



# SNS COLLEGE OF TECHNOLOGY

(Autonomous Institution)

COIMBATORE-35

DEPARTMENT OF BIOMEDICAL ENGINEERING



## 19BME308 - Medical Radiation Safety

### UNIT I - INTRODUCTION TO RF AND MICROWAVE RADIATION

#### 1.3 Development of Standards for Human Safety

##### **Basic concepts of RF safety standards and guides for human exposure**

In order to provide guidelines for RF safety it is necessary to try and define safety limits which will reflect those findings of researchers in the field of RF safety which have been accepted by governments or standards bodies. It is inevitable that these limits will be subject to constant scrutiny and change and no book will ever be able to keep up with such changes. The aim of this part is to assist the reader in interpreting standards as they are developed. Many countries have standards or guides on this subject and some have direct statutory laws. Those bodies which have had some recent influence include:

##### **1. The American National Standards Institution (ANSI)**

The C95.1 committee was operated directly under ANSI but now operates as a committee of the American Institution of Electrical and Electronic Engineers (IEEE).

##### **2. International Commission on Non-Ionising Radiation Protection (ICNIRP)**

ICNIRP is linked to IRPA, the International Radiation Protection Association. This body has operated for a number of years and provides recommendations for safety provisions in the radio frequency field. It also is concerned with other forms of non-ionising radiations. It has a link with the World Health Organisation (WHO). IRPA is an association of professional societies concerned with ionising and non-ionising radiation protection and states that it is non-governmental and non-political.



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### **3. The UK National Radiological Protection Board (NRPB)**

The NRPB acts as Statutory Adviser to the Health and Safety Commission on both ionising and non-ionising radiation and provides recommendations for the United Kingdom.

### **4. The USA Federal Communications Commission (FCC)**

The FCC has responsibilities under the National Environmental Policy Act of 1969 for the assessment of RF emissions. It provides a considerable amount of technical information to the public via the Internet.

### **5. The Commission of the European Communities (EC)**

The EC is currently drafting requirements for radiation protection involving the Directive for the Protection of Workers against the risks from exposure to Physical Agents and also the radiation content of the Machine Safety Directive. Radiation here covers all forms of ionising and non-ionising radiation.

### **The purpose of standards and guides in this field**

1. Control of the exposure of people to electromagnetic fields.
2. The prevention of the ignition of flammable vapours and electro-explosive devices (EEDs) by RF energy.
3. The reduction of interference from sources of RF which may consequently cause harm to people and equipment.



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## Typical current safety standards for human exposure

Three standards have been chosen for more detailed examination and these are:

1 UK NRPB document: Documents of the NRPB – ‘Board statement on restrictions on human exposure to static and time-varying electromagnetic fields and radiation’, Volume 4, No. 5, 1993. Frequency range 0 to 300 GHz.[27] This should be read with NRPB Report NRPB-R3011998, which materially affects the detailed interpretation of the document. Some of this material has been used below.

2 USA document: IEEE Standard for safety levels with respect to human exposure radio frequency electromagnetic fields 3 kHz to 300 GHz. Formerly IEEE C95.1–1992 now updated to IEEE C95.1–1999. The recent update mainly affected the body current provisions.

3 ICNIRP document: Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (>0 Hz to 300 GHz). The ‘greater than zero sign’ excludes static fields as these are dealt with in another document.

**Table 1** Terminology and frequency coverage of selected standards

| Attribute                             | NRPB93<br>(Doc. of NRPB<br>Vol. 4, No. 5)                         | IEEE99<br>(IEEE C95.1–1999)                                       | ICNIRP98<br>(ICNIRP 1998*)  |
|---------------------------------------|---|---|---|
| Term used for limits                  | Investigation levels  | Maximum permitted exposure (MPE)                                  | Reference levels  |
| Classification of people/ environment | 1. Adults<br>2. Children present                                  | 1. Controlled environments<br>2. Uncontrolled environments        | 1. Occupational<br>2. General public  |
| Frequency coverage                    | 0 to 300 GHz  | 3 kHz to 300 GHz  | >0 to 300 GHz   |
| Notes                                 | Read the NRPB93 document in conjunction with NRPB-R301 report[28] | IEEE99 incorporates the 1999 modifications to the IEEE91 document | *This document was published in ‘Health Physics’ Vol. 74, No. 4, April 1998 |

**Reference:** Ronald Kitchen - RF and Microwave radiation safety handbook.