

## ELECTROMAGNETIC POLLUTION OF THE ENVIRONMENT

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The recent development of the radar and telecommunication via satellite devices have imposed to the attention of the researches the necessity to solve the problem regarding the protection of radiofrequency electromagnetic and microwave radiations.

The use of high power devices have besides stimulated many interests in the research of the possible biological effects from human exposition to the electromagnetic radiations in acute or chronic form.

The present research deals with national situation concerning the ambient pollution by the radiofrequency electromagnetic waves and the microwaves (1)(2)(3).

The experimental part is limited from 0.5 to 500 MHz. This one is divided into section:

- devices numbering: broadcasting, telecommunication, television, air traffic control, air and shipborne navigation, meteorology, metallurgy, food processing, etc.;
- environmental tests: rural zones, towns, industries.

In this report are shown the results of measures that have been effected in Livorno (Fig. 1), to make out the real entity of electromagnetic pollution, in order to intervene if it will be necessary.

## METHODOLOGY AND MEASUREMENT

Livorno has a surface of  $104.6 \text{ km}^2$ , a population of 177523 persons, a density of population of 1697 persons/ $\text{km}^2$ , medium altitude on the sea-level is 3 m, but some places have a higher position, as Valle Beneditta (338 m), Montenero (293 m), Quercianella (91 m), Castellaccio (300 m), Collinaia (52 m), Monterotondo (149 m).

Livorno is endowed with several factories and an industrial part that is characterized by an uninterrupted flux of ships.

According to the distribution of the installations we have divided the territory in three areas (Fig. 2 and Table 1):

- area A, including the port in which are situated about thirty stations for marine support and aid, working in HF, UHF and VHF band; their maximum power is 150-400 W and they have an inconstant time of work.

You can find them both on earth and on boats;

- area B, including Castellaccio and the places near there, where you can find 6 relay stations in VHF band for the communications of power 10 W and 6 relay stations with parabolic antennas in UHF band of power is 1 kW and they work almost uninterrupting;
- area C: in this area all the broadcasting and television stations of

the town, public and private (transmitters and relay stations) are grouped and they have a power with fixed time of work.

About 12 km far from the town in Coltano there is another station with remarkable power, in Monte Serra; about 35 km from Livorno, there are antennae with great power for broadcasting, television and telephony.

The stations of O.M. and C.B. are not individualized.

We have chosen 50 test points (Fig. 3 and Table 2):

- area of the port: 6 stations;
- central area: 6 stations;
- peripheral area: 8 stations;
- area of Montenero: 5 stations;
- area of Castellaccio: 10 stations;
- the surroundings: 15 stations.

We have used the Electric and Magnetic Field Sensor TE 307, by Aeritalia (Torino), maximum range 10 V/m, to measure the electric field. The RAHAM, by General Microwave, has been used to measure the density of power.

## RESULTS AND DISCUSSION

The results of our measurements are shown in Table 3.

The following areas can be individualized (Fig. 4):

- area 1 - including the area of the port; obtained results:  $0.1 \pm 0.2$  V/m and  $0.05 \pm 0.3$  mW/cm<sup>2</sup>;
- area 2 - Castellaccio - obtained results:  $1 \pm 5$  V/m and  $0.2 \pm 0.5$  mW/cm<sup>2</sup>;
- area 3 (coinciding with area C): obtained results:  $0.2 \pm 1$  V/m and  $0.05 \pm 1$  mW/cm<sup>2</sup>;
- area 4 - it is the central area, excepted area C: obtained results:  $0.05 \pm 0.2$  V/m and  $0.03 \pm 0.1$  mW/cm<sup>2</sup>;
- area 5 - it is the peripheral area: obtained results:  $0.05 \pm 0.2$  V/m and  $0.05 \pm 0.1$  mW/cm<sup>2</sup>;
- area 6 - including the surroundings: obtained results:  $0.1$  V/m and  $0.05 \pm 0.1$  mW/cm<sup>2</sup>;

## CONCLUSIONS

- The stations of area around the port have an influence that can't be measured on the electric field and the density of power in the central area.
- The stations of area C have a greater influence on the central area.
- According to our expectations, the stations of area B give the greatest contributions to values of the electric field and of the density of power.
- In the peripheral area and in the surroundings the electric field and the density of power have the same values of the central area (area 4).

Making a comparison between the obtained results and the maximum values that have been fixed in the national rules we can believe that this are near these maximum values especially regarding to the density of power.

TABLE 1 - Distribution of the installations

Area A : the port

Area B : Castellaccio

Area C : Montenero, Castellaccio, Cavour and Roma square

TABLE 2 - Measurement stations

AREA	STATION N°
The port	1-2-3-4-5-6
Central	7-8-9-10-11-12
Peripheral	13-14-15-16-34-35-36-37
Montenero	17-18-19-20-21
Castellaccio	22-23-24-25-26-27-28-29-30-31
Surroundings	32-33-38-39-40-41-42-43-44-45-46- -47-48-49-50

TABLE 3 - Results of the measures

STATION n°	ELECTRIC		STATION n°	ELECTRIC		STATION n°	ELECTRIC	
	FIELD V/m	E.M. DENSITY mW/cm <sup>2</sup>		FIELD V/m	E.M. DENSITY mW/cm <sup>2</sup>		FIELD V/m	E.M. DENSITY mW/cm <sup>2</sup>
1	0.2	0.05	18	0.1	0.1	35	0.1	0.05
2	0.2	0.1	19	0.2	0.15	36	0.1	0.05
3	0.2	0.1	20	0.1	0.05	37	0.2	0.05
4	0.2	0.3	21	0.2	1	38	0.1	0.1
5	0.2	0.3	22	2	0.2	39	0.1	0.1
6	0.1	0.1	23	0.2	0.15	40	0.1	0.05
7	0.1	0.1	24	0.8	0.21	41	0.1	0.05
8	0.05	0.05	25	1	0.2	42	0.1	0.05
9	1	0.1	26	2.4	0.2	43	0.1	0.05
10	0.5	0.05	27	3.4	0.25	44	0.1	0.05
11	0.2	0.03	28	4	0.4	45	0.1	0.05
12	0.2	0.15	29	4.4	0.5	46	0.1	0.05
13	0.1	0.15	30	5	0.5	47	0.1	0.05
14	0.2	0.1	31	1	0.1	48	0.1	0.05
15	0.05	0.05	32	0.2	0.1	49	0.1	0.05
16	0.1	0.05	33	0.1	0.05	50	0.1	0.05
17	0.8	0.1	34	0.1	0.1			

The measurements are been executed in collaboration with the Italian Navy.

## REFERENCES

1. Argiero L. (1976): L'Elettrotecnica LXIII, 11.
2. Argiero L. (1979): La Medicina del Lavoro 70,3.
3. Argiero L. (1979): Radio Rivista 9.



Fig. 1: The position of Livorno.

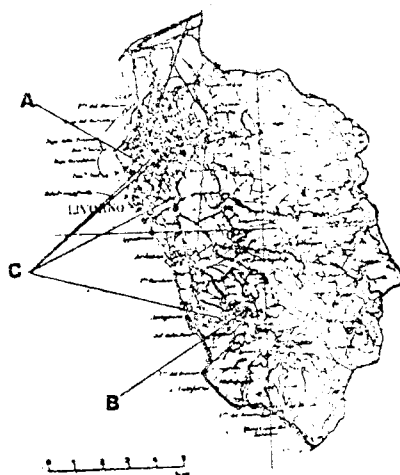


Fig. 2: Distribution of the installations.

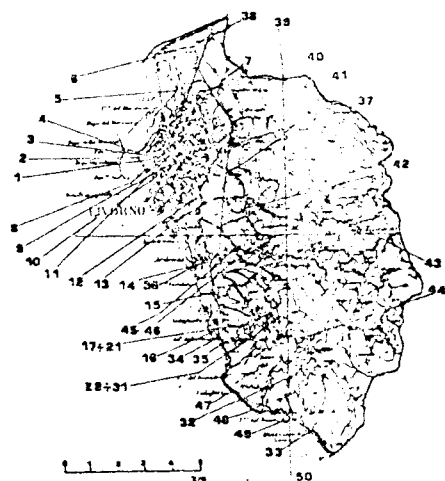


Fig. 3: Measurement stations.

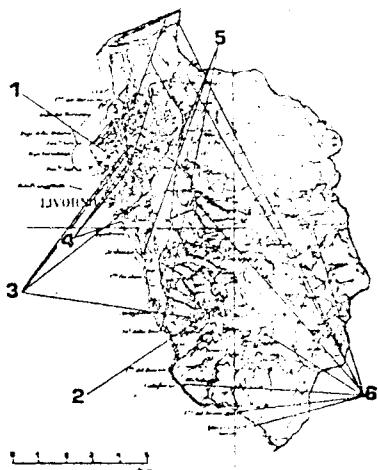


Fig. 4: Irradiation areas.