COMMUNICATIONS AUTHORITY OF KENYA

FRAMEWORK FOR ASSESSMENT OF EXPOSURE TO RADIO FREQUENCY ELECTROMAGNETIC FIELDS(RF-EMF)

2025

Version 1.0.

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Terms and Definitions

Quality of Service	The performance of a system/solution as compared to the set performance metrics
Quality of Experience	The subjective satisfaction and overall user perception when utilising a system or service
Electromagnetic Fields	The energy dissipated into the environment by radio frequency equipment, natural phenomenon like the sun, and human activities that use electricity
Radio Frequency	Electromagnetic signals characterised by alternating currents within the range of 3 kHz to 300 GHz, typically used in various communication and wireless technologies
Know Your Customer	Activities undertaken by organisations to verify and validate the identity of their clients
Electric Field Strength	The intensity of the force produced by stationery charged particles at a specific point in space, measured in volts per meter (V/m)
Magnetic Field Strength	The intensity of the force produced by moving charged particles , measured in amperes per meter (A/m)
Power Density	The amount of electromagnetic energy emitted/received per unit area, measured in watts per square meter (W/m^2).
Specific Absorption Rate (SAR)	The rate at which electromagnetic energy is absorbed by the human body when exposed to an RF electromagnetic field, measured in watts per kilogram (W/kg)

Abbreviations and Acronyms

CA	Communications Authority of Kenya
COSMOS	Cohort Study of Mobile Phone Use and Health
EMF	Electromagnetic Fields
kHZ, MHZ, GHz	Kilohertz, Megahertz, Gigahertz
IARC	International Agency for Research on Cancer
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICT	Information and Communications Technology
KYC	Know Your Customer
kHz	Kilo Hertz
QoS	Quality of Service
QoE	Quality of Experience
RF	Radio Frequency
SAR	Specific Absorption Rate
WHO	World Health Organisation

1. Introduction

The Communications Authority of Kenya (CA), established in 1999 by the Kenya Information and Communications Act (KICA), 1998, is the regulatory authority for the communications sector in Kenya. The Authority is entrusted with the responsibility of facilitating the development of the information and communications sectors, including broadcasting, cybersecurity, multimedia, telecommunications, electronic commerce, postal, and courier services.

In addition, the Authority has a critical role in ensuring consumer protection in the Information and Communications Technology (ICT) sector, specifically with regard to Safety, Health, Quality of Service (QoS) and Quality of Experience (QoE).

The consumer protection mandate is executed through various regulatory measures, including tariff regulation, type approval of ICT equipment, monitoring of QoS/QoE for voice and data services, monitoring frequency use and interference, inspection of ICT equipment installations, and ensuring the proper implementation of Know Your Customer (KYC) measures.

The Authority has developed various regulations, guidelines, and code of practice to facilitate the protection of consumers. This framework for assessement of exposure to Radio Frequency Electromagnetic Fields is an integral component of the Authority's ongoing efforts to safeguard the public and users of telecommunication services and therefore enhances existing regulatory instruments aimed at consumer protection.

2. Background

In pursuance of its mandate under section 5 of the Kenya Information and Communications Act (KICA), the Authority licenses ICT service providers who deploy transmission equipment that generate Electromagnetic Field (EMF) radiation in the Radio Frequency spectrum(RF-EMF). The emitted RF-EMF radiations must be controlled within internationally agreed limits to mitigate potential harmful effects on living organisms.

At the international level, there have been significant and concerted efforts geared towards research on the effects of RF-EMF on human health. These efforts are spearheaded by organisations such as the World Health Organisation (WHO), which established the International EMF Project in 1996 to evaluate the scientific evidence surrounding the potential health risks of EMF exposure in the frequency range from 0 to 300 GHz.

The classification of radiofrequency electromagnetic fields as being carcinogenic to humans by the International Agency for Research on Cancer (IARC), a specialized cancer agency of the WHO, was also influenced by increased risk for glioma, a malignant type of brain cancer, associated with wireless phone use. However, recent results from the Cohort Study of Mobile Phone Use and Health (COSMOS) project indicate no significant correlation between extended hours of mobile phone use and an increased risk of developing a brain tumour.

The International Commission on Non-Ionizing Radiation Protection (ICNIRP), a non-profit organization with a scientific mission, is another key entity involved in the development and dissemination of science-based guidance on limiting exposure to non-ionizing radiation. ICNIRP evaluates the risk of exposure to non-ionizing radiation and provides exposure guidance through published Guidelines, Reviews, and Statements.

The International Telecommunication Union(ITU), the United Nations specialized agency for Information and Communication Technologies (ICTs), makes recommendations on various facets of the ICT sector, including those related to EMF matters. Notable recommendations include mitigation techniques for limiting human exposure to EMFs in the vicinity of radiocommunication stations (ITU-T K.70), guidance on assessing and monitoring human exposure to radio frequency electromagnetic fields (ITU-T K.91), and managing of compliance with exposure limits for workers at radiocommunication sites and facilities (ITU-T K.145)

Given that the Authority is a member of the ITU, it has domesticated various standards and guidelines, including those related to RF-EMF exposure as developed by the WHO, ICNIRP, and the ITU.

This framework for assessment of RF-EMF exposure is therefore designed to adopt and implement international standards and guidelines, ensuring that the exposure limits are in line with best practices set by these organizations.

3. Scope

The framework is specifically focused on and limited to Non-Ionizing Radiation (NIR) within the audio and radio frequency ranges used in telecommunications. It applies to the assessment and management of RF-EMF exposure in telecommunications and related services.

4. Objective

The primary objectives of this framework for the assessment of exposure to RF-EMF are to:

a) Specify maximum levels of exposure to RF-EMF.
b) Provide general procedures for limiting the exposure of the general public and personnel working in the vicinity of RF and microwave devices to specified RF-EMF levels.
c) Provide a reporting template for assessment of exposure to RF-EMF.

The framework is applicable to:

a) Situations where the general public (including persons of any age or health status) or employees may be exposed to RF-EMF, whether intentionally or incidentally;
b) Continuous and intermittent RF-EMF exposure at single or multiple frequencies within the range 100 kHz to 300 GHz.
c) Situations where RF-EMF are generated, either intentionally or incidentally, by the operation of telecommunications and postal-courier equipment or devices, or installations.

It is the responsibility of the manufacturer/supplier, installer, employer/service provider, and user to ensure compliance with this framework through proper operation and management of such devices and installations.

5. RF-EMF Exposure Assessment Principles

This Framework is anchored on the following foundational principles:

a) The protection of the health of both the public and occupational workers who are at or near ICT installations.

b) Ensuring the safety of both the public and occupational workers at or near ICT installations

c) Maintaining the quality of service (QoS) and quality of experience (QoE) from ICT systems while adhering to safe exposure limits.

6. Sources of EMF

Electromagnetic Fields (EMFs) are emitted in two primary forms: Ionizing and Non-Ionizing Radiation. The ionizing radiations are emitted by frequencies that have enough power to change the sub-atomic composition of other atoms they come in contact with. The non-ionizing radiations are from frequencies with low power and therefore do not have sufficient energy to change the sub-atomic composition of other atoms they come in contact with.

The sources of Non-ionizing radiation include:

a) Radiofrequency waves used in telecommunication services
b) Microwaves used in domestic appliances
c) Infrared used in home infotainment devices
d) Visible light from the sun.

Ionizing radiation, in contrast, emanates from radioactive activities like nuclear energy generation, and other activities, like nuclear decay that generate alpha and beta particles, as well as from gamma and X-rays used in medical equipment.

This framework focuses exclusively on the RF-EMF radiations, which fall under the category of non-ionizing radiation.

A summary of EMF sources is depicted in Figure 1.

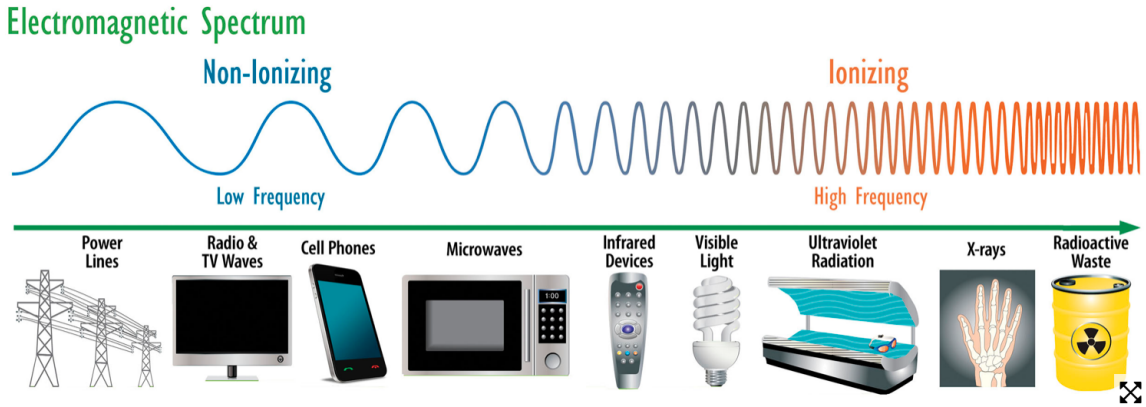

Figure 1: Sources of EMF

The entire range of the Electromagnetic Spectrum, which consists of ionizing and non-ionizing radiation, is depicted in Figure 2.

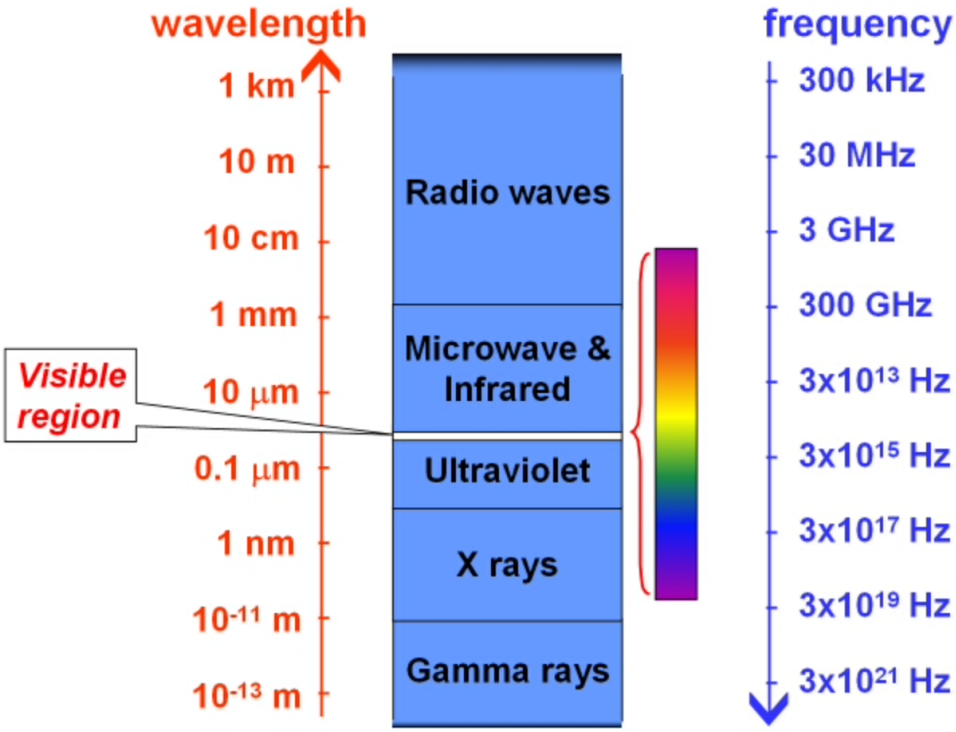

Figure 2: The Electromagnetic Spectrum Range

The EMF radiations normally move from their source to potential target equipment and non-targeted equipment, and are affected by the environment in which they propagate, as shown in Figure 3.

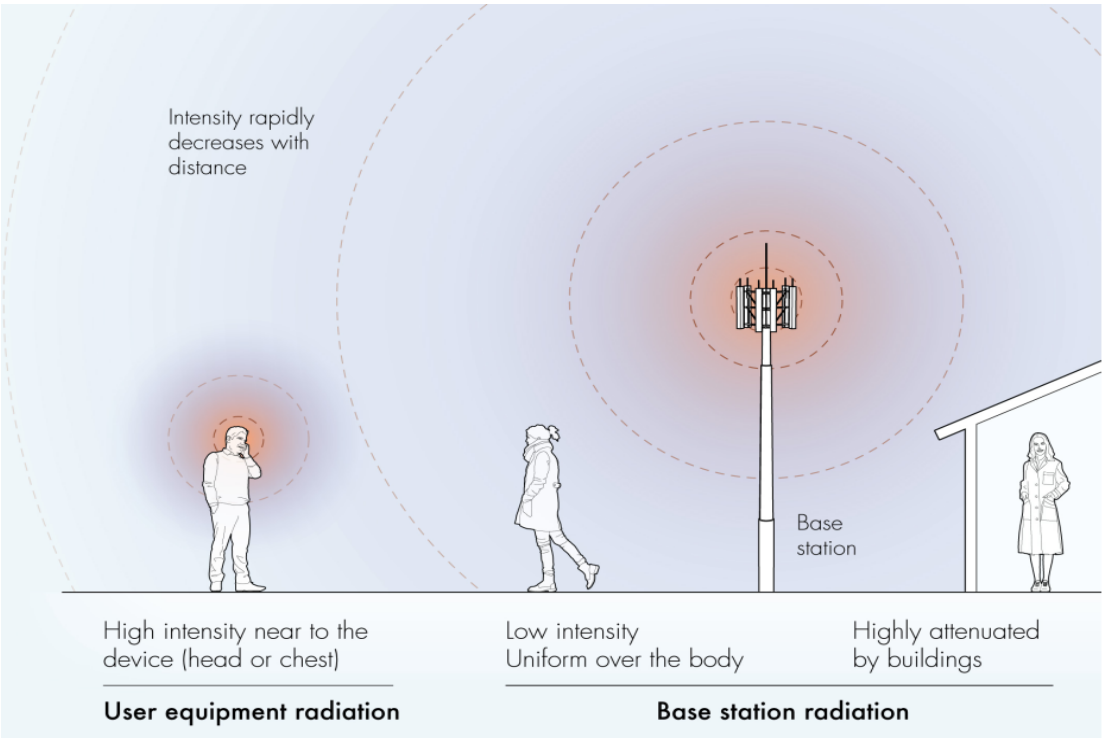

Figure 3 : Flow of RF-EMF Radiation

7. Assessment of RF-EMF from ICT Installations

The assessment of RF-EMF exposure can be conducted using two primary techniques: calculation and measurement. ICT service providers are required to assess RF-EMF exposure levels emanating from their installations and submit results in three distinct forms:

a) Baseline Results- Measurements taken prior to the installation of new ICT equipment;

b) Projected EMF Results- calculated exposure levels based on the proposed installations;

c) Annual Audit Results- a random audit of at least 50% of ICT installations per year, ensuring that audits cover sites not previously audited in the preceding year.

Measurements must be recorded in the following units: Electric Field Strength (V/m), Magnetic Field Strength (A/m), Power Density (W/m^2), and Specific Absorption Rate (SAR) (W/kg). Additionally, the EMF measurements shall include relevant site parameters such as antenna height, operating frequency, and radiated power.

7.2 Compliance with International Standards

The assessment of RF-EMF exposure for site compliance shall adhere to the international technical standards established by the International Electrotechnical Commission (IEC) and the International Telecommunications Union (ITU).

The EMF measurement shall:

a) Utilize of the best estimates of the 3D antenna pattern gain
b) Take into account the different positions, tilt angles, and directions
c) Use reduction factors to account for attenuation of the RF-EMF through walls or windows to estimate RF-EMF levels inside buildings from external antennas
d) Use the best estimates of system losses (i.e.feeder, combiner, connector, and antenna losses)
e) Avoid the use of Enhancement factors for ground reflections in areas that are not close to the ground, like elevated antennas on free standing masts
f) Use appropriate near-field calculation methods to obtain an accurate antenna far-field beam pattern, and the far-field gain close to the antenna

7.3 Service Provider Compliance Declaration

Service providers must declare compliance with RF-EMF exposure limits based on actual maximum parameters, as specified in the IEC 62232 standard. The declaration of compliance shall include:

a) Declaration and confirmation of compliance using the actual maximum transmitted power or EIRP (time-averaged value) threshold configured on the site.

b) Verification that the actual maximum threshold is not exceeded during operation using monitoring counters and control features.

c) Validation of monitoring counters and control features in accordance with the methods specified in the IEC 62232 standard.

7.4 Compliance and Enforcement of EMF Exposure Assessment

The Authority shall periodically, and on an ad hoc basis, verify the reported EMF exposure measurement from audits done by service providers. Service providers found to be having sites whose EMF exposure exceeds the set levels shall be notified to correct the exposure levels, after which continued violations will be dealt with in line with the Kenya Information and Communications Act, 1998.

The reporting template to be used by service providers shall be as prescribed in Form 1.

Form 1: Measurement of Electromagnetic Fields Exposure

Service Provider /Site Owner				
Date of Measurement				
Site Name				
Site location (County, Sub-County, Town /Village)				
Site Coordinates				
Site Frequency				
Site Service (Broadcasting/Telecommunication /PMR				
Antenna Height				
Distance to the transmitting antenna				
Rationale for distance selection				
Type of measurement (broadband RF EMF measurement/ frequency-selective RF EMF measurement)				
	Power Density (W/m^2),	Electric Field (V/m)	Magnetic Field (A/m)	SAR (W/kg)
Measurements Values				
EIRP Measurements and Calculations	Tx Power (W)	Antenna Gain (dBi)	Cable losses (approx)	EIRP (W)
Note : Incase of more than one frequency all operating frequencies have to be covered by the measuring equipment and total exposure level determined				

Form 1: EMF Exposure Measurement Template

This form shall be annexed to the quarterly returns form, but shall be filled annually by service providers for all new sites in the reporting financial year.

8. RF-EMF Safety Limits

In accordance with the International Commission for Non-Ionizing Radiation Protection (ICNIRP) 2020 guidelines, and the International Telecommunications Union (ITU) ITU-T Recommendations K.91, K. 52, K.61, K.70, K.83 and K.100, this framework establishes the RF-EMF safety limits for Electric Field, Magnetic Field, and Power Density, as depicted in Figure 4.

Exposure scenario	Frequency range	Incident E-field strength; E_{inc} (V m^{-1})	Incident H-field strength; H_{inc} (A m^{-1})	Incident power density; S_{inc} (W m^{-2})
Occupational	0.1 – 30 MHz	$660/f_M^{0.7}$	$4.9/f_M$	NA
	>30 – 400 MHz	61	0.16	10
	>400 – 2000 MHz	$3f_M^{0.5}$	$0.008f_M^{0.5}$	$f_M/40$
	>2 – 300 GHz	NA	NA	50
General public	0.1 – 30 MHz	$300/f_M^{0.7}$	$2.2/f_M$	NA
	>30 – 400 MHz	27.7	0.073	2
	>400 – 2000 MHz	$1.375f_M^{0.5}$	$0.0037f_M^{0.5}$	$f_M/200$
	>2 – 300 GHz	NA	NA	10

[a]Note:

1. "NA" signifies "not applicable" and does not need to be taken into account when determining compliance.
2. f_M is frequency in MHz.
3. S_{inc}, E_{inc}, and H_{inc} are to be averaged over 30 min, over the whole-body space. Temporal and spatial averaging of each of E_{inc} and H_{inc} must be conducted by averaging over the relevant square values (see eqn 8 in Appendix A for details).
4. For frequencies of 100 kHz to 30 MHz, regardless of the far-field/near-field zone distinctions, compliance is demonstrated if neither E_{inc} or H_{inc} exceeds the above reference level values.
5. For frequencies of >30 MHz to 2 GHz: (a) within the far-field zone: compliance is demonstrated if either S_{inc}, E_{inc} or H_{inc}, does not exceed the above reference level values (only one is required); S_{eq} may be substituted for S_{inc}; (b) within the radiative near-field zone, compliance is demonstrated if either S_{inc}, or both E_{inc} and H_{inc}, does not exceed the above reference level values; and (c) within the reactive near-field zone: compliance is demonstrated if both E_{inc} and H_{inc} do not exceed the above reference level values; S_{inc} cannot be used to demonstrate compliance, and so basic restrictions must be assessed.
6. For frequencies of >2 GHz to 300 GHz: (a) within the far-field zone: compliance is demonstrated if S_{inc} does not exceed the above reference level values; S_{eq} may be substituted for S_{inc}; (b) within the radiative near-field zone, compliance is demonstrated if S_{inc} does not exceed the above reference level values; and (c) within the reactive near-field zone, reference levels cannot be used to determine compliance, and so basic restrictions must be assessed.

Figure 4: EMF Exposure limit for Electric Field, Magnetic Field, and Power Density

Exposure limits for specific Absorption Rate (SAR) are as shown in Figure 5.

Exposure scenario	Frequency range	Whole-body average SAR (W kg^{-1})	Local Head/Torso SAR (W kg^{-1})	Local Limb SAR (W kg^{-1})	Local S_{ab} (W m^{-2})
Occupational	100 kHz to 6 GHz	0.4	10	20	NA
	>6 to 300 GHz	0.4	NA	NA	100
General public	100 kHz to 6 GHz	0.08	2	4	NA
	>6 to 300 GHz	0.08	NA	NA	20

[a]Note:

1. "NA" signifies "not applicable" and does not need to be taken into account when determining compliance.
2. Whole-body average SAR is to be averaged over 30 min.
3. Local SAR and S_{ab} exposures are to be averaged over 6 min.
4. Local SAR is to be averaged over a 10-g cubic mass.
5. Local S_{ab} is to be averaged over a square 4-cm^2 surface area of the body. Above 30 GHz, an additional constraint is imposed, such that exposure averaged over a square 1-cm^2 surface area of the body is restricted to two times that of the 4-cm^2 restriction.

Figure 5: SAR EMF Safety Limits

9. Access Controls to RF-EMF Sites

Sites where RF-EMF emissions exceed occupational exposure thresholds must implement appropriate access controls. These controls include: shall have necessary pre -access controls that will include:

a) Supervised access to restricted areas;
b) EMF awareness trainings/briefings for individuals accessing these sites;
c) Installation of appropriate Signage;
d) Physical barriers to limit unauthorized access.

10. Signage for RF-EMF Sites

Broadcast transmission sites and mobile network base station sites must be designated to prevent unauthorized public access to areas/regions designated as exclusion zones.

In addition, appropriate and adequate signage, as outlined in Table 1, shall be displayed in accordance with the risk level of the exposure zone:

For rooftop base station sites, additional physical safety measures and precautions must be put in place to meet this requirement.

Table 1: Recommended RF-EMF Sites Signage

HAZARD LEVEL	SIGN	DESCRIPTION	placement
NOTICE		• Area of Unrestricted Occupancy, • Possibility of exposures exceeding the reference levels for general public.	• On the Fence, Gate or Rooftop access to the RF equipment typically beyond 35 metres
CAUTION		• Area of restricted Occupancy • Possibility of exposures exceeding the reference levels for workers.	• On the Fence, Gate or Rooftop access to the RF equipment typically 20 – 35 metres
WARNING		• Area of Restricted Occupancy (Authorised Personnel Only) • Potential exposures that may exceed the reference levels for workers by a factor of 10 (the safety factor in the (ICNIRP, 1998) guidelines	• At the base of the tower or Roof Top mast with RF Equipment, typically 10 – 20 metres.
DANGER		• Area of Denied Occupancy • Immediate and serious injury may occur such as in the case of RF burns and/or RF electrical shocks.	• At the edge of compliance zones of an RF equpment, typically 1- 5 metres • Transmitting equipment must be powered off prior to access.

11. Employee Exposure to RF- EMF

Where employees may be exposed to EMFs in the workplace, the employer is required to conduct a risk assessment, which must be carried out by a National Environmental Management Authority (NEMA) licensed Environmental Impact Assessment expert. This assessment should include measurements or calculations of RF-EMF levels, considering factors such as the frequency, level, exposure duration, and type of exposure.

Situations warranting such assessments may include, but are not limited to:

- Proximity or location of an office or work facility within fifty (50) metres of a mast with more than 3 antennas, considered a transition zone between near-field zone and far-field zone.

- Employers with employees who wear active or passive implanted medical devices, or employees with medical devices worn on the body.

- Pregnant women and workers bearing personal medical devices should not be exposed to levels of RF fields above the limits of general public exposure, therefore, pregnant women shall NOT perform jobs labelled as RF workers' jobs, for example, telecom test lab engineers and telecommunication infrastructure maintenance engineers (tower climbers, installation engineers, etc.).

12. Training RF workers

All workers exposed to RF-EMF must be adequately trained and informed on RF safety, risk management, and the basic restrictions and reference levels of RF exposure. This training should include safe working practices to minimize risks, an understanding of both direct and indirect effects of RF-EMF, and the circumstances under in which workers are entitled to health surveillance.