EMF Exposure Compliance Policies for Mobile Network Sites

Good practice policies for compliance of mobile network sites with radiofrequency electromagnetic field limits

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Author
Dr Jack Rowley, Senior Director Research & Sustainability, GSMA

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Summary

Adoption of the following key principles and good practice policies supports the efficient assessment and management of radiofrequency electromagnetic field (RF-EMF) exposure compliance for mobile network sites.

Key principles for RF-EMF compliance of mobile network sites

- Countries should adopt RF-EMF limits based on the International Commission for Non-Ionizing Radiation Protection (ICNIRP) guidelines.
- National RF-EMF compliance regulations should reference international technical standards for the methods to demonstrate compliance.
- Use of electronic procedures to manage RF-EMF compliance, including defined timeframes for processing, is administrative good practice and improves efficiency for all stakeholders.

The following good practice policies ensure RF-EMF protection of the public and workers.

Good practices for site RF-EMF compliance

Allow operator declaration of site RF-EMF compliance

Assess site RF-EMF compliance through calculation

Specify assessment uncertainty based on best practice

Carry out appropriate post-installation measurements

Reassess sites only when RF-EMF compliance changes

Apply public or worker RF-EMF limits depending on access controls

Define standardised site RF-EMF compliance assessment methods

Agree compliance procedures for shared sites

Adopt uniform small cell deployment rules

Update assessment rules for active antennas

Adopt efficient approaches to monitor compliance

Practice effective communication of compliance information

Introduction

This document sets out good practice policies for the efficient assessment and management of compliance with radiofrequency electromagnetic field (RF-EMF) exposure compliance for mobile network sites to ensure protection of the public and workers.

These good practices provide guidance for policymakers developing or updating national rules based on international RF-EMF exposure limits and technical standards.

On-going mobile network developments such as the expanded use of small cells and active antenna systems require all stakeholders to examine existing practices.

National RF-EMF policy should give due consideration to the guidelines of International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the international reference standards for assessment of compliance.

Existing technical requirements for RF-EMF assessments in some countries are based on assumptions that lead to large overestimation of RF-EMF exposure levels and the size of corresponding RF-EMF compliance zones.

These impact the efficient deployment of mobile network infrastructure limiting the potential benefits for citizens, industries and public administrations and imposing regulatory burdens on operators, local authorities and national bodies.

It is important that national regulatory authorities take a leading role in communication efforts to inform the public and address misinformation about RF-EMF.

The good practices outlined in the document are supported by evidence and examples of implementation in different markets.

For up-to-date information please consult **https://www.gsma.com/emf**

RF-EMF compliance for networks

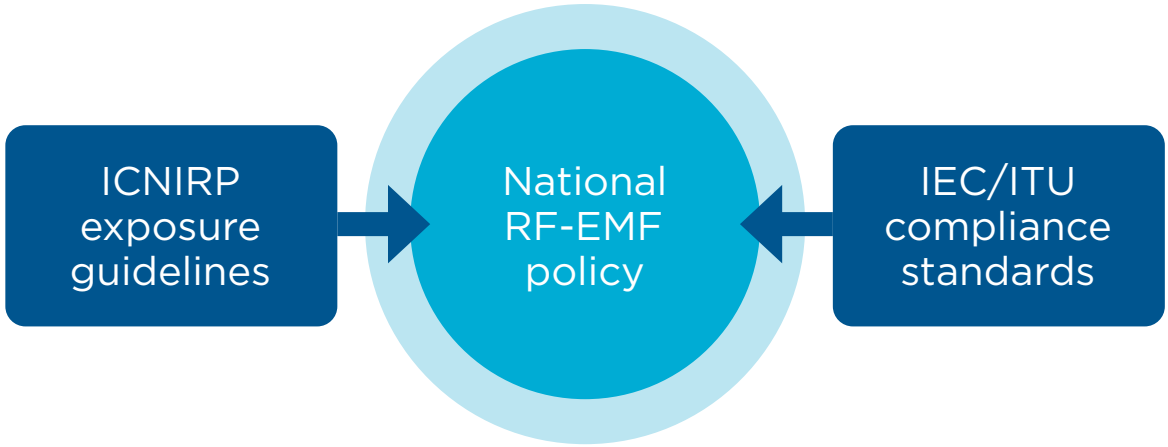
Exposure limits and compliance standards

As shown in Figure 1, the GSMA position is that the basis for national RF-EMF exposure policies should be the international RF-EMF exposure guidelines developed by the International Commission for Non-Ionizing Radiation Protection (ICNIRP) that set the recommended human exposure limits on the basis of up-to-date acknowledged scientific evidence.

Assessment of site compliance with the RF-EMF limits should be based on methods provided in international technical standards produced by the International Electrotechnical Commission (IEC) and the International Telecommunications Union (ITU).

Figure 1

National RF-EMF policy should be harmonised with the international RF-EMF exposure guidelines and technical standards for compliance assessment



Approaches to regulating site RF-EMF compliance

National regulatory practices and traditions result in differing approaches to regulating compliance with RF-EMF limits. These broadly divide into *Declaration based* or *Permit based* approaches.

Declaration based: it is the responsibility of the operator to self-assess compliance using appropriate technical standards and declare compliance with RF-EMF limits.

Permit based: the operator submits a site compliance file that is checked and may include an assessment by a third party before the site can be made operational.

In both cases authorities may audit a sample of sites, while reserving the right to check the declared compliance of any site as deemed appropriate. Operator declaration based self-assessment reduces the administrative burden for all stakeholders and allows for more efficient network deployment.

Adopt international RF-EMF guidelines

Basis for international RF-EMF policy

Countries should adopt RF-EMF limits based on the International Commission for Non-Ionizing Radiation Protection (ICNIRP) guidelines [1]. These guidelines, based on up-to-date and acknowledged scientific evidence, form the basis of policy in the majority of countries around the world[1]. Additional details are provided in the GSMA publication EMF Exposure Guidelines [2].

The consensus of expert reviews is that there are no established health risks for mobile devices or base stations that comply with the limits in the ICNIRP guidelines[2].

ICNIRP states that there is no evidence that additional precautionary measures will result in a benefit to the health of the population.

ICNIRP strongly recommends that countries update national regulations to align with the ICNIRP (2020) guidelines [1].

The ITU says that the best practice for administrations is to use the ICNIRP (2020) guidelines [3].

Harmonization of RF-EMF limits

Adoption of the updated ICNIRP guidelines will foster greater harmonisation of RF-EMF limits.

The World Health Organization (WHO) encourages countries to adopt international exposure guidelines. The WHO warns that large differences between national limits and international guidelines can foster confusion for regulators and policy makers and increase public anxiety [4].

There are no significant differences in environmental radio signal levels in countries with the ICNIRP or restrictive limits [5].

Moreover, real-world measurements show higher quality mobile reception, fewer base stations and fewer coverage holes in a country with ICNIRP limits than a country with restrictive limits [6].

Assessment of compliance using basic restrictions or reference levels

The international RF-EMF guidelines include both basic restrictions and reference levels. The basic restrictions relate to exposures internal to the body, for example, the Specific Absorption Rate (SAR). The reference levels are based on external field quantities, for example, incident power density, and represent a practical means of demonstrating compliance using quantities that are more-easily assessed than basic restrictions.

ICNIRP (2020) says that the basic restrictions and reference levels provide equivalent protection.

It is important that regulatory frameworks for RF-EMF compliance assessment allow for the use of either type of limit as appropriate to mobile network sites. International technical standards provide methods for assessment of compliance using both types of limits.

1 https://www.gsma.com/publicpolicy/emf-and-health/emf-policy
2 https://www.gsma.com/publicpolicy/emf-and-health/expert-reports

Use international compliance standards

Technical methods to assess compliance with RF-EMF limits

GSMA recommends that national RF-EMF compliance regulations reference international technical standards rather than duplicating content. This allows for simpler updating of national regulations when new techniques become available.

There are two main international technical committees working on standards for RF-EMF exposure assessment:

- International Electrotechnical Commission (IEC) Technical Committee 106 (TC106), and
- International Telecommunications Union standardisation division (ITU-T) Study Group 5 (SG5)

IEC Technical Committee 106

The role of the IEC TC106 technical committee is to prepare international standards and technical reports on measurement and calculation methods to assess human exposure to electric, magnetic and electromagnetic fields (0 Hz to 300 GHz).

ITU-T Study Group 5

ITU-T SG5 produces standards (called recommendations by the ITU) for RF-EMF evaluation of base stations through calculation or measurement.

There is cooperation between the two technical committees and alignment on the compliance assessment approaches.

Accurate assessment of compliance boundaries

It is important that the results of RF-EMF compliance assessments are accurate and represent the actual operation of the site, avoiding unrealistic overestimation of compliance zones. Accurate assessments use standardised technical methods appropriate to the antenna installation and include uncertainty evaluation. Realistic assessments require the use of actual equipment and installation parameters rather than overly conservative theoretical assumptions. International technical standards provide a range of techniques for achieving these aims.

Existing practices based on the assumption of continuous operation of transmitters at the maximum theoretical output, using the boresight gain in off-axis directions, or neglecting the effect of beam steering provide inaccurate assessments of RF-EMF compliance zones and should be reviewed and updated.

Follow administrative good practice

Efficient management of RF-EMF compliance

The use of electronic procedures to manage RF-EMF compliance for sites, including defined timeframes for processing, is administrative good practice and improves efficiency for both administrations and the mobile industry.

A properly designed electronic system can avoid duplication of information requests, ensure that all required information is collected and allow for parallel processing to reduce administrative delays.

Such a system would also allow for authorities to request supplementary information and for operators to submit alternative designs.

In addition to compliance management, these systems can also be used to increase transparency of information towards the public.

Permit procedures should not request unnecessary data. The RF-EMF compliance system should not capture information that is of a commercial nature (for example, whether a lease exists) that is not required for the assessment of compliance.

All administrative procedures should allow for an independent appeals process with one or more levels to allow decisions to be challenged and additional information provided.

Where required, costs for processing applications should be low and consistent with the actual administrative requirements.

Internet based electronic document processing systems with standardised forms are recommended and successfully implemented in several countries either by government or industry.

Clear timelines for permit procedures

All approvals should be provided in a timely manner and the timetable for administrative decisions clearly specified in order to support efficient base station deployment.

Where multiple authorities need to provide approval, this processing should happen in parallel whenever possible.

In order to avoid delays, there should be a deemed approval process in the event that there is no administrative response to a valid application within the specified timeline.

Good practices for site RF-EMF compliance

Adopting the international RF-EMF exposure guidelines and basing RF-EMF compliance assessments on international technical standards combined with good administrative practice are the foundation for a national policy. Additional policy settings are needed to give practical effect to the process for regulating and determining RF-EMF compliance for mobile network sites.

This section draws on the experience around the world to identify good practice policy recommendations for RF-EMF compliance of mobile network sites.

Good practices for site RF-EMF compliance

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Adopt efficient approaches to monitor compliance

Practice effective communication of compliance information

These good practices are explained in the following pages and illustrated with examples.

01

Allow operator declaration of site RF-EMF compliance

Operator compliance declaration

Mobile network operators should be able to prepare declarations of RF-EMF compliance for mobile network antenna sites.

If required, the declaration may be submitted as a notification as part of the site approval process.

Appropriate records should be maintained by the mobile network operator to substantiate the declaration of compliance.

There should be no general requirement for third-party RF-EMF compliance assessments. However, regulatory authorities retain the right to conduct or commission audits and independent checks.

The general requirements for a supplier's declaration of conformity are provided in ISO/IEC 17050-1 [7] and ISO/IEC 17050-2 [8] describes the requirements for supporting documentation. See page 21 for an example declaration of compliance.

Assessment of skills

The assessment of RF-EMF exposures requires qualified and high level technical skills and equipment. Only those persons or organizations with these capabilities should conduct assessments.

This may include either operator staff or third-party contractors so long as their independence and commitment to quality is adequately assured by appropriate administrative procedures.

The ISO 9000 series provides guidance on quality management and quality assurance [9].

Example

Operator declaration of compliance with public RF-EMF limits (Canada)

Industry Canada[3] requires that the operator of radiocommunication and broadcasting antenna systems 'attest' (declare) that its station (or the site if co-located) is in compliance with the uncontrolled (public) limits in areas accessible to the public [10].

Assessments for simple installations may be conducted using an evaluation template provided by Industry Canada. For more complex sites, assessments using sound engineering practices or detailed measurements may be required. If the exposure level in publicly accessible areas exceeds 50% of the limit, Industry Canada must be notified and information submitted to demonstrate compliance.

3 Industry Canada is now known as Innovation, Science and Economic Development Canada (ISED) but Industry Canada is used throughout the relevant documents.

02

Assess site RF-EMF compliance through calculation

The starting point for RF-EMF site compliance assessment should be calculation techniques. Calculation techniques are widely recognised as a well-established and reliable way to assess the majority of RF-EMF compliance zones.

Calculations are particularly well suited for evaluating base station sites which typically require cumulative assessments of multiple antennas located in areas that are difficult to access for measurements or where the measurements maybe affected by variable power.

Continual improvements in computer hardware and numerical calculation software, as well as the establishment of reliable and extensive antenna pattern databases, has been boosted in recent decades. Calculation techniques are thoroughly covered in international standards.

Large overestimation of RF EMF exposures can unnecessarily restrict access to areas around a base station site, impeding work activities (such as maintaining rooftop air conditioning plant) and public enjoyment of the area (such as hanging out laundry).

The following recommendations guard against unrealistic overestimations:

- Use the best estimates of the 3D antenna pattern gain. In particular, the practice of applying the maximum gain of the antenna in all directions should be avoided.
- Use the best estimates of system losses (i.e. feeder, combiner, connector and antenna losses) and not simply assume the the full rated transmitter power.
- When estimating RF-EMF levels inside buildings from external antennas, use reduction factors to account for attenuation of the RF-EMF through walls or windows.
- Enhancement factors for ground reflections should not be used in areas that are not close to ground, such as around elevated antennas on free standing masts.
- Close to an antenna the antenna far-field beam pattern, including the far-field gain, is not fully formed. Appropriate near field calculation methods can be applied to obtain the most accurate results.
- The different positions, tilt angles and directions of the antennas at a site should be taken into account to ensure accurate estimations of the total RF-EMF exposure.

For some complex antenna installations or surrounding environments measurements may be required.

Example

Code of best practice on mobile network development (Wales, UK)

Under the Code for Wales [11], compliance with the ICNIRP public exposure guidelines is normally determined by mathematical calculation, and implemented by careful location of antennas, access restrictions and/or barriers and signage as necessary. The calculation should be based on recognised, standard methods taking into account all transmitters on the site.

03

Specify assessment uncertainty based on best practice

The estimation of the uncertainty of RF-EMF exposure assessments has substantially improved over the last decade for both measured and calculated assessments.

Properly applied, uncertainty estimates are a very useful common gauge for determining and specifying the quality of an assessment without being overly prescriptive on how the assessment is conducted.

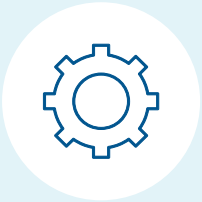
The IEC 62232 standard [12] is recommended as a thorough guide on how to estimate uncertainty in RF-EMF exposure assessments. ITU-T K.91 [13] includes software for calculating uncertainty based on the IEC approach.

IEC 62232 recommends determining the target uncertainty for an assessment method. If the expanded uncertainty is less than the target, then compare the assessed value with the limit. If it is less than the limit, the location complies.

IEC 62232 also explains how to specify uncertainty tolerances for good quality in situ measurements. According to IEC 62232 the target expanded uncertainty is 4 dB or below, which is considered best practice.

The expanded uncertainty for the RF exposure evaluation used for the product installation compliance assessment shall not exceed 6 dB.

Example



Assessment of compliance with public limits (United Kingdom)

The Ofcom guidance [14] on RF-EMF compliance and enforcement states that where Ofcom conducts its own measurement, it will assess compliance based on whether the measured value averaged over the relevant time interval is above or below the public RF-EMF limits.

This approach will be used where the expanded measurement uncertainty, at a confidence interval of 95%, does not exceed a target of ±4 dB. In cases where this is not the case, the measured value will be reduced by an appropriate amount (based on the difference between the target uncertainty and the actual uncertainty) before comparison with the public limits.

04

Carry out appropriate post-installation measurements

Measurements not always required

There should be no general requirement for post-installation measurements of all sites as part of site commissioning. The calculation tools used to assess RF-EMF compliance boundaries can do so with a high degree of accuracy.

The mobile network operator may consider the need for a post installation measurement where the calculated compliance boundaries need to be verified or where some aspect of the site environment has changed.

International technical standards provide guidance on conducting accurate in situ measurements.

It is important that the measurement equipment has an appropriate frequency range and response; adequate sensitivity and that techniques are applied that can deal with the varying nature of mobile communications signals.

Environmental estimates

The simulation of RF-EMF levels in the environment should also consider factors that provide for a more accurate assessment.

For example, the Agence Nationale des Fréquences (ANFR - France) specifies a 6-minute reduction factor of 6 dB for mobile technology base stations using fixed beam antennas and 13.5 dB for mobile technology base stations using active antennas. An additional TDD attenuation factor of 1.2 dB is applied to 5G systems operating in the 3.4 to 3.8 GHz band [15].

Real world assessments

Studies show that the actual transmitted power of 2G, 3G [16], 4G [17] and base stations during operation is generally below the theoretical maximum time-averaged configured power.

Even on sites that combine 2G, 3G and HSPA the realistic maximum is substantially lower than the theoretical maximum [18].

With 5G and increased use of active antenna systems, the antenna beam direction and EIRP also vary in response to traffic resulting in lower time-averaged exposures when measured in commercial networks [19].

Example

Regulator RF-EMF compliance strategy (Australia)

The Australian Communications and Media Authority (ACMA) makes it a condition of radiocommunication licences that operators comply with public limits based on the international RF-EMF exposure guidelines [20].

ACMA encourages industry to self-monitor compliance and does not routinely require measurements of base stations. From time-to-time, ACMA may check compliance through audits of documents or site inspections.

ACMA assessed compliance of a sample of small cells in 2020 and a sample of 5G equipped sites in 2021. In both cases exposure levels were well below the limit values.

05

Reassess sites only when RF-EMF compliance changes

It should be possible to conduct an RF-EMF compliance assessment for a site configuration that will result in a conservative RF-EMF compliance boundary. This might include higher transmit powers or larger antenna downtilt than intended for initial use.

Provided the site configuration stays within those predefined parameters a separate assessment should not be required for each minor change to the site configuration.

Changes that result in an increase in the size or the position of the RF-EMF compliance zone in accessible areas would require a new assessment.

It follows, that as base station sites do not change in unpredictable ways there should not be a requirement for periodic re-certification of compliance through assessment or calculation.

Mobile network operators should ensure that site visits for maintenance purposes also include checks for changes in the surrounding environment that could affect RF-EMF compliance. This might include construction of nearby structures that could block radio signals or changes to access controls.

Example

Frequency of site RF-EMF assessments (United Kingdom)

Ofcom does not specify an interval for updating RF-EMF assessments [14].

Ofcom expects RF-EMF compliance to be reassessed when a change at the site is likely to increase RF-EMF exposure above the levels in the most recent EMF assessment in any area where the general public may be present when transmissions are taking place.

In some cases, it may be possible to carry out an assessment for a realistic 'worst-case' equipment configuration that would cover most future changes to configuration of the relevant equipment.

06

Apply public or worker RF-EMF limits depending on access controls

The application of public or worker RF-EMF limits should be based on the controlled access area at a site.

A controlled access area is a defined region around a radio transmitter which is subject to access controls that ensure entrants to an area are not exposed to levels above the relevant RF-EMF exposure limits.

Access controls ensure awareness of entrants of local RF-EMF hazards through a combination of supervision, awareness briefings, signs and barriers around transmitting antennas.

Policy should allow that persons who are aware of the potential RF-EMF hazards and the required safety procedures can be exposed up to the occupational limits for RF-EMF exposure.

The use of the controlled access area approach is recommended for base station sites where maintenance workers require access to areas above the public RF-EMF safety limits.

This is the approach taken by Ofcom where all workers (regardless of whether or not they work in the radiocommunications industry) are regarded as occupationally-exposed individuals and are not members of the general public whilst they are working [14].

ITU-T K.145 [21] proposes that where such workers are given information regarding RF-EMF safety and risk management they can be exposed up to the occupational exposure limits.

The public RF-EMF exposure limits would apply in areas where there are no access controls and in areas that are accessed by people who are unaware of transmitting antennas.

Example

Protection—occupational and general public exposure (Australia)

In the Australian standard for RF-EMF exposure, ARPANSA – the health regulator, outlines an approach to compliance for occupationally exposed persons and the general public [22].

For ARPANSA occupational exposure is only permitted under controlled conditions, with appropriate risk analysis and risk management procedures. The standard defines different groups of workers that can be exposed up to the occupational limits in their course of their work. A key to this is the identification of a controlled areas where '*exposure to RF fields may reasonably be expected to exceed general public exposure limits.*'

Members of the public cannot reasonably be expected to take precautions to minimise exposure and may not be aware that the exposure is occurring.

07

Define standardised site RF-EMF compliance assessment methods

Simplified Assessment Criteria

The compliance of many base station installations can be determined by examining some key site characteristics without resorting to more complex and costly assessment methods. Low power sites may be exempt, for example, less than 10 watts EIRP in the Ofcom rules [14].

The application of a site classification approach is described in the international standards IEC 62232 [12] and ITU-T K.100 [23]. The approach uses information on the transmitter EIRP and antenna installation characteristics, such as mounting height, main lobe direction and distance to other ambient sources to provide a simplified assessment procedure to determine compliance.

See also the section on small cells on page 20.

Pre-assessed site configurations

Pre-assessed site configuration approaches to compliance should be allowed for base station sites using standardised installations. Ofcom provides for this approach [14]. One example, is the small transmitters commonly used for in-building coverage and small cells.

A defined set of site parameters (such as antenna height, frequency, transmit power, etc) can be used to assess the RF-EMF compliance boundary (including e.g. antenna type, height, frequency and averaged transmit power). To be consistent with the pre-assessed equipment configuration, the site equipment would need to operate within the parameters (or within the range of parameters) defined for the relevant pre-assessed equipment configuration

This is similar to type testing used for RF-EMF devices such as mobile phones and tablets. It provides obvious and reasonable reductions in compliance effort.

Example

Implementation of simplified RF-EMF evaluation procedure (Colombia)

The national spectrum agency (Agencia Nacional del Espectro - ANE) implemented the ITU-T K.100/IEC 62232 simplified site classification approach in 2018 [24]. Depending on the site EIRP, a mounting height and protection distance is defined that provides for site compliance without the need for verification by measurements.

The same Resolution also specifies site modifications that do not require a new site assessment to be submitted to the regulator: increase of EIRP by ≤3 dB, change of downtilt by ≤10˚ or of azimuth direction by ≤90˚.

08

Agree compliance procedures for shared sites

Procedures should be agreed to manage RF-EMF compliance for shared sites. The procedures may be developed in consultation with responsible authorities, site owners, facilities planners, site planners, site personnel and operators of radiocommunication equipment.

Antennas may be collocated at a base station site. These locations may be a shared radiocommunication tower or the structure of a third party.

At shared sites it would not be necessary to calculate aggregate exposures where transmitters do not have overlapping target coverage areas or where transmitters do not transmit simultaneously. In general sources that do not contribute more than 5% of the exposure limit do not need to be considered in shared site assessments [23].

Appendix II of ITU-T K.121 [25] provides guidance on the principles to be considered for the management of RF-EMF compliance at shared sites.

Example

Principles of management of RF-EMF compliance for shared sites (ITU)

Appendix II of ITU-T K.121 outlines seven principles for management of RF-EMF compliance at shared sites.

1. Information sharing to assess compliance.
2. Standardized documentation describing compliance procedures.
3. Site design for compliance by positioning or access controls.
4. Site compliance assessment based on agreed procedures.
5. Agree site compliance procedure for operators of new equipment.
6. Cooperation on plans to restore site compliance.
7. Agreed procedures for site access by workers.

09

Adopt uniform small cell deployment rules

Adopt uniform rules for RF-EMF compliance based on the guidance in IEC 62232 and ITU-T K.100. Where small cell installations comply with the power and installation parameters defined by the IEC/ITU they should be deemed to comply with the exposure limits without further requirements.

The term small cells covers femtocells, picocells, microcells and metrocells that are used in residential enterprise, urban and rural environments.

Low power RF-EMF transmitters are addressed in different ways through existing national regulations and international standards.

In general, where low power antennas are mounted above human body height they will comply with the recommended exposure limits.

Example

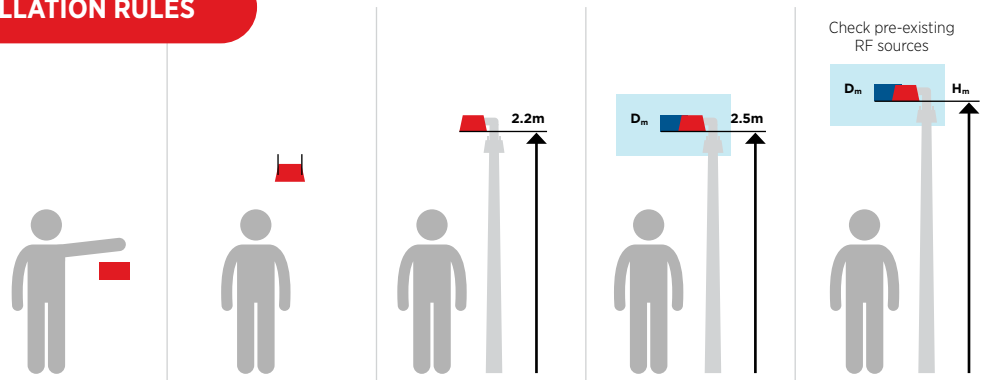
Simplified RF-EMF compliance for small cells (Small Cell Forum/ GSMA guidance)

The Small Cell Forum and the GSMA recommend adoption of a harmonized set of installation rules for RF-EMF compliance based on the installation classes defined in IEC 62232 and ITU-T K.100. These documents define the necessary installation requirements based on the equivalent isotropic radiated power (EIRP) of all equipment at the site and are outlined below. Implementation examples are provided in IEC TR 62669.

SIMPLIFIED INSTALLATION RULES

From IEC 62232 Ed.2.0

Installation must be done according to instructions from the manufacturer or entity putting into service



Installation class	E0	E2	E10	E100	E+
Total EIRP	N/A	< 2W	< 10W	<100W	No limit
Minimum height above walkway	None	None	2.2 m	2.5 m	H_m (calculation)
Exclusion zone	None, touch compliant	Provided in manufacturer's instructions Small D_m not shown on the picture		Provided in manufacturer's instructions D_m in main lobe direction	
Check pre-existing RF sources	N/A	N/A	N/A	$5D_m$ in main lobe direction D_m in other directions	

10

Update assessment rules for active antenna systems

The increasing use of smart antennas (active/advanced antenna systems, AAS) in mobile networks requires new approaches to RF-EMF compliance to improve the accuracy of assessments.

To date, some national rules require that assessments were based on theoretical output powers or site configurations that are not achieved in practice. This is inaccurate and overestimates RF-EMF exposure and the size of compliance zones.

In normal operation the RF-EMF exposure of mobile network base stations varies in response to changes in traffic and is a function of the antenna beam gain in the direction of the assessment location, whether fixed or variable (for example, massive MIMO - MaMIMO).

Studies demonstrate that 5G base station sites using active antenna systems do not transmit continuously at their maximum configured power and that beam steering reduces the average actual exposure.

Improved accuracy in the assessment of RF-EMF compliance can be obtained by the application of the actual maximum approach introduced in IEC TR62669 [26] and specified in IEC 62232 [12].

This can be incorporated into RF-EMF compliance assessments and predictions of levels by the using of factors to represent the time-averaged actual maximum output power or EIRP of the site. Where this approach is used, network software functions may be implemented to ensure that this value can't be exceeded over time.

International technical standards committees are studying methods for in situ measurement of active antenna systems that take account of the changing beam direction and transmit power.

Example

Compliance based on actual maximum base station parameters (international)

The main elements of the actual maximum transmitted power or EIRP approach to RF-EMF compliance specified in IEC 62232 are:

1. Operator declares compliance using the actual maximum power or EIRP (time-averaged value) threshold configured on the site.
2. The operator verifies that the actual maximum threshold is not exceeded during operation using monitoring counters and control features.
3. The monitoring counters and control features are validated using the methods specified in IEC 62232.
4. If the operator intends to change the site in a way that impacts the RF-EMF compliance boundary, the RF-EMF compliance is updated.

This is implemented by countries such as Canada [27].

11

Adopt efficient approaches to monitor compliance

As radio waves cannot be seen there is public interest in demonstrating that RF-EMF compliance of network antennas is being assured.

Measurements in multiple countries show that typical environmental base station RF-EMF signal levels are a small fraction of the international limits.

Fixed area RF-EMF monitors have been deployed to address public concern are not needed to confirm mobile network site compliance with limits [28]. Such systems have not been independently shown to reduce public concern.

Regulatory authorities retain the possibility to randomly assess the compliance of a base station by either inspecting the site documentation or conducting a site visit and commissioning independent RF-EMF assessments (calculation or measurement).

Measurements in publicly accessible areas locations at a random sample of sites may be useful to address public concern where they are undertaken as part of a clear communications programme.

Alternative approaches such as transparency of site compliance information may be a more efficient use of resources.

In order to build public confidence, the costs for auditing and monitoring procedures should be borne by the authority and not the mobile network operator.

Example

No significant change in environmental RF-EMF levels (Research)

Some countries have implemented continuous RF-EMF monitoring systems. Published analysis from such systems show typical levels to be far below the ICNIRP public limit values [29, 30].

Scientific publications and reports by government agencies show no significant increase in public RF-EMF exposure despite increased numbers of base stations. This has been shown by base station measurements for a large group of international countries [31] and also for African countries [32]. Alternative approaches based on personal exposimeter measurements also do not show a significant increase in Europe since 2012 [33].

12

Practice effective communication of compliance information

Providing information for the public

National regulatory authorities and trusted bodies should take the lead in RF-EMF communication and addressing misinformation.

While many people recognise the personal benefits of mobile services, some members of the public may have concerns about possible risks from the radio signals used by antenna sites and mobile devices.

It has been found that the wrong communication messages can increase public concern. Information should be based on credible sources, for example, the WHO.

Transparency is important to public trust and the public should be able to determine whether a site complies with the limits. This information can be provided in many ways.

Some countries have implemented public websites with information about site compliance and RF-EMF exposure levels. These websites may be operated by industry or government agencies.

While such websites are suggested as a means to address public concern their effectiveness in reducing concern has not been independently evaluated.

RF-EMF signage at sites

Signage should be visible before the compliance zone boundary but not cause alarm. The position and visibility of the sign should be appropriate to the antenna installation and accessibility of the RF-EMF compliance zone.

For example, antennas at the top of a tower that is fitted with anti-climbing devices would not usually require RF-EMF signs at ground level. Low-power installations where the compliance zone is within the equipment will generally not require signage.

The physical size of signs should take account of the range of different sizes of antennas and compliance zones.

Example

Application of risk communication principles

Where stakeholders are concerned about RF-EMF exposure the techniques of risk communication should be applied to support effective communications. Guidance on effective EMF risk communication is available in publications by GSMA [34] and the WHO [35].

Risk communication is based on anticipating possible reactions, understanding the audience and conveying clear information that addresses people's concerns and establishes an organisation as responsible and trustworthy.

When communicating it is important to take account of the prevailing social, political and administrative traditions and regulatory frameworks in a country.

Example declaration of compliance

This is a sample declaration of RF-EMF compliance for a radio base station with a tower.

Mobile Network Operator Declaration of Conformity

Declaration ID	DC_2015_01_27634.1
Issuer's name	X. Com B.Sc. C.Eng.
Issuer's address	Mobile Network Operator, Some Street, City, Country
Cell site ID	27634
Cell site location	Map reference
Cell site address	N/A – Freestanding 15 m tower @ NE corner of field

The cell site identified above is in conformity with the requirements of the following documents:

Document No.	**Title**	**Edition / date of issue**
ICNIRP 1998	Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)	Health Physics 74 (4):494-522; 1998
MNO12345	Mobile Network Operator RF H&S policy	V2.2 3 Jan 2014
Additional information	The supporting assessment documentation is available for inspection by arrangement at the issuer's address.	

Signed for and on behalf of Mobile Network Operator	6th January 2015 City

X. Com

X. Com B.Sc. C.Eng, RF compliance manager, Mobile Network Operator

Abbreviations

AAS	Active/Advanced Antenna Systems
EIRP	Equivalent or Effective isotropic radiated power
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEC	International Electrotechnical Commission
ITU	International Telecommunications Union
MIMO/MaMIMO	Multiple Input Multiple Output / Massive MIMO
RF-EMF	Radiofrequency Electromagnetic Field
SAR	Specific Absorption Rate (unit of W/kg)
WHO	World Health Organization

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For more information, please visit the
GSMA website at www.gsma.com/emf

GSMA HEAD OFFICE
Floor 2
The Walbrook Building
25 Walbrook
London EC4N 8AF
United Kingdom
Tel: +44 (0)20 7356 0600
Fax: +44 (0)20 7356 0601