

# EM Radiation Hazard Survey in the Vicinity of RF Broadcasting Stations

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## INTRODUCTION

This article presents the results of a 1994 survey conducted on the hazards of electromagnetic radiation to personnel (HERP) in the vicinity of RF broadcasting stations or radio relay stations. The prime purpose of the HERP survey was to determine whether the residents who live in the vicinity of the radio relay stations (RRS) are exposed to EM radiation which exceeds International Radiation Protection Association (IRPA) permissible exposure levels (PEL) for the general public.

The intent of the survey was to identify and to mark areas where the radiation levels exceeded IRPA PEL, and areas where the radiation levels were over 50% of the PEL. The field intensities and power densities in the vicinity of the RRS were found to be below IRPA PEL for the general public. Typical radiation levels were less than half the IRPA PEL. Table 1 defines IRPA PEL for the general public. All the radiation levels in the table are averaged over a period of 6 minutes, for a random start of the 0.1 h period.

## GENERAL PUBLIC ELECTROMAGNETIC FIELD EXPOSURE PER IRPA GUIDELINES

IRPA guidelines are divided into two categories: occupational PEL, which applies to personnel who work in

*Excessive  
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radiation levels at  
specific sites  
underscore the  
importance of  
research on  
radiation hazards.*

the vicinity of radio frequency (RF) transmitters, and general public PEL, which applies to residents who are exposed to the RF electromagnetic environment 24 hours per day, 365 days per year. The essence of the general public PEL is to limit the specific absorption rate (SAR) to a maximum of 0.08 W/kg for the whole body exposure. This limit constitutes a safety margin of 1:50 for hyperthermal effects on living biological tissues and it is relevant for both children and adults.

## SURVEY STUDY

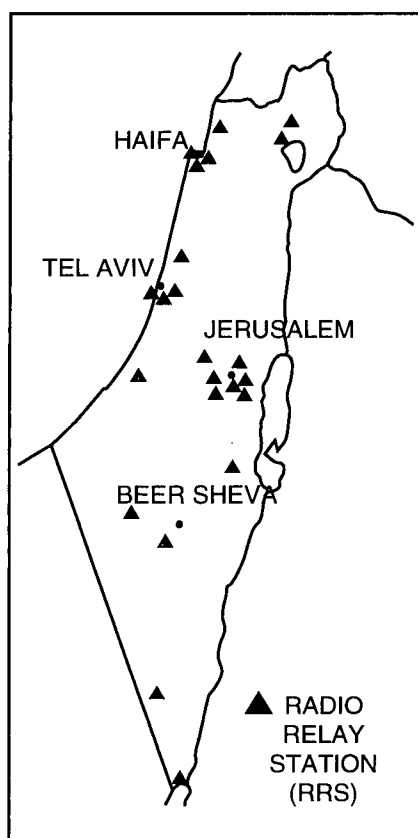
Sixteen Bezek Telephone Company RRS and seven government RRS were surveyed across the country (Figure 1). The surveyed RF spectrum encompassed medium waves (MW), short waves (SW) or high frequency (HF), VHF FM radio, VHF TV, UHF TV and various microwave antenna links. Due to the wide radio frequency spectrum that was to be covered, the measurement techniques employed both narrowband and broadband apparatus: antennas plus receivers, and RF hazard monitors, respectively. Measurements of MW and SW radiation levels at the antenna's Fresnel (near-field) zone had to be performed separately for electric and magnetic fields.

## SUMMARY OF THE HERP MEASUREMENT RESULTS

Tables 2 and 3 give maximum broadband and narrowband RF radiation

Frequency	E-Field	H-Field	Power Density	
MHz	V/m	A/m	W/m <sup>2</sup>	MW/cm <sup>2</sup>
0.1-1	87	0.23/f <sup>0.5</sup>		
1-10	87/f <sup>0.5</sup>	0.23/f <sup>0.5</sup>		
10-400	27.5	0.073	2	0.2
400-2,000	1.375f <sup>0.5</sup>	0.0037f <sup>0.5</sup>	f/200	f/2000
2,000-300,000	61	0.16	10	1

Table 1. IRPA General Public PEL.



**Figure 1.** RRS Surveyed for HERP.

measurement results obtained in the vicinity of Bezek and government RRS, respectively. As is evident from both tables and from the following information, electromagnetic field exposure for the general public in the vicinity of all RRS is well within IRPA PEL guidelines.

Table 4 describes the effective radiation power of the most dominant transmitters in the surveyed RRS and the maximum radiation level versus distance from a transmitting antenna. Prior to the electromagnetic environment measurements, the actual transmitted power from the RRS transmitters was verified. If the reported transmitted power was less than the station's power capability, a linear extrapolation of the measured electromagnetic environment to the maximum transmitted power capability was performed and the results were presented in the HERP survey report.

Most of the EME measurements were performed 2.5 m above-ground. Hence, apart from "long wire" MW antennas, the measured HF, VHF, and UHF radiation levels may be generally attributed to antenna sidelobe or backlobe radiation patterns. Measurements were taken in residential apartments and yards and on open porches, patios and terraces. In cases where multi-story buildings were adjacent to a RRS, measurements were also conducted on rooftops and in top floors where electromagnetic environment radiation was likely to be greater than on ground level, due to antenna mainlobe exposure.

## RADIATION MEASUREMENTS NEAR THE PALNORD (HAIFA) RRS

A rather interesting electromagnetic topographical phenomenon was identified at the government RRS east of Palnord. A MW antenna was installed at the upper rim of a quarry. Opposite the quarry, RF radiation measurements showed a considerable increase in the EM field intensity as if caused by a reflector antenna (Figure 2). One month later, for reasons not connected with our survey, the MW antenna was replaced. Repeated radiation level measurements at the site indicated a drop in radiation level to about 70% of the IRPA PEL (see Table 3).

The field intensity along the street opposite the crater is shown in Figure 3. It is evident that reflections from the dish-shaped terrain make it appear as if the wire conical MW antenna is a directional antenna with a mainlobe that represents 6-7 dBi directivity.

Name and Location of RRS	Type of Transmitters	% of IRPA General Public PEL		
		Power Density	E-Field	H-Field
Bait Vegan, Jerusalem	MW, VHF-FM	16.5	44	38
Yavne	MW, HF	7.0	50	11
Acco, East	MW, HF, UHF-TV	9.0	30	30
Eilat, Hotel District	MW, VHF-FM, UHF-TV	5.5	20	27
Har Hacarmel, Haifa	VHF-FM, VHF & UHF-TV, Microwave Links	0.2		
Eitanim, Jerusalem	VHF-FM, VHF & UHF-TV	0.6		
Holiday Inn, Jerusalem	UHF-TV	0.4		
Hadassah Hospital, Jerusalem	UHF-TV	1.6		
Eshel, Beer Sheva	VHF-FM, VHF & UHF-TV	3.0		
Shalom Tower, Tel Aviv	VHF & UHF-TV	8.0		
Arad, Negev	VHF-TV	2.0		
Hillel, Tel Mond	MW, HF	17.0	40	43
Tel Hayyim, Givatayim	MW (Backup)	7.5	30	25
Hayyim Station, Givatayim	VHF-FM	1.5		
Stella Maris, Haifa	UHF-TV, LW	0.1		
Har Çanaan, Safed	MW, VHF-FM, UHF-TV	1.4	12	12

**Table 2.** Summary of Maximum RF Radiation in the Vicinity of Bezek RRS.

Name and Location of RRS	Type of Transmitters	% of IRPA General Public PEL		
		Power Density	E-Field	H-Field
Philon, Rosh-Pinna	MW		18	21
Palnord, Haifa	MW		68	
Shoor, Ramle	MW		17	
Rama, Jerusalem	MW		10	
Mishmar Hanegev	MW, VHF-FM		25	6
Abu-Gosh	MW		22	
Hayon, Tzukey Ovdah	MW		40	3

Table 3. Summary of Maximum RF Radiation in the Vicinity of Government RRS.

Name and Location of RRS	Dominant Transmitters and ERP (Watts)	Radiation Level		Distance from Antenna (m)
		Power Density (mW/cm <sup>2</sup> )	E-Field (V/m)	
Bait Vegan, Jerusalem	MW, 10 kW		35	210
Yavne	MW, 200 kW		32	460
Acco, East	MW, 50 kW		20	350
Eilat, Hotel District	MW, 10 kW		44	150
Har Canaan, Safed	MW, 10 kW	0.5	40	180
Eitanim, Jerusalem	VHF-TV, 300 kW		2	420
Shalom Tower, Tel Aviv	UHF-TV, 30 kW	0.02		20
Hillel, Tel Mond	MW, 1200 kW		32	500
Hayyim Station, Givatayim	VHF-FM, 1 kW	0.003	2	80
Palnord, Haifa	MW, 10 kW		60	300

Table 4. Some Summary RF Radiation Sources and Measurement Results.

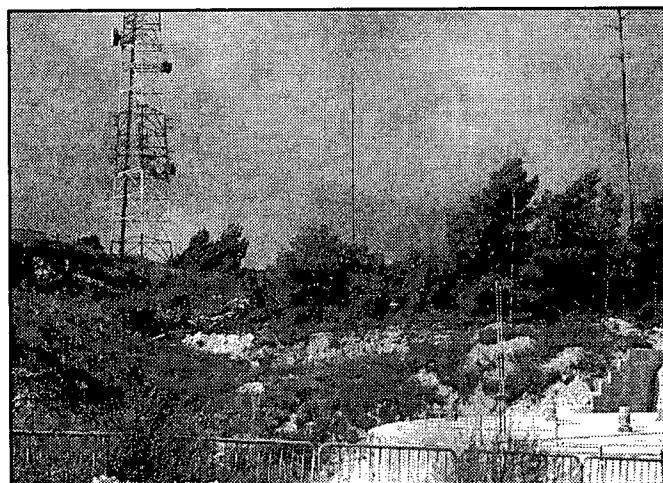


Figure 2. Westward View of MW Antenna at Palnord Government RRS.

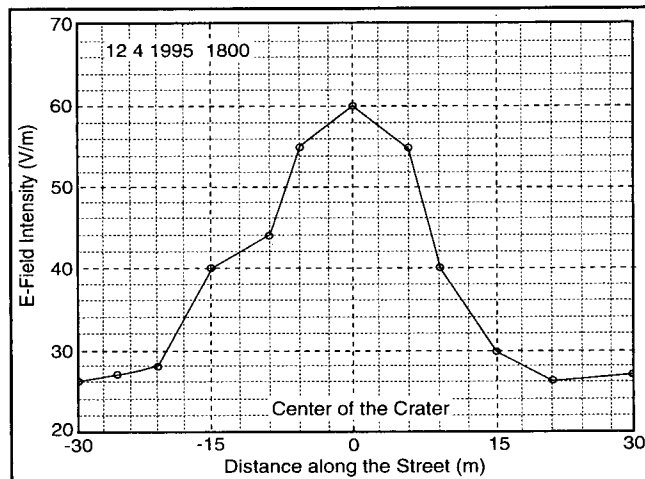


Figure 3. E-Field Intensity along the Street opposite the Quarry.

## CONCLUSIONS

The HERP survey in the vicinity of 16 Bezek radio relay stations (RRS) and seven government RRS determined that residents who live near these RRS were not exposed to EM radiation which exceeded International Radiation Protection Association (IRPA) permissible exposure levels (PEL).

The radiation intensity that was initially measured near Palnord was in excess of the IRPA PEL for the general public. Only a few weeks later, after the MW long wire antenna was replaced by a conical wire antenna, the EM field intensity was found to be below IRPA maximum PEL. The electromagnetic-topographical phenomenon that was identified east of the Palnord RRS reinforces the importance of such a HERP survey.

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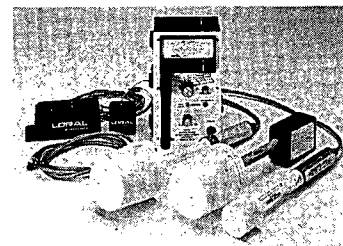
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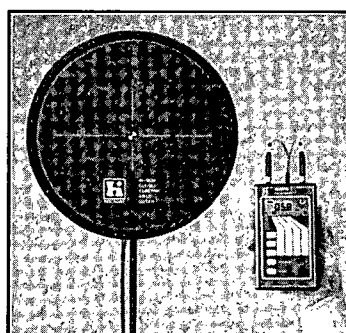
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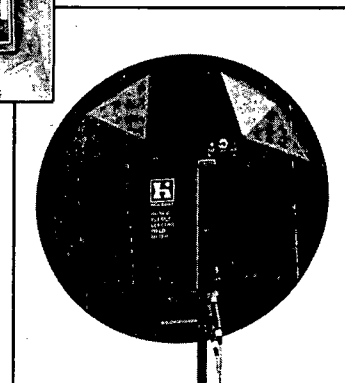


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