$S = \frac{EIRP}{4\pi R^2} \qquad (2)$$

where: EIRP=equivalent (or effective) isotropically radiated power.

When using these and other equations care must be taken to use the correct units for all variables. For example, in equations (1), if power density in units of mW/cm^2 is desired then power should be expessed in milliwatts and distans in cm. Other units mey be used, but care must be taken to use correct conversion factor when necessary. Also, it is important to note that the power gain factor, G, in equation (1) is normally numeric gain. Therefore, When power gain is expressed in logarithmic terms, i.e., dB, a conversation is required using the relation:

$$G = 10^{\frac{dB}{10}} \qquad (3)$$

İn some cases operating power may be expresed in terms of "effective radiated power" or "ERP" instead of EIRP. EIRP is power referanced to a half-wave dipole radiator instead of to an isotropic radiator. Therefore, if ERP is given it is necessary to convert ERP into EIRP in order to use the above equations. This is easily done by multiplying thr ERP by the foctor of 1.64, which is the gain of a half wave dipole relative to an isotropic radiator. For exmaple, if ERP is used in Equation (2) the relation becomes:

$$S = \frac{EIRP}{4\pi R^2} = \frac{1.64\,ERP}{4\pi R^2} = \frac{0.41\,ERP}{\pi R^2} \qquad (3)$$

For a truly worst-case prediction of power density at or near a surface, such as at ground-levels or on a rooftop, %100 reflection of incaming radiation can be assumed, resulting in a potantial doubling of predicted field strength and a four-hold increase in (far-field equivalent) power density. İn that case equations (1) and (2) can be modified to:

$$S = \frac{(2)^2 PG}{4\pi R^2} = \frac{PG}{\pi R^2} = \frac{EIRP}{\pi R^2} \qquad (4)$$

In the some case of FM radio and television broadcast antennas, The U.S Environmental Protection Agency (EPA) Has developed models for predicting ground-levels field strength and power density[4]. The EPA model recommends a more realistic approximation for ground reflection by assuming a maximum 1.6-fold increase in field strength leading to an increase in power density of 2.56 Equation (2) can be modified to:

$$S = \frac{2.56EIRP}{4\pi R^2}, \quad S = \frac{(0.64)(1.64)ERP}{\pi R^2} = \frac{1.05ERP}{\pi R^2} \qquad (5)$$

It is sometimes convenient to use units of microwatts Per centimeter squared ($\mu W/cm^2$) instead of (mW/cm^2) in describing power density. The following simpler form of equation (5) can be derived if power density, S, is to be expressed in units of $\mu W/cm^2$:

$$S = \frac{33.4ERP}{R^2} \qquad (6)$$

Where: S=power density $\mu W/cm^2$
ERP=power in watts
R=distans in meters

3. LOCAL TV TRANSPONDER MEASUREMENTS

We measure the frequency and electrical field strenght of TV bands in the vicinity. We use the SATELLITE LEVEL METER for these measurements. "Local station (A) measurements" have been given on table-2.
Station A is placed North of city of Isparta, and it's 3 miles away. Station B is placed South West of city of Isparta, and it's far from 15 miles away.

Table-2 Measurement of station A
Date:17.05.1999, Time:15[10]
50m far from transmitters of tower

VHF-UHF

TV Programmes	Frequency	E.Field
1	210.25 MHz	73 dBμV
2	224.53 MHz	44 dBμV
3	503.25 MHz	79 dBμV
4	511.25 MHz	66 dBμV
5	527.25 MHz	46 dBμV
6	535.25 MHz	67 dBμV
7	551.25 MHz	89 dBμV
8	583.25 MHz	87 BμV
9	607.25 MHz	84 dBμV
10	603.25 MHz	42 dBμV
11	639.25 MHz	58 dBμV
12	647.25 MHz	---dBμV
13	663.20 MHz	49 dBμV
14	679.25 MHz	71 dBμV
15	695.20 MHz	89 dBμV
16	719.25 MHz	78 dBμV
17	711.00 MHz	86 dBμV
18	727.25 MHz	95 dBμV

Table-1 shows maximum power levels. From this table we anderstand that we musn't exceed 50 watts for TV transponder. On the other hand, from our measurements at the station A and B,we realized that power out put of the each TV programme is critical or more[2]. Particularly from table-2 for TV programme of 18,15, and 7 exceeds the maximum permissible levels From table-3 TV programme of 1, 3, 20, 4,7, 8, 14, 15, 16, and 17 exceeds the permissible level. So very near of the tower areas may be hazardous. In this way, according to the current regulation and standarts these areas must be restirected for all people, workers as well.
From table-4 (This station is the legal base station for Isparta and Burdur and made by Government) all measurable ratings are very high and dangerous.

Table-3 Measurement of station A
Date:17.05.1999, Time:16[10]
10m far from transmitters of towers

VHF-UHF

TV Programmes	Frequency	E.Field
1	210.25 MHz	93 dBμV
2	224.53 MHz	83 dBμV
3	503.25 MHz	101 dBμV
20	519.25 MHz	92 dBμV
4	511.25 MHz	91 dBμV
5	527.25 MHz	58 dBμV
6	535.25 MHz	---dBμV
7	551.25 MHz	95 dBμV
8	583.25 MHz	92 dBμV
19	591.25 MHz	86 dBμV
9	607.25 MHz	87 dBμV
10	603.25 MHz	62 dBμV
11	639.25 MHz	79 dBμV
12	647.25 MHz	73 dBμV
13	663.20 MHz	89 dBμV
14	679.25 MHz	100dBμV
15	695.20 MHz	107dBμV
16	719.25 MHz	92 dBμV
17	711.00 MHz	89 dBμV
18	727.25 MHz	95 dBμV

Table-4 Measurement of station B
Date:28.05.1999, Time:16[10]
10m far from transmitters of tower

VHF-UHF

TV Programmes	Frequency	E.Field
1	210.25 MHz	101 dBμV
2	224.53 MHz	-- dBμV
3	503.25 MHz	-- dBμV
20	519.25 MHz	-- dBμV
4	511.25 MHz	110 dBμV
5	527.25 MHz	-- dBμV
6	535.25 MHz	---dBμV
7	551.25 MHz	-- dBμV
8	583.25 MHz	-- dBμV
19	591.25 MHz	-- dBμV
9	607.25 MHz	-- dBμV
10	603.25 MHz	133 dBμV
11	639.25 MHz	-- dBμV
12	647.25 MHz	113 dBμV
13	663.20 MHz	-- dBμV
14	679.25 MHz	-- dBμV
15	695.20 MHz	-- dBμV
16	719.25 MHz	-- dBμV
17	711.00 MHz	-- dBμV
18	727.25 MHz	-- dBμV

So at the such a big station the values of field strenghts may be over the maximum permissible levels.
For little transponder stations all the power out put are bigger than 50 watts of rates.

4. CONCLUSION

By comparing the results of measurements to reference tables; we can anderstand that they are dangerous values. It is very important to stand or walk around such stations. Perhaps some all the workers who works on the towers absolutely is endangered. Unless the shut off the power during maintenance .
In our country there is no any safety rule, legal regulation, and specific standart. Government should set up nescessary standarts and regulation about RF exposure.

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