

## RF Safety – Updated May 2004

### **Disclaimer**

Whilst it is believed that the information and guidance given in this paper are correct, all parties must rely upon their own skill and judgement when making use of it. The Radio Amateurs Emergency Network (RAYNET) does not assume any liability to anyone for any loss or damage caused by any error or omission in the work, whether such an error or omission is the result of negligence or any other cause. Any such liability is disclaimed. On any specific matter, appropriate professional advice should be sought.

### **Purpose**

This paper was originally prepared in response to the query raised by the West Midlands Regional Emergency Communications Group (WMRECG) about Risk Assessments and RF Safety and was intended as an interim response to that query and as a discussion paper for the RAYNET Committee of Management. Subsequently the National Radiological Protection Board (NRPB) issued revised "Advice on Limiting Exposure to Electromagnetic fields (0-300GHz)" (Ref 1). In this advice the Board of NRPB recommended the adoption in the UK of the guidelines of the International Commission on Non-Ionising Radiation Protection (ICNIRP).

This document updates the original 'RF Safety' paper prepared by the Author on 12<sup>th</sup> March 2004 to reflect the new NRPB position.

### **Legislation and Guidance**

Currently there is no specific legislation to protect persons against Electromagnetic fields (EMFs) in the UK. However the Health and Safety at Work etc. Act 1974 places under Section 2 a duty upon every employer, so far as is reasonably practicable, to ensure the health, safety and welfare at work of all their staff and others who may be affected by their acts or omissions. This duty is also an explicit requirement of Regulation 3 of the Management of Health and Safety at Work Regulations 1999 which require employers to conduct suitable and sufficient risk assessments.

There are proposals for the EU 'Physical Agents (EMF) Directive' which is a health and safety directive designed to protect workers from the risks arising from exposure to electromagnetic fields. The EU approval procedure for the Directive could be completed as early as April 2004, and the Health and Safety Executive (HSE) has suggested that it would come into force in the UK around 2008/2009. Once approved by the EU parliament, UK statutory instruments will be drawn up and there will be a period for implementation.

The publication of the new NRPB advice puts UK guidance on the same basis as an EMF Directive (1999/519/EC) issued by the EU Council as a 'Council Recommendation' in July 1999 which recommended limits for exposure of the General Public to electromagnetic fields and was based on ICNIRP limits. However whilst no evidence can be found that this directive has ever been directly adopted as UK law, RoSPA published an article (Ref 2) recently which summarised the position perfectly as follows;

"By complying with the current statute law and by implementing the guidance from the ICNIRP and the NRPB will help to protect employees against any harmful effects from EMFs and will also help to protect the employer from prosecution, and any potential civil claims made by disgruntled employees in the future."

The new guidance from the NRPB has been used by them to update the only directly relevant guidance published on the World Wide Web for UK Amateur Radio operations ( Ref 3 ) which sets down field strengths for all amateur bands which if exceeded should provoke a more thorough investigation of whether what are termed 'basic restrictions' have been breached. Whilst the ICNIRP and Ref 1 differentiate between 'occupational' and 'general public' exposure this is not reflected in the specific Amateur Radio Guidance in Ref 3 where only 'General Public' limits are applied. It must be assumed therefore that Amateur Radio cannot take advantage of the relaxed limits for 'occupational' exposure to RF.

The guidance from the NRPB cannot be directly compared with any similar guidance or publication from the United States of America given the use of two different sources for setting the Maximum Permissible Exposure. The UK guidance is now based on ICNIRP recommendations whilst USA guidance is based on a hybrid of IEEE/ANSI C95.1-1992 and a report written by their National Council on Radiation Protection and Measurements. However the methodology set out within “RF Exposure and You” (ARRL, 1998) is useful within the context of calculating the exposure to the general public.

In this situation the Network has difficulty in issuing authoritative guidance to its member groups and has referred the matter to the Radio Society of Great Britain as an issue which has a potential impact on ALL radio amateurs.

### Sample Calculations

To apply the calculations as we understand them to a typical 145/433 MHz installation it should be assumed that a 50W FM transmitter is used with a lossless feeder. The antenna will be a common co-linear with a gain of 4.5dB on 145MHz and 7.2dB on 433MHz. To further increase the pessimism since exposures at these frequencies are averaged over a 6 minute period assume that the station is continuously transmitting over that period. The method of calculation used is that found in the ARRL publication ‘RF Safety and You’ where the RMS electric field strength is found from the following equation.

$$e = \frac{\sqrt{P \frac{376.7}{4\pi}}}{R}$$

Where P is Effective Radiated Power.  
R is distance in metres  
E is RMS field strength in V/m

	Public Limits	
	144MHz	433MHz
ERP (dBW)	21.49	24.19
ERP (Watts)	140.92	262.40
E Field Limit ( V/m )	28	28.61
Distance at which limit exceeded (metres)	2.32	3.10

It must be emphasised however that these calculations are felt to represent the absolute worst case of a 100% duty cycle<sup>1</sup> transmission and the person being exposed standing in the path of the beam of greatest intensity from the antenna. In reality our antennas are frequently sited on masts where the beam of greatest intensity is above both members of the public and ordinary roof workers and the frequency of use of the facilities is low so further reducing the risk.

The original query implied an extension of rooftop facilities to include HF antenna, in this case the limits set by the NRPB would imply that for a system working on 7MHz ( assume 100W transmitter 100% Duty Cycle) no member of the public should remain within 2.12 metres of the main beam of the antenna. This is more consistent with the principle of ‘placing out of reach’ given the normal ‘bare wire’ construction of HF antenna and the high voltages and currents capable of being developed on the antenna. Indeed the NRPB guidance states that there is an investigation level for a member of the General Public of 20 mA for contact current (current flowing through a person when a metallic object is touched) within the frequency range 100 kHz to 110MHz.

<sup>1</sup> **Duty Cycle** – The ratio between the actual RMS value of an RF signal and the RMS value of a continuous signal having the same peak envelope power value, expressed as a percentage. A duty cycle of 100% relates to a CW(Morse code) or Frequency Modulated signal. A single sideband transmission would have a duty cycle of 20-40%. Lower duty factors then result in lower RF exposures.

This enquiry originally arose within the Local Authorities for installation on their buildings. The Radiocommunications Agency (now Ofcom) published a Code of Practice for Radio Site Engineering (MPT1331, April 1997). The first paragraph of Section 6 'Health and Safety' remains particularly relevant given that RAYNET installations are rarely the sole users of sites.

"With the increasing use of single antenna arrays to radiate the combined output of several transmitters, radio site operators must assess the physiological hazard presented by the radio frequency energy radiated from their antennas. It is the responsibility of the site operator to ensure that antenna systems and access arrangements do not expose personnel to hazards. Everyone who is allowed access to the antenna structure must be properly informed of all necessary precautions."

RAYNET Groups will co-operate within the extent of their knowledge and experience with Local Authorities in the provision of technical information for the production of integrated risk assessments for Local Authority sites at which they have permanent installations. However it must be recognised that actual measurements of field strengths may be required on multi-occupancy sites given the numbers of transmitters involved and professional advice would need to be sought in this situation.

Detailed guidance is still awaited from the RSGB especially in light of forthcoming EMF directives. Meanwhile the Network considers that Risk Assessments should be carried out for all its activities but in the absence of guidance and the normal operating conditions for their stations it is understandable that Groups concentrate on more conventional risks whilst the physiological effects of RF remain such a hotly debated topic within the scientific community.

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References:

1. "Advice on Limiting Exposure to Electromagnetic Fields (0-300GHz), Documents of the NRPB, Volume 15 No.2 2004.
2. 'Understanding Electromagnetic Fields (EMFs), Peter Ellis, The RoSPA Occupational Safety & Health Journal, February 2004 P18-20'
3. 'Reference Levels for UK Amateur Bands' First Issued September 2002 & revised April 2004.  
[http://www.nrbp.org/press/information\\_sheets/amateur\\_radio.htm](http://www.nrbp.org/press/information_sheets/amateur_radio.htm)