

PRECAUTION AND CONTROVERSIES:

Regulating Radio-Frequency Fields in Italy

Paolo Vecchia and Kenneth R. Foster

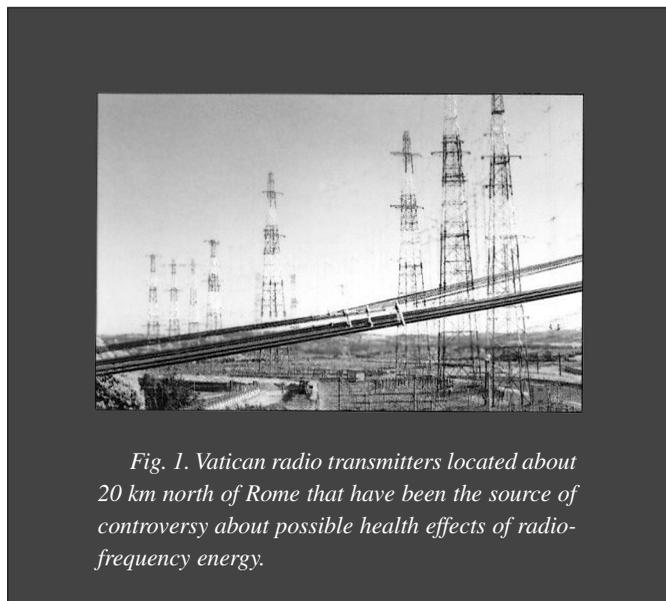


Fig. 1. Vatican radio transmitters located about 20 km north of Rome that have been the source of controversy about possible health effects of radio-frequency energy.

Throughout the world, there has been a move to “harmonize” exposure limits to radio-frequency (RF) energy from sources such as mobile phones, communications transmitters, radar, industrial equipment, and the like.

“Harmonization,” in practice, means the adoption of a consistent set of exposure limits in different nations around the world. For prac-

Paolo Vecchia is with the National Institute of Health, Physics Laboratory, Istituto Superiore di Sanità, Viale Regina Elena 299, I- 00161 Rome, Italy. Kenneth R. Foster is with the Department of Bioengineering, University of Pennsylvania, Philadelphia, PA 19104.

tical reasons related to the extensive and increasing globalization of wireless communications, and for philosophical reasons such as the desire to provide a consistent level of protection to different populations around the globe, harmonization has widespread support of governments and industry alike. In July 1999, for example, the Council of the European Union (EU) passed a recommendation for a common framework of regulations for human exposure to electromagnetic fields including RF energy [1]. The Council urged its member states to adopt the guidelines of the International Commission on Nonionizing Radiation Protection (ICNIRP), an influential commission on which one of the present authors (Vec-

chia) serves as a member.

The ICNIRP limits (as well as similar limits developed by the IEEE) had been designed by expert committees after a review of a large and in places inconsistent scientific literature. They are designed to avoid all known hazards of RF energy, with a large safety margin. They do not, however, protect against possible hazards from long-term exposures at low levels, such as would be experienced by a resident near a cellular base station. Indeed, a number of independent reviews, by ICNIRP and other expert groups around the world, have consistently failed to identify any such hazards.

Not all governments agree with this approach. Italy, the only

Member State that opposed the EU Recommendation, has established exposure limits for RF energy that are far more restrictive than ICNIRP limits. These measures were taken as precautions against the possibility of (so far unknown) hazards from low level exposure. Fears of such hazards have been voiced by many Italian citizens (as well as citizens of many other countries around the world), who have vocally opposed mobile base stations on health grounds. The issue is complex, but public discussion has often focused on reports of biological effects of RF energy that the expert committees have failed to find as convincing evidence for hazards.

recreational areas, etc. In addition, the law introduced “quality goals,” additional limits that shall be reached within given periods of time, to minimise public exposure.

The law did not specify the numerical values of these limits. Instead, it provided that the government should set the limits by specific decrees for different frequencies and sources. Due to complex legal reasons, however, radio-frequency fields (100 kHz - 300 GHz) had been regulated before the general law was enforced [3]. The Italian government then set attention levels of 6 V/m for the electric field strength, 0.016 A/m for the magnetic field strength, and 0.1 W/m² for the power density,

goals) were not intended to protect the public against any particular hazard of RF energy. Rather, they were arbitrary reductions in science-based exposure limits intended as precautionary measures – to add an extra measure of safety against the possibility of as yet undiscovered hazards.

It soon became obvious that the public had misunderstood the reasons for the new limits: the new “precautionary” limits actually increased public fears and controversies. The public interpreted the new limits as government recognition that long-term effects of radio-frequency fields actually do exist. The public perceived the new “precautionary” limit of 6 V/m (or its equivalent in other field quantities) as a threshold for such effects or, at least, as the exposure level above which the risk of such effects is unacceptable.

As a result, public demands started to increase for still stricter regulations to be enforced at the local level, as quality goals. Whatever their legal definitions might have been, the attention levels and quality goals were both perceived by many members of the public as exposure limits. The result was an apparently endless rush towards lower and lower limits. For example, the Region of Tuscany recently set a limit for RF fields of 0.5 V/m, which is a reduction by a factor of about 1500 in power density below the ICNIRP guidelines. Tuscany and other regions thus found themselves with “precautionary” RF exposure limits that were exceeded by many common transmitters in the society, including cellular base stations, many other communications transmitters, and radio and TV broadcast transmitters.

The resulting controversies about cellular base stations and radio and TV broadcasting transmitters have proliferated and become more intense. The controversy surrounding the Vatican Radio station, with its political and

TABLE I
ICNIRP vs. ITALIAN LIMITS FOR GENERAL PUBLIC EXPOSURE
TO TIME-VARYING ELECTRIC AND MAGNETIC FIELDS
(UNPERTURBED RMS VALUES) AT SELECTED FREQUENCIES

Frequency	E-field strength (V m ⁻¹)		Magnetic-field strength (A m ⁻¹)	
	ICNIRP	Italy	ICNIRP	Italy
1 MHz (AM radio)	87	6	0.73	0.016
100 MHz (FM radio)	28	6	0.073	0.016
1000 MHz Mobile phone	44	6	0.12	0.016

ITALIAN PRECAUTIONS

In 2001 the Italian Parliament passed a law [2] that introduced, in addition to its previous limits (which generally followed ICNIRP), additional restrictions beyond those in ICNIRP or in other national regulations. The new law defined “attention levels” as values of electric field strength, magnetic field strength, or power density (when applicable) that cannot be exceeded in areas where the public may stay for extended periods of time. These sites include dwellings, schools, hospitals,

irrespective of the frequency. The law left the establishment of quality goals to regional or local authorities.

Table I compares the attention levels in the new Italian limits for electromagnetic fields at selected frequencies with the ICNIRP limits. Depending on whether one expresses the limits in terms of electric field strength or power density, at cell phone frequencies the new Italian limits are a factor of about 7 or 50 below ICNIRP limits.

These new Italian regulations (both attention levels and quality

diplomatic implications, is an interesting case in point.

VATICAN RADIO TRANSMITTERS

About 20 km north of Rome is a large (nearly 2.0 by 1.5 km) enclave of the Vatican State and the site of Vatican-owned radio transmission facilities that include two medium-wave (MW) and 27 short-wave (SW) antennas. The former transmit their signals almost isotropically to serve Central Italy, whereas the latter (short wave) antennas transmit in specific directions, sending messages in different languages to different areas of the world. To this purpose, one or two SW antennas are operated at a time, for limited periods, broadcasting in narrow sectors (8 in all) for one or two hours per day in each sector (Fig. 1).

The transmitters operate at power levels that are typical for broadcasting facilities of the sort, with maximum effective radiated power levels reaching 500 kW for the MW, and 600 kW for the SW transmitters. The electric field strength outside the border of the enclave is generally a few V/m or less, but levels as high as 15-20 V/m may be reached at a few selected sites when the corresponding sector is irradiated. Although no systematic survey has been carried out, the results of spot measurements (by several agencies) do not show any clear dependence on the distance from the antennas. This is not surprising, since different antennas radiate towards different directions, with different powers and different radiation patterns; in addition, the area is hilly, and trees, buildings, and other obstacles are present that scatter the beams.

PUBLIC CONTROVERSY

The Vatican radio station had been in operation for several decades, without provoking much noticeable concern in the nearby population. During this time, the

local population increased, however. From 1991 to 1999, for example, the number of residents within a radius of 10 km from the center of the transmitting facilities grew from about 48 500 to about 60 000.

On occasion, complaints were lodged against the station, mainly related to electromagnetic interference with domestic devices such as apartment intercom systems (where, it was said, hallway intercom speakers would often play programs from the station when a resident pushed the button).

More recently, a far more visible and emotional protest developed against the Vatican Radio. The controversy has involved two different issues: the radio transmitters were accused a) of exceeding the Italian limits, and b) of causing severe health effects in the nearby population.

The Vatican State had officially adopted the ICNIRP standard in 1992, and in the intervening years the station has operated in compliance with it. However, the station exceeded the 6 V/m attention level enacted by the Italian decree in 1998. This created a difficult legal issue: must electromagnetic radiation generated in a foreign country, in compliance with international guidelines, comply with Italian limits in Italian territory?

The dispute was very long and very lively at times, perhaps exacerbated by the complex relations that have historically existed between the Vatican and the Italian state. The Vatican maintained that it was sufficient that it comply with ICNIRP limits; the Italian government in turn accused the Vatican of arrogance. The two States came close to diplomatic crisis when the Italian Minister of the Environment threatened to cut off the electricity to the station. A political crisis within the Italian Government seemed possible, with different Ministers having diverging positions on the issue, and the issue was prominent in the political are-

na during a major national election.

In the end, a compromise was found. The Vatican agreed to have part of its programs broadcast by other stations in Italy or abroad (from within Principality of Monaco), and Italy agreed to pay for the costs of the transfer.

HEALTH CONCERNS

At the same time, members of the local population were expressing strong concern about the possible adverse effects of the electromagnetic fields generated by the station. In particular, some members of the public claimed that in the last years there were many more cases of cancer — especially childhood leukemia — than were expected to have occurred. To investigate this claim, the Regional Government commissioned the Public Health Agency (ASP) of Latium (the region with the station) to perform an epidemiological survey in the area. The survey has recently been the subject of a scientific paper [4].

ASP examined the incidence of childhood leukemia within a radius of 10 km from the center of the plant, over a period of 13 years (1987-1999). It found no excess risk (with a relative risk of 1.22 with a 95% confidence interval from 0.56-2.27) based on 8 observed cases of childhood leukemia in the area.

However, the authors of the report noted a disturbing trend: there seemed to be a decreasing risk of childhood leukemia with increasing distance, that appeared when the analysis was conducted in concentric rings of 2 km (Table II). Such trend was found to be statistically significant if evaluated through a particular test (Stone's test). One (very arguable) interpretation is that the higher exposures near the tower led to increased cancer risk.

The study, however, provoked strong debates within the scientific community. Experts criticized the

study because of the limited size of the sample, the applicability of the Stone's test, the lack of adequate assessment of exposure, and the use of distance from the transmitters as a surrogate for exposure. These criticisms were expressed, among others, by an Expert Group that was officially commissioned by the Minister of Health to review the study [5]. Given the rarity of childhood leukemia, and the modest size of the population near the transmitter, it seems that a more definitive study of the issue is not likely to be possible.

Political factors helped conjoin the issues. The ASP report — which at the time was nothing more than a draft document for internal discussion — was made public by the Green Party on the same day and hour when one of trials mentioned above was being opened.

The controversy was further amplified by the media in selective reporting of the ASP report. The media placed great emphasis on the apparent decrease in risk with distance from the transmitter, or on the impressive risk ratio of 6 for

population to RF energy has increased or decreased. Thus, transferring the Vatican broadcasts to different transmitters reflected a NIMBY (not in my back yard) approach to the problem, rather than a consistent application of the precautionary principle.

HEALTH, PRECAUTION, AND SCIENCE

In the conclusion of their report, the ASP epidemiologists pointed out the severe limitations to their study, related to the very small number of cases and the post-hoc design of the study, that severely limit the conclusions that can be drawn from it. Nevertheless, the study caused a strong debate among Italian epidemiologists about the statistical significance of the findings.

A group of experts appointed by the Court to provide advice in the trials of executives of the Vatican Radio has recently concluded that “the weight of evidence..... is *much more* in favor of the existence of a risk than against” and “is in favor of a *causal* relationship”. These strong conclusions were based only on the statistical analysis of the data from the ASP survey; in fact the experts acknowledged that no convincing evidence existed in the scientific literature for long-term effects of radio-frequency fields. In other words, they considered that the epidemiological evidence from the ASP study *per se*, is strong enough to allow them to assign causality in the case.

Most scientists would view the only positive finding of the ASP study — the trend of decreasing risk with distance from the transmitters — with great caution. The study was small, found no overall excess in risk, and there is a lack of biological support to the hypothesis that RF fields are carcinogenic. The attitude of the court-appointed experts, by contrast, seems to be that such a trend *might* be the evidence of a real effect of the expo-

**TABLE II
INCIDENCE OF CHILDHOOD LEUKEMIA IN
CONCENTRIC RINGS AROUND THE STATION OF THE
VATICAN RADIO, AND VALUES OF RELATIVE RISK**

	0-2 km	2-4 km	4-6 km	6-8 km	8-10 km	0-10 km
Cases observed	1	2	5	0	0	8
Cases expected	0.16	0.86	2.66	1.74	1.14	6.57
Relative risk	6.07	2.32	1.87	-	-	1.22

HEALTH, PRECAUTION, AND POLITICS

The controversy about the Vatican Radio goes well beyond scientific discussion and conjoins the different issues we have mentioned above. Whether or not the station has to comply with Italian regulations is purely a legal one, which is quite different from the scientific and medical issue of identifying the risks involved. Managing risks of technology is, in part, a political matter that is constrained by legal and technical considerations.

With the Vatican transmitters, the boundary between science, politics, and the law has become very indistinct. Activist groups have filed two lawsuits in the same court, both against Vatican officials. One alleges that the station violated Italian exposure limits. The second involves the legal charge of manslaughter.

leukemia in the residents closest to the station. The media did not, in general, note that only one case had been observed close to the transmitters (or in general discuss the great difficulties in interpreting the findings of the study because of its very small number of cases). The media also failed to mention the absence of an overall increase in risk for leukemia in the area.

Italy and the Vatican found a compromise that solved the immediate legal and political problems. RF exposure levels have been reduced around the Vatican Radio station, and recent measurements indicate that the station now complies with Italian limits. However, shifting the broadcasts to other transmitters may well have increased the RF exposure to people living around those transmitters. There is no data to judge whether the overall exposure of the

sure, and therefore it *must* be regarded as such, for the sake of the precaution. Clearly, how one weighs discordant evidence may be different in the laboratory, courtroom, or regulatory arena. One thing is clear: exposing the population to RF fields above the legal limits is a criminal matter in Italy, and there is a lot at stake in the issue.

IMPROPER USE OF THE PRECAUTIONARY PRINCIPLE

Authoritative international bodies, such as the World Health Organization (WHO) and ICNIRP, have warned against the improper use of the precautionary principle. WHO notes in particular that “a principle requirement is that [precautionary] policies be adopted only under the condition that scientific assessments

of risk and science-based exposure limits should not be undermined by the adoption of arbitrary cautionary approaches. That would occur, for example, if limit values were lowered to levels that bear no relationship to the established hazards or have inappropriate arbitrary adjustments to the limit values to account for scientific uncertainty.”

These concerns seem justified by the experience in Italy, where the precautionary principle has been invoked to set arbitrary limits of exposure to radio-frequency radiation.

The case of the Vatican Radio shows that a misuse of the precautionary principle not only may cause mistrust in science by the public, but lead to a misuse of data and methodology by scientists themselves.

REFERENCES

- [1] Council Recommendation of 12 July 1999 on the Limitation of Exposure of the General Public to Electromagnetic Fields (0 Hz to 300 GHz). [http://www.europa.eu.int/comm/health /ph/programmes/ph_fields_cr_en.pdf](http://www.europa.eu.int/comm/health/ph/programmes/ph_fields_cr_en.pdf)
- [2] Framework Law on the Protection from Harmful Exposure to Electric, Magnetic, and Electromagnetic Fields. http://www.who.int/peh-emf/EMFStandards/who-0102/Europe/Italy_files/table_datoteke/italy_law.pdf
- [3] Decreto 10 settembre 1998, n. 381. Regolamento recante norme per la determinazione dei tetti di radiofrequenza compatibili con la salute umana. http://www.who.int/peh-emf/EMFStandards/who-0102/Europe/Italy_files/table_datoteke/Decreto_98.pdf (in Italian).
- [4] P. Michelozzi, A. Capon, U. Kirchmayer, F. Forastiere, A. Biggeri, A. Barca, C.A. Perucci, “Adult and childhood leukemia near a high-power radio station in Rome, Italy,” *Am. J. Epidemiol.*, vol. 155, pp.1096-1110, 2002.
- [5] D. Greco, P. Boyle, G. Masera, M. Mertelsmann, “Radio-frequency waves and childhood leukemia: current status of scientific knowledge with reference to the situation in the Cesano area” (in Italian and English), Rep. ISTISAN 25/01, 2001; <http://www.iss.it/scientifica/pubblica/rapporti/01-25.pdf>.



Suicide Bombers and Their Diety, *continued*

Dear Editor:

Regarding the letter from Lewis Smith in the Fall 2002 issue of T&S Magazine (p. 4):

It is widely held that Ludwig Boltzmann did indeed die for thermodynamics!

Peter Excell

Bradford, U.K.

P.S.Excell@Bradford.ac.uk

Assistant Professor in Science, Technology and International Affairs

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