GUIDELINE ON THE MANDATORY STANDARD

FOR ELECTROMAGNETIC FIELD EMISSION FROM RADIOCOMMUNICATIONS INFRASTRUCTURE

(COMPLIANCE TOWARDS DETERMINATION NO. 1 OF 2010)

MCMC(T)13-TDD/170/001 Jld. 1 (02)

Published by:
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ISBN No.: 978–967–13284–8–4

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CHAIRMAN'S FOREWORD

Rapid development of wireless network technologies has significantly improved the performance of cellular network services through deployment of multiple radiocommunications infrastructures (RCI) such as base stations with shorter transmission distances for provision of higher data rates. However, the proliferation of these infrastructures and high use of mobile devices has led to growing public concerns over possible health effects from exposure to electromagnetic field (EMF) emission. Which is why careful deployment and effective monitoring of wireless networks are vital in ensuring EMF emission does not have negative impact on the public's health particularly in cities and communities with dense concentrations of communications users.

The Malaysian Communications and Multimedia Commission (MCMC) as the regulator of the communications and multimedia industry has published the "Mandatory Standard for EMF Emission from Radiocommunications Infrastructure, Determination No. 1 of 2010" (MS for EMF) on 24 December 2010 to ensure industry–wide compliance with the standard on EMF emission as well as to reinforce public confidence on the matter.

Due to the advancement in cellular technology and new antenna design, MCMC recognised the need for a source of reference to complement and reinforce the MS for EMF. Thus, the "Guideline on the Mandatory Standard for Electromagnetic Field Emission from Radiocommunications Infrastructure" was developed in consultation with experts in the field of EMF and has gone through an extensive assessment during the development process that includes review at multiple draft stages by the consultant and relevant stakeholders.

The main objective of this Guideline is to facilitate the communications and multimedia industry in managing smooth roll out of wireless network in Malaysia. The Guideline provides detailed guidance on the procedures and methods to ease the Network Facility Provider (NFP)'s and Network Service Provider (NSP)'s compliance towards the MS for EMF. It also includes information pertaining to the requirements for submission of report, timeline, contact, verification of compliance, warning signage, reference and definition.

Since the wireless communications technologies are a fast changing and dynamic field, this document will be continuously updated to keep abreast of the changes.

Thank you.

TAN SRI DR HALIM SHAFIE
Chairman
Malaysian Communications and Multimedia Commission

ABBREVIATION

For the purposes of this framework, the following abbreviation applies.

ADB	Assessment Domain Boundary
AGL	Above Ground Level
BCCH	Broadcast Control Channel
BS	Base Station
CB	Compliance Boundary
CDMA	Code Division Multiple Access
CPICH	Common Pilot Channel
DI	Domain of Investigation
DVB–T	Digital Video Broadcasting – Terrestrial
EIRP	Equivalent Isotropically Radiated Power
EMF	Electromagnetic Field
ER	Exposure Ratio
EUT	Equipment Under Test
FDMA	Frequency Division Multiple Access
GSM	Global System for Mobile communications
ICNIRP	International Commission on Non–Ionizing Radiation Protection
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
LTE	Long Term Evolution
MCMC	Malaysian Communications and Multimedia Commission
OFDM	Orthogonal Frequency–Division Multiplexing
PBCH	Physical Broadcast Channel
RBW	Resolution Bandwidth
RCI	Radiocommunications Infrastructure
RF	Radio Frequency
RMS	Root Mean Square
SAR	Specific Absorption Rate
SD	Standard Deviation
TDMA	Time Division Multiple Access
TER	Total Exposure Ratio
UMTS	Universal Mobile Telecommunication System
WCDMA	Wideband Code Division Multiple Access
WLAN	Wireless Local Area Network

GUIDELINE ON THE MANDATORY STANDARD FOR ELECTROMAGNETIC FIELD EMISSION FROM RADIOCOMMUNICATIONS INFRASTRUCTURE (COMPLIANCE TOWARDS DETERMINATION NO. 1 OF 2010)

1. INTRODUCTION

MCMC had published Commission Determination on Mandatory Standard for Electromagnetic Field Emission from Radiocommunications Infrastructure (Determination No.1 of 2010), also known as MS for EMF.

This guideline defines procedures and methods to achieve compliance assessment and verification to supplement and reinforce the MS for EMF when a Radiocommunication Infrastructure (RCI) is put into service, taking into account of potential effect to the environment and general public in its surrounding.

Mandatory Standard was published in 2010, referring to Recommendation ITU–T K.52 and K.61 as basis documents. The Guideline document will refer to the latest IEC 62232:2017 Standard as basis document but keeping the existing ITU references intact.

The EMF Exposure Limit shall be in accordance and harmonize to any changes made in MS for EMF exposure limit. The Exposure Limit[1] prescribed in the MS for EMF is shown in **Appendix I**.

2. PREDICTION METHODS FOR COMPLIANCE ACHIEVEMENT

This guideline defines the calculation and computation methods to assess compliance with MS for EMF Exposure Limit. MCMC recommends that the compliance procedure to be achieved using the following prediction methods which refers to Recommendation ITU–T K.61 or IEC 62232:2017 Standard. Procedure to achieve the compliance is described in Figure 1: Compliance Procedure Flow Chart.

Compliance procedure is divided into:

a) Compliance by Calculation for single transmitter RCI; and
b) Compliance by Advanced Computation using a Simulation Software, for complex RCI (where there are two or more antennas/transmitter).

Compliance status shall be revoked for any configuration changes on the RCI and requirement for new compliance shall be asserted. Service provider shall have to submit a revised compliance report with updated configuration parameters.

[1] MCMC Mandatory Standard for Electromagnetic Field Emission from Radiocommunications Infrastructure; Clause 6 and Clause 7

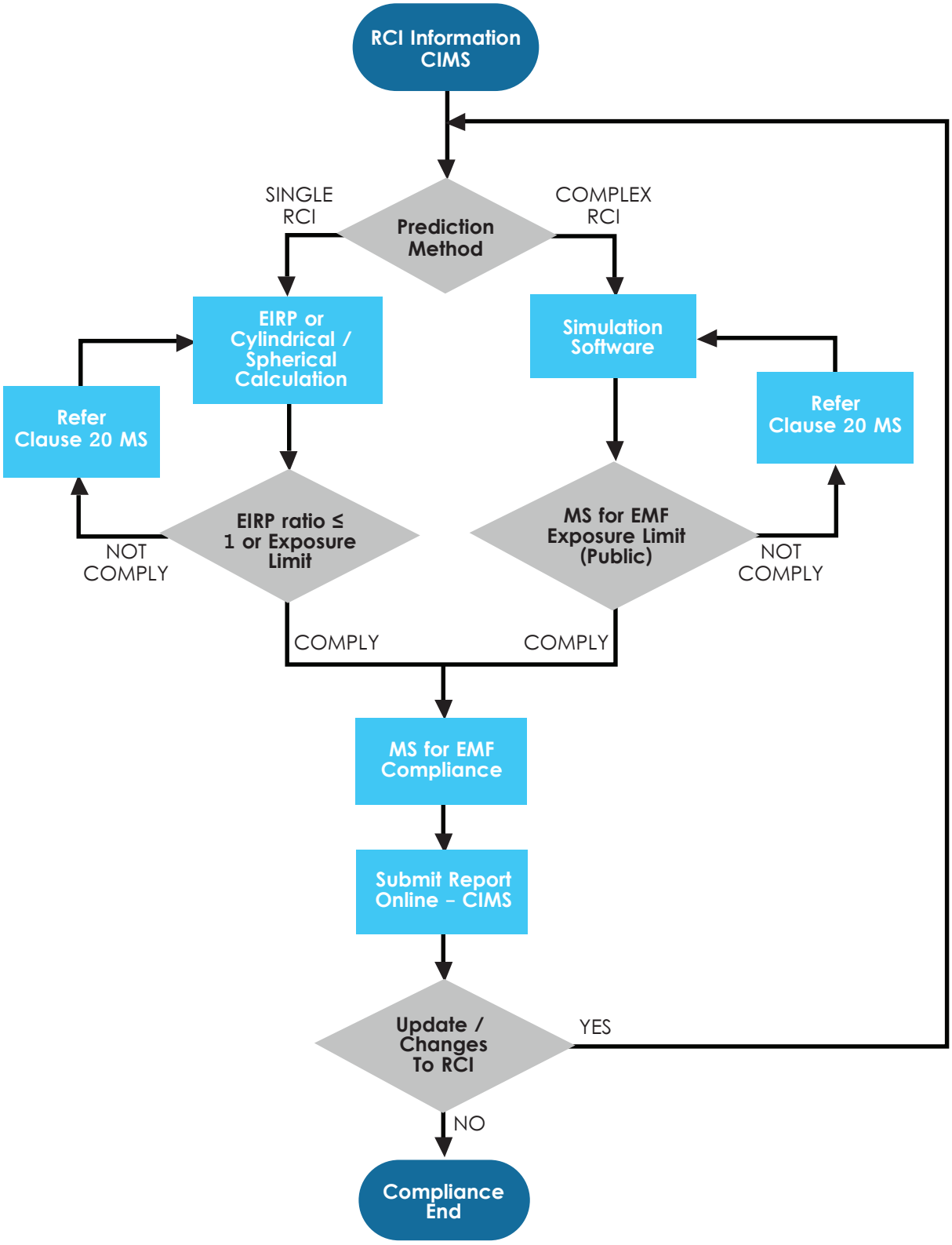


Figure 1: Compliance Procedure Flow Chart

2.1 Compliance by Calculation

2.1.1 Compliance for Single Transmitter RCI (three sector / panel for coverage in all directions) shall be allowed to use basic calculation of output power. Calculation by Equivalent Isotropic Radiated Power (EIRP) formulae[2] as shown in **Appendix II** or calculation by Spherical and Cylindrical formulae[3] as shown in **Appendix III** are recommended.

2.1.2 Calculation by Spherical formulae or Cylindrical formulae shall be used either for sectoral or omni linear array configuration antenna with arbitrary polarization. Cylindrical formulae are used in near field region, whereas the Spherical formulae are used in far field region.

2.1.3 The ITU Calculator can be used as a calculation tools using EIRP formulae as in K.Sup2: ITU–T K.52 – *"Calculator for Equivalent Isotropic Radiated Power as Described in Recommendation ITU–T K.52"*.

2.1.4 Calculation report template using EIRP formulae is as per **Appendix IV**. The following data and technical requirement are required:

a) Radiocommunications Infrastructure Information:
   i. RCI ID;
   ii. RCI address;
   iii. GPS coordinate; and
   iv. Date of commission.

b) Technical parameters:
   i. RCI type – Tower/pole, dual function or rooftop;
   ii. RCI height in meter;
   iii. Electrical tilt and mechanical tilt in degree;
   iv. Antenna transmit gain in dB;
   v. Antenna vertical bandwidth beam in degree;
   vi. Antenna side lobe attenuation in dB;
   vii. Antenna type, model and manufacturer; and
   viii. Transmitter power output in Watt.

c) Other Technical Parameters:
   i. Uncertainty estimation analysis, consist of:
      - Cable, connector and combiner loss in dB;
      - Scattering from nearby object and ground in dB;
      - Mismatch between antenna and its feed in dB; and
      - Antenna radiation pattern data.

d) Calculation Tool's Information:
   i. Calculation tool's version, model and manufacturer (if any);
   ii. Operator name and designation; and
   iii. Date and time of calculation report.

[2] Recommendation ITU–T K.52
[3] IEC 62232:2017

2.2 Compliance by Advance Computation

Advanced computational electromagnetic mapping using a simulation software is required for complex sites where there are two or more transmitters/antennas. Numerous simulation software packages exist for analysing EMF exposure produced by RCI.

2.2.1 Simulation software using ray tracing algorithms[4] implements either single–ray, two–ray or multi–ray methods. These methods are practised with single, multi or with no environment reflector.

2.2.2 Every methods requires uncertainty analysis report to be submitted together with the Simulation Report.

2.2.3 Uncertainty analysis of ray tracing computation[5] identifies the uncertainty factors as per **Appendix V**. Uncertainty factors for ray tracing fall into three categories:

a) Transmitter system;
b) Modelling technique; and
c) Environmental uncertainties.

2.2.4 The software estimation of uncertainty involves four tasks:

a) Identification of all sources of uncertainty (influence quantities) that may reasonably be expected to cause significant variation or uncertainty in the evaluation;
b) For each source of uncertainty, an estimation of the probability distribution type and parameter;
c) Specification of how the sources of uncertainty are combined to provide a total uncertainty value (a mathematical model which defines how the influence quantities are combined or added); and
d) Determine the best estimate of the evaluation and expanded uncertainty for a 95% confidence interval.

2.2.5 The simulation software shall be validated with reference example[6] depending on the choice of computational method used. If the maximum deviation from the reference results is within ±3dB, the simulation package has passed the validation.

2.2.6 Validation report of the software algorithm for each version and model shall be registered to MCMC. Latest simulation software validation registration is required for updated version or/and model.

2.2.7 Simulation software operator shall be trained and training certificate shall be provided for verification purpose. Software operator name and designation shall be available in simulation report. ITU has developed a simulation software; the EMF Estimator as defined in ITU–T K.70.

[4,5,6] IEC 62232:2017

2.2.8 RCI shared site is defined as having multiple services or systems on the same or different infrastructure and shall be divided into the following categories:

a) Tower/Pole RCI

Multiple service providers or systems installed within a tower or pole. The tower or pole may be in the form of steel mono leg, three–legged, four–legged, guyed wire or in other shape or material specifically built for communication purpose.

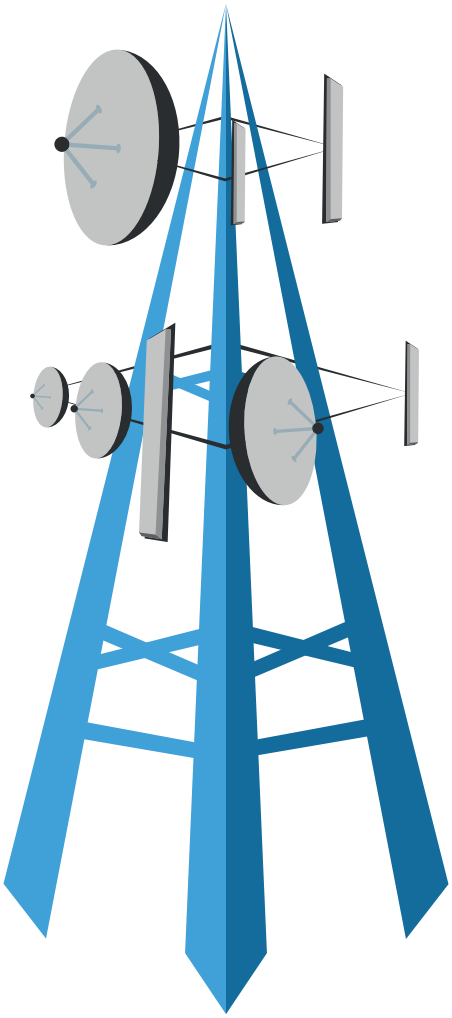


Figure 2: Example of Tower RCI

b) Dual Function RCI

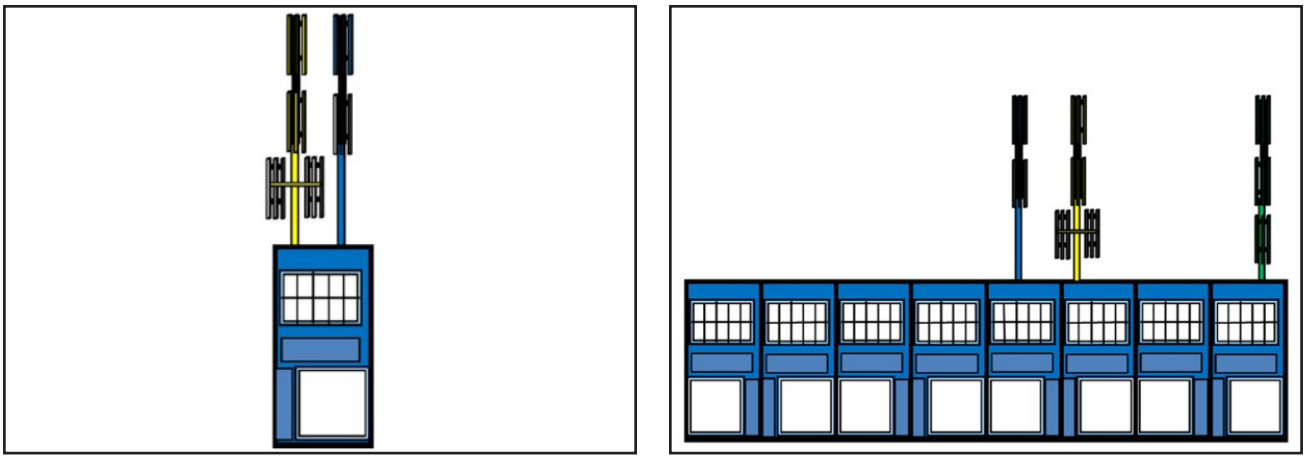
Multiple service providers or systems installed within an infrastructure meant for certain usage other than communication. The infrastructure may be in form of minaret, street light pole, water tank, advertising board, etc.

(i) (ii) (iii)

Figure 3: Example of Dual Function RCI
(i) street light pole; (ii) water tank; (iii) advertising board.

c) Rooftop RCI

Multiple service providers or systems installed within rooftop, wall or any part of a building. The building may be a single, double or multi storey with any size or shape.



(i) (ii)

Figure 4: Example of Rooftop RCI
(i) multiple RCI single owner; (ii) single RCI single owner.

2.2.9 The responsibility of MS compliance of shared RCI lie equally within all participating service provider. One RF owner shall be appointed among the participant. RF owner's roles are:

a) To access and get the RCI technical parameter from the Communication Infrastructure Management System (CIMS);
b) To simulate the RCI using validated simulation software; that is to generate the simulation report;
c) To upload the simulation report to the system; and
d) To undertake responsibility on the reliability of the submitted simulation report.

2.2.10 As a guide, the following consideration is recommended to be adopted to appoint RF owner:

a) Tower/Pole and Dual Function RCI

i. Each tower or pole or dual function RCI shall have its own simulation report.
ii. Every service provider within a tower or pole or dual function RCI is equally responsible on submitting the simulation report.
iii. Service providers shall identify the most probable sharing partners to be appointed as RF owner based on:
- the service provider who own the most transmitters; or
- the highest of channel (in case of equal number of transmitter among multiple service provider).

iv. A new or existing provider with additional transmitter or new configuration updates shall be appointed as the new RF owner and new simulation report shall be submitted.
v. In the event that the simulation report results exceed the exposure limit, rectification[7] work shall be implemented.

b) Rooftop RCI

i. A 30–meter vicinity radius[8] on a rooftop shall be considered for each simulation report and in the event the vicinity radius is more than the specified 30 meter radius, a separate simulation report shall be submitted.
ii. Every service provider within a rooftop is equally responsible on submitting the simulation report.
iii. Service provider shall identify the most probable sharing partners to be appointed as RF owner based on:
- The service provider who own the most transmitters; or
- The highest of channel (in case of equal number of transmitter among multiple service provider).

iv. A new or existing provider with additional transmitter or new configuration updates shall be the new RF owner and new simulation report shall be submitted.
v. In the event that the simulation report results exceed the exposure limit, rectification work shall be implemented.

[7] MCMC Mandatory Standard for Electromagnetic Field Emission from Radiocommunications Infrastructure Clause 20
[8] MCMC Mandatory Standard for Electromagnetic Field Emission from Radiocommunications Infrastructure Clause 16

2.2.11 Simulation report template is as per **Appendix VI.** The following data and technical requirement are required.

a) Radiocommunications Infrastructure Information:

i. RCI ID;
ii. RCI address;
iii. GPS coordinate; and
iv. Date of commission.

b) Technical Parameters:

i. RCI type – Tower/pole, dual function or rooftop;
ii. RCI height in meter;
iii. Electrical tilt and mechanical tilt in degree;
iv. Antenna transmit gain in dBi;
v. Antenna vertical bandwidth beam in degree;
vi. Antenna side lobe attenuation in dB;
vii. Antenna type, model and make;
viii. Antenna GPS position; and
ix. Transmitter power output in Watt.

c) Other Technical Parameters:

i. Uncertainty estimation analysis, consists of:
- Cable, connector and combiner loss in dB;
- Scattering from nearby objects and ground in dB;
- Mismatch between antenna and its feed in dB; and
- Antenna radiation pattern data.

d) Cut–plane Figures for:

i. Orthoslice at Ground Level: horizontal plane 2 meter above ground level in term of power density or emission percentage against exposure limits. Legend with logarithmic rainbow colour scale shall be marked clearly.
ii. Orthoslice at Rooftop Level (not applicable for tower RCI): horizontal plane 2 meter above rooftop level in term of power density or emission percentage against exposure limits. Legend with logarithmic rainbow colour scale shall be marked clearly.
iii. Exclusion Zone Crossover with Adjacent Building: at antenna height level to analyse the crossover within adjacent nearby building in close vicinity, in term of power density or emission percentage against exposure limits. Legend with logarithmic rainbow colour scale shall be marked clearly.
iv. Public, occupational, and exceedance exposure limits shall be marked clearly.

e) Simulation Software Information:

i. Simulation software's version, model and manufacturer;
ii. Simulation software operator's Name and designation; and
iii. Date and time of simulation report.

3. SUBMISSION OF REPORT, TIMELINE AND CONTACT

The requirement of the report format shall be independent of the choice of computation method used.

Submission of report must be using MCMC's Communication Infrastructure Management Systems (CIMS) online and available at http://cims.skmm.gov.my.

Softcopy (in PDF) and raw data must be submitted in ZIP (not RAR) format. For further information, please refer to User Guide for EMF Submission Module in CIMS document available at CIMS website.

Raw data is required for the purpose of error analysis test against compliance report submitted to CIMS.

Latest report shall supersede precedent report of the same site automatically by system.

All RCI calculation or simulation compliance report shall be submitted to CIMS within the following timeline:

a) For existing sites, defined as sites in operation before this guideline is published, submission must be within 1 year.
b) For new sites, compliance report must be submitted within 3 months after operation.

This Guideline shall come into effect on 29th December 2017 and shall continue to be effective unless modified, varied or revoked by the Commission.

For any queries and further information on this Guideline please contact:

Technology Development Department
Phone : 03–8688 8000
Email : tdd@cmc.gov.my

4. VERIFICATION OF COMPLIANCE

In case of simulation report shows non–compliance, or public complains, or exceed MS for EMF exposure limits, a verification of compliance procedure shall be applicable.

4.1 Compliance shall be verified by accurately measuring the EMF field strength using calibrated and appropriate instruments[9] in the following conditions:

a) If the value of EIRP / $EIRP_{th}$>1 or power density value is greater than the MS exposure limits at any point in the environment;
b) OR, if there are highest spot in simulations is 25% of the exposure limits;
c) OR if special conditions exist like of shared site, as detailed in MS for EMF.

[9] Recommendation ITU–K.61 and IEC 62232:2017

4.2 At any RCI location, measurement shall be undertaken to satisfy the following requirements:

a) At least 1.5 to 2.0 meter height from RCI ground level.
b) The points of expected maximum EMF exposure, based on the site parameters such as antenna direction.
c) Various points and corners on publicly accessible location.
d) Various points near exclusion zone.
e) Rooftop of adjacent buildings and at various heights if required.
f) Represent locations on Ground Level surrounding the RCI.
g) 6 minutes average value of field strength recorded.

4.3 The choice of instrument can be made based on characteristics[10] like frequency range, antenna directivity, measured quantity, device selection and calibration requirements. Proper measuring instrument with valid calibration shall be used for measurement. Requirement for different measurement method are:

a) Broadband Measurement
Broadband measurements[11] take the sum of all signals over the frequency range of the probe without distinguishing the contribution of different sources operating at different frequencies. Broadband measurement is suitable to determine overall level and is helpful in determining whether a frequency selective measurement is required. If the total broadband measurement is less than 25% of the MS exposure limits for general public reference, the position can be declared compliant.
b) Frequency Selective Measurement
If the total broadband measurement is more than 25% of the MS exposure limits for general public, frequency selective measurements[12] with extrapolation for maximum traffic must be performed.
c) Extrapolation procedures for worst case traffic using Broadband measurement can be accurately extrapolated to determine maximum RF field strength or worst case traffic if the following criteria are met:
   i. The parameter is known during measurement (the transmitted power output);
   ii. No significant ambient signal; and
   iii. Transmission is a single frequency band.

The extrapolation calculation is using this formula:

$$E_{asmt} = E_{eval} \times \sqrt{F_{ext}}$$

Where
E_{asmt} is the assessment electric field strength in V/m
E_{eval} is the evaluated electric field strength in V/m
F_{ext} is the extrapolation factor

4.4 Measurement uncertainty shall be considered in three categories:
a) The measurement equipment uncertainty;
b) The measurement methodology uncertainty; and
c) Source and environment factor.

[10] Recommendation 2017 ITU-T K.61
[11] IEC 62232:2017
[12] IEC 62232:2017

4.5 It is recommended that equipment and methodology uncertainty combination shall not exceed 4 dB while source and environment uncertainty factor is quantified.

4.6 Verification of compliance report is per **Appendix VII** and requirement as follows:

a) Radiocommunications Infrastructure Information:
   i. RCI ID;
   ii. RCI address;
   iii. GPS coordinate; and
   iv. Date of commission.

b) Technical Parameter:
   i. RCI type – Tower/pole, dual function or rooftop;
   ii. RCI height in meter;
   iii. Antenna type, model and make;
   iv. Antenna GPS position; and
   v. Transmitter power output in Watt.

c) Measurement Instrumentation Information:
   i. Instrumentation calibration information;
   ii. Instrumentation version, model and manufacturer;
   iii. Instrumentation operator name and designation; and
   iv. Date and time of measurement.

d) Comprehensibility: Results should be clear and comprehensible for the general public without excessive technicalities. It is important to show the applicable limit values when presenting the results.

e) Accessibility: Results should be published on the Internet, and the access to them should be easy for the general public; the link should be accessed from home page and not from inside pages of a web site with a difficult access.

5. WARNING SIGNAGE

RF wave radiation is not detectable by human senses. Appropriate signs and labels are necessary to indicate the presence of the radiation and its potential hazards. Areas where the RF radiation is expected to result in exposure exceeding the public exposure limits but less than occupational limits shall have a warning sign as shown in Figure 5. On the other hand, areas where RF radiation level is expected to exceed the occupational exposure limits will have a warning sign as shown in Figure 6 displayed.

All warning signs are to be placed clearly. Electrical and electronic devices that potentially release RF and microwave exceeding public limits but below occupational limit are to be labelled clearly with Figure 6. In the event that the devices potentially emit RF and microwave radiation in excess of the occupational limit then they are to be labelled with Figure 7 clearly.

Figure 5: Warning signage for public exposure limit.

Figure 6: Warning signage for occupational exposure limit.

Figure 7: Warning signage for exceedance occupational exposure limit.

NOTE: Minimum size for signage is 20 cm x 14 cm

6. REFERENCE AND DEFINITION

6.1 Reference

The following ITU–T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Guideline. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Guideline are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU–T Recommendations is regularly published. The reference to a document within this Guideline does not give it, as a stand–alone document, the status of a Guideline.

a) Recommendation ITU–T K.52 (12/2016), Guidance on complying with limits for human exposure to electromagnetic fields.

b) Recommendation ITU–T K.61 (02/2008), Guidance to measurement and numerical prediction of electromagnetic fields for compliance with human exposure limits for telecommunication installations.

c) Recommendation ITU–T K.70 (04/2016), Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations.

d) Recommendation ITU–T K.83 (03/2011), Monitoring of electromagnetic field levels.

e) Recommendation ITU–T K.91 (07/2017), Guidance for assessment, evaluation and monitoring of human exposure to radio frequency electromagnetic fields.

f) Recommendation ITU–T K.100 (07/2017), Measurement of radio frequency electromagnetic fields to determine compliance with human exposure limits when a base station is put into service.

g) Recommendation ITU–T K.113 (2015), Generation of radiofrequency electromagnetic field level maps.

h) Australia Communications Alliance Ltd, Industry Code C564:2011 Mobile Phone Base Station Deployment

i) CENELEC EN 50400:2017, Basic standard to demonstrate the compliance of fixed equipment for radio transmission (110 MHz – 40 GHz) intended for use in wireless telecommunication networks with the basic restriction or the reference levels related to general public exposure to radio frequency electromagnetic fields, when put into service.

j) CENELEC EN 50401:2017, Product standard to demonstrate the compliance of fixed equipment for radio transmission (110 MHz – 40 GHz) intended for use in wireless telecommunication networks with the basic restriction or the reference levels related to general public exposure to radio frequency electromagnetic fields, when put into service.

k) EN 50383:2010, Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz – 40 GHz).

l) EN 50413 (2008)+A1:2013, Basic standard on measurement and calculation procedures for human exposure to electric, magnetic and electromagnetic fields (0 Hz – 300 GHz).

m) ICNIRP (1998), Guidelines for Limiting Exposure to Time–Varying Electric, Magnetic and Electromagnetic Fields (up to 300 GHz).

n) IEC 62311 (2007), Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz – 300 GHz).

o) IEEE Std C95.3.1–2010, IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz – 300 GHz.

p) IEC 62232 (2017), Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure.

q) IEEE C95.3.1–2010 IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz to 300 GHz.

r) Malaysian Standard MS 2232–2:2010 Guidelines for Limiting Exposure to Time–Varying Electric, Magnetic and Electromagnetic Fields Part 2 For Frequency from 3 kHz to 300 GHz.

6.2 Definition

a) **Antenna Gain** : G (Θ,φ) is the ratio of power radiated per unit solid angle multiplied by 4π to the total input power. Gain is frequently expressed in decibels with respect to an isotropic antenna (dBi). The equation defining gain is:

$$G(\theta,\varphi) = \frac{4\pi}{P_{in}} \frac{dP_r}{d\Omega}$$

Where
Θ,φ are the angles in a polar coordinate system
P_r is the radiated power along the (Θ,φ) direction
P_{in} is the total input power
Ω is elementary solid angle along the direction of observation

b) **Ambient Source** : A radio frequency (RF) source operating in the frequency range from 3 kHz to 300 GHz generating electromagnetic fields other than the emission from the Radiocommunication Infrastructure.

c) **Average Power** (P_{avg}) : The time–averaged rate of energy transfer defined by:

$$P_{avg} = \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} P(t)\, dt$$

d) **Averaging Time** (T_{avg}) : The averaging time is the appropriate time period over which exposure is averaged for purposes of determining compliance with the limits.

e) **Compliance Boundary** : Boundary defining a volume outside which the RF exposure from the radiocommunication infrastructure is below the exposure limit.

f) **Electric Field Strength** (E) : Magnitude of a field vector at a point that represents the force (F) on a small test charge (q) divided by the charge:

$$E = \frac{\mathrm{F}}{q}$$

The electric field strength is expressed in units of volt per metre (V/m).

g) **Equivalent Isotropically Radiated Power** (EIRP) : The product of the power accepted by the antenna and the maximum antenna gain relative to an isotropic antenna.

h) **Exposure** : occurs whenever a person is exposed to electric, magnetic or electromagnetic fields.

i) **Far–Field Region** : Region of the field of an antenna where the radial field distribution is essentially dependent inversely on the distance from the antenna. In this region, the field has a predominantly plane–wave character, i.e., locally uniform distribution of electric field and magnetic field in planes transverse to the direction of propagation.

NOTE – In the far–field region, the vectors of the electric field E and the magnetic field H are perpendicular to each other, and the quotient between the value of the electric field strength E and the magnetic field strength H is constant and equals the impedance of free space Z_o.

j) **Magnetic Field Strength** (H) : The magnitude of a field vector in a point that results in a force (F) on a charge q moving with the velocity v:

$$F = q\,(v \times \mu H)$$

The magnetic field strength is expressed in units of amperes per meter (A/m).

k) **Near Field Region** : Region generally in proximity to an antenna or other radiating structure, in which the electric and magnetic fields do not have a substantially plane–wave character, but vary considerably from point to point. The near–field region is further subdivided into the reactive nearfield region, which is closest to the radiating structure and that contains most or nearly all of the stored energy, and the radiating near–field region where the radiation field predominates over the reactive field, but lacks substantial plane–wave character and is complex in structure.

l) **Power Density** (S) : Radiant power incident perpendicular to a surface, divided by the area of the surface. The power density is expressed in units of watt per square metre (W/m^2).

m) **Radiocommunication Infrastructure** : Any fixed of mobile equipment for radio transmission used in cellular communication and/or wireless installation for local area networks. For the purpose of this Guideline, the term Radiocommunication Infrastructure includes all radio transmitter(s) and associated antenna(s).

n) **Radio Frequency** (RF) : Any frequency at which electromagnetic radiation is useful for telecommunication.

NOTE – In this Guideline, radio frequency refers to the frequency range 9 kHz – 300 GHz allocated by ITU–R Radio Regulations

o) **Root Mean Square** (rms) : Effective value or rms value obtained by taking the square root of the average of the square of the value of the periodic function taken throughout one period.

p) **Specific Absorption Rate** (SAR) : The time derivative of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given mass density (ρ_m).

$$SAR = \frac{d}{dt}\frac{dW}{dm} = \frac{d}{dt}\left(\frac{1}{\rho_m}\frac{dW}{dV}\right)$$

SAR is expressed in units of watts per kilogram (W/kg).

$$SAR = \frac{\sigma E^2}{\rho_m}$$

$$SAR = c\frac{dT}{dt}$$

$$SAR = \frac{j^2}{\rho_m \sigma}$$

Where

E	is the value of the electric field strength in body tissue in V/m
σ	is the conductivity of body tissue in S/m
ρ_m	is the density of body tissue in kg/m^3
c	is the heat capacity of body tissue in J/kg°C
dt/dT	is the time derivative of temperature in body tissue in °C/s
j	is the value of the induced current density in the body tissue in A/m^2

q) **Wavelength** (λ): The wavelength of an electromagnetic wave is related to frequency (f) and velocity (v) of an electromagnetic wave by the following expression:

$$\lambda = \frac{v}{f}$$

APPENDIX I:

MANDATORY STANDARD EXPOSURE LIMITS

Mandatory Standard Reference Levels of EMF Exposure

Type of Exposure	Frequency range (Hz-GHz)	Electric field strength (V/m)	Magnetic field Strength H (A/m)	Equivalent Plane Wave Power Density S_{eq} (W/m^2)
Occupational	1 – 10 MHz	610/f	1.6/f	–
	10 – 400 MHz	61	0.16	10
	400 – 2000 MHz	$3f^{½}$	$0.008f^{½}$	f/40
	2 – 300 GHz	137	0.36	50
General Public	1 – 10 MHz	$87/f^{½}$	0.073/f	–
	10 – 400 MHz	28	0.073	2
	400 – 2000 MHz	$1.375f^{½}$	$0.0037f^{½}$	f/200
	2 – 300 GHz	61	0.16	10

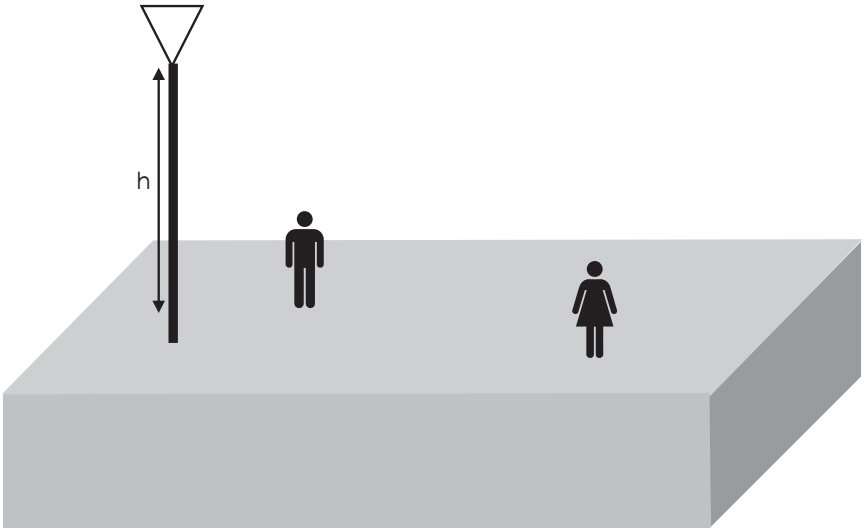
f is the frequency of operation in MHz.

APPENDIX II:

EIRP CALCULATION CONDITION

EIRP Calculation should be calculated based on the following condition:

Condition A: Antenna above ground, h > 3 meter



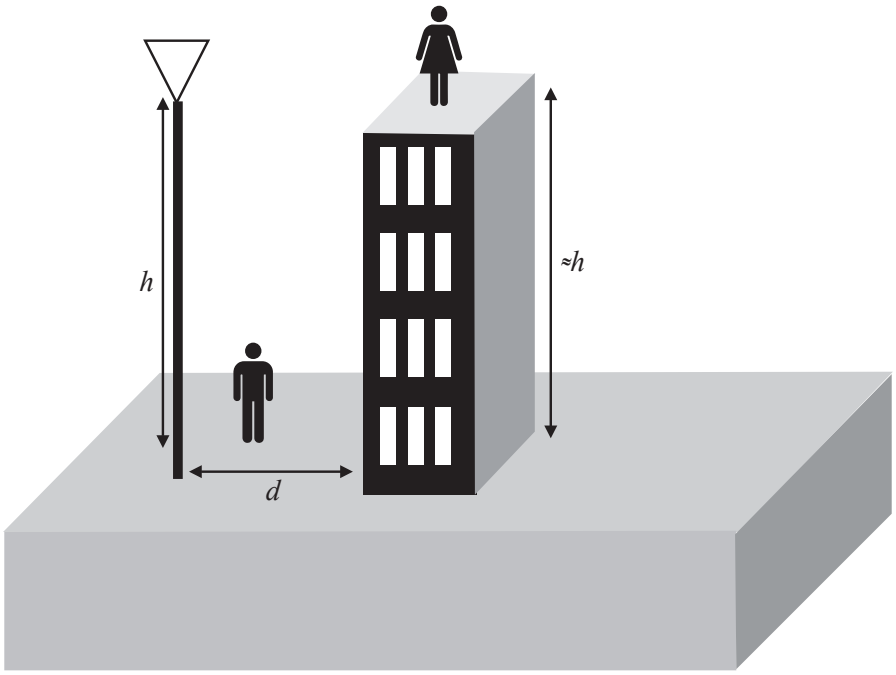
The EIRP calculated as $\frac{f\pi (h - 2)^2}{500}$ ***or*** $4\pi (h - 2)^2$

Where

f = frequency in MHz
π = mathematical constant 3.14159
h = height in meter

EIRP Calculation should be calculated based on the following condition:

Condition B: Antenna above ground, h>3 meter, public can access to direction of antenna propagation



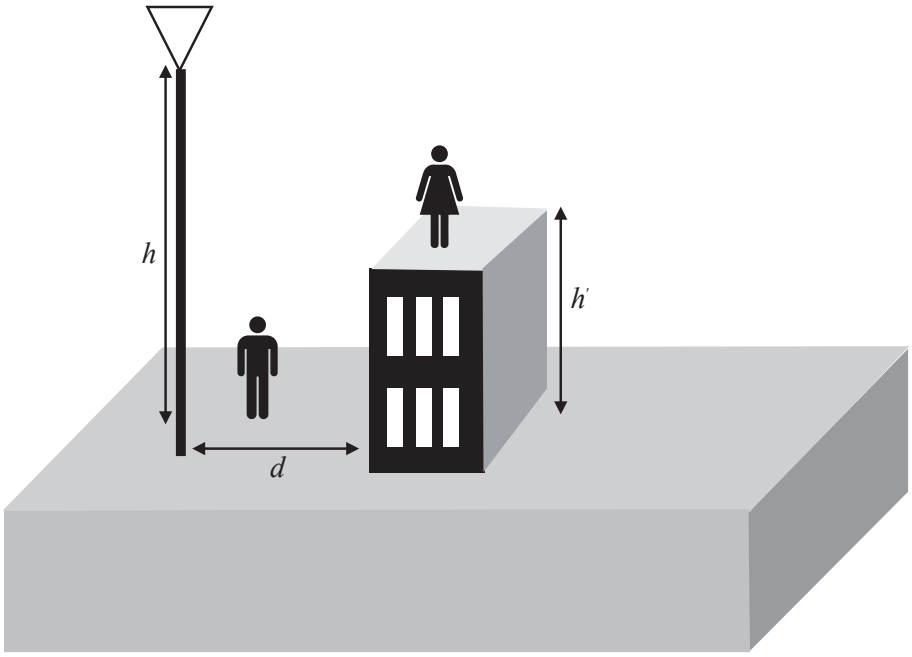
The EIRP calculated as $\frac{f\pi}{2000A_{sl}}(h-2)^2$ ***or*** $4\pi\,(h-2)^2$

Where

f = frequency in MHz
π = mathematical constant 3.14159
h = height in meter
A_{sl} = a factor, largest attenuation of antenna side lobe Vertical Pattern converted to decimal.

EIRP Calculation should be calculated based on the following condition:

Condition C: Antenna above ground, h>3 meter, public can access to direction of propagation at certain height



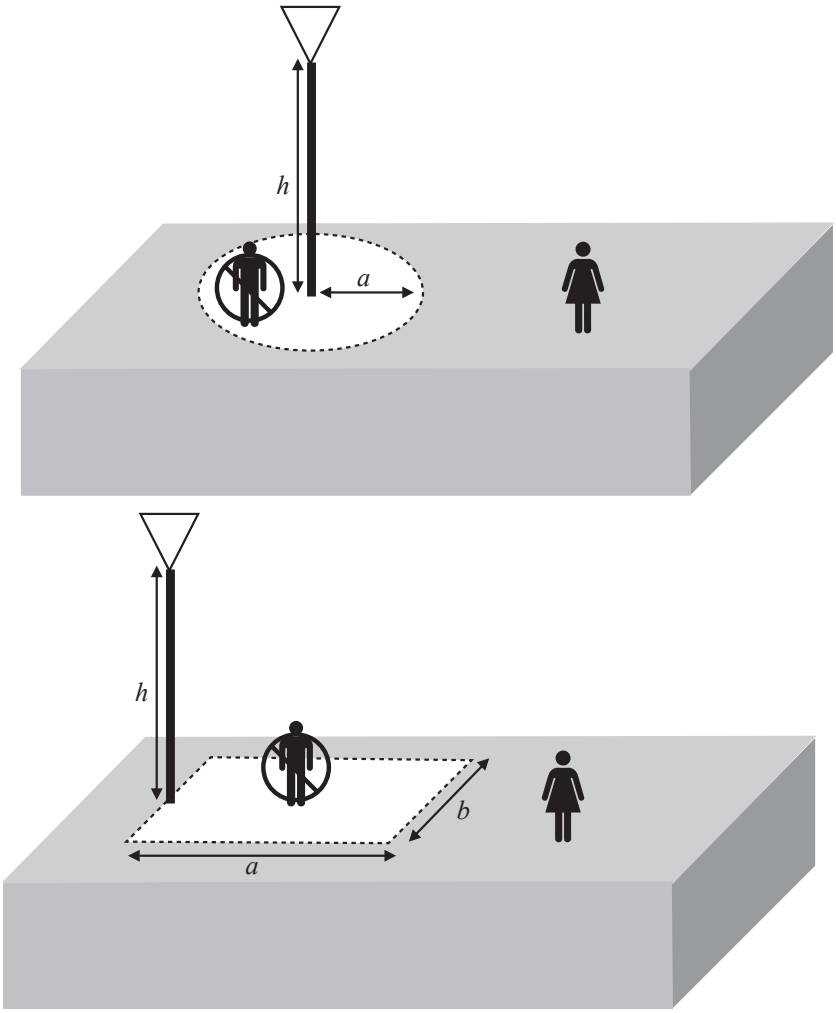
The EIRP calculated as $\frac{f\pi}{2000A_{sl}}(h-2)^2$ ***or*** $\frac{\pi}{A_{sl}}(h-2)^2$

Where

f = frequency in MHz
π = mathematical constant 3.14159
h = height in meter
A_{sl} = a factor, largest attenuation of antenna side lobe Vertical Pattern converted to decimal.

EIRP Calculation should be calculated based on the following condition:

Condition D: Antenna above ground, h>3 meter, public cannot access to circular area with radius *a* or a rectangular area of size *a x b* in front of antenna



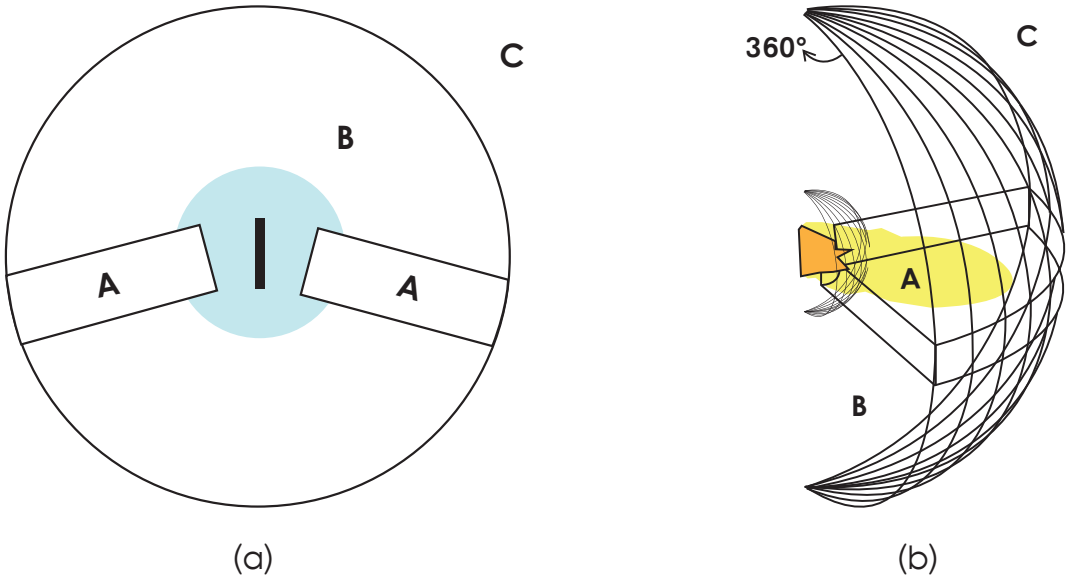
The EIRP calculated as $\frac{\pi (h - 2)^2}{A_{sl}}$

Where

f = frequency in MHz
π = mathematical constant 3.14159
h = height in meter
A_{sl} = a factor, largest attenuation of antenna side lobe Vertical Pattern converted to decimal.

APPENDIX III:

CYLINDRICAL / SPHERICAL FORMULAE



(a) (b)

(a) Two-dimensional and (b) three-dimensional view illustrating three valid zones for field strength calculation around an antenna.

	Point of interest in zone:		
	A	B	C
Method of calculation	**Peak/Average Cylindrical formulae**	**Peak/Average Adjusted spherical formulae**	**Peak/Average Classical spherical formulae**
Boundary restrictions	$3{,}6\lambda \leq r_\gamma \leq max\left[\frac{\frac{2L^2}{\lambda}}{L/2+2{,}5\lambda}\right]$ Applicable in boresight within height of antenna[a]. Sector arrays: $-\pi/2 \leq \varnothing \leq \pi/2$ Omnidirectional arrays: $-\pi \leq \varnothing \leq \pi$	$L/2+2{,}5\lambda \leq r \leq \frac{2L^2}{\lambda}$ Applicable off-boresight above and below height of the antenna[a].	$r \leq max\left[\frac{\frac{2L^2}{\lambda}}{L/2+2{,}5\lambda}\right]$ Applicable anywhere in source region III.
Radio	[a] In the case of electrical downtilt, the condition "in boresight within height of antenna" is defined by: $-\frac{L}{2}-r_\gamma \cdot \sin(\gamma) \leq = \leq \frac{L}{2}-r_\gamma \cdot \sin(\gamma)$ where z is defined by Figure D.1 case a) and case b)		

Definition of boundaries for selecting the zone of computation.

Omnidirectional arrays

$$\bar{S}(r_\gamma) = \frac{\bar{P}_{avg}}{2 \cdot \pi \cdot r_\gamma \cdot L \cdot \cos^2(\gamma) \cdot \sqrt{1+(r_\gamma / r_o)^2}} \qquad r_o = \frac{1}{2} G \cdot L \cdot \cos^2\gamma$$

Sector-coverage arrays

$$\bar{S}(r_\gamma, \phi) = \frac{\bar{P}_{avg} \cdot 2^{-(2\phi/\phi_{3dB})^2}}{\phi_{3dB} \cdot r_\gamma \cdot L \cdot \cos^2(\gamma) \cdot \sqrt{1+(r_\gamma / r_o)^2}} \qquad r_o = \frac{\phi 3dB}{12} G \cdot L \cdot \cos^2\gamma$$

Average Cylindrical Formulae

Omnidirectional arrays

$$S(r_\gamma) = \frac{P_{avg}}{\pi \cdot r_\gamma \cdot L \cdot \cos^2(\gamma) \cdot \sqrt{1+(2r_\gamma / r_o)^2}} \qquad r_o = \frac{1}{2} G \cdot L \cdot \cos^2\gamma$$

Sector-coverage arrays

$$S(r_\gamma, \phi) = \frac{2 \cdot \bar{P}_{avg} \cdot 2^{-(2\phi/\phi_{3dB})^2}}{\phi_{3dB} \cdot r_\gamma \cdot L \cdot \cos^2(\gamma) \cdot \sqrt{1+(r_\gamma / r_o)^2}} \qquad r_o = \frac{\phi 3dB}{12} G \cdot L \cdot \cos^2\gamma$$

Peak Cylindrical Formulae

Omnidirectional arrays

$$S(r,\theta) \approx \bar{S}(r,\theta) = \frac{1{,}2 \cdot \bar{P}_{avg} \cdot G_\theta}{4 \cdot \pi \cdot r^2} \qquad G_\theta = 1{,}26 \cdot G_{side\ lobe} + G \cdot 2^{-\left[\frac{\theta - \gamma - \pi/2}{\theta 3dB}\right]^2}$$

Sector-coverage arrays

$$S(r,\theta,\phi) \approx \bar{S}(r,\theta,\phi) = \frac{1{,}2 \cdot \bar{P}_{avg} \cdot G\phi}{4 \cdot \pi \cdot r^2} \qquad G_{\theta,\phi} = 1{,}26 \cdot G_{side\ lobe} + G \cdot 2^{-\left[\frac{\theta - \gamma - \pi/2}{\theta 3dB}\right]^2 - \left[\frac{1{,}9 \cdot \phi}{\phi 3dB}\right]^2}$$

Spherical Formulae

APPENDIX IV:

EIRP CALCULATION REPORT FORMAT

SITE DATA & TECHNICAL PARAMETERS

Name of the IBTS : sample

	Item	Units	OPERATOR (ABC)	REMARKS
SITE DATA	Site ID		sample	
	Name		sample	
	Date of commissioning		17/4/2013	
	Address		92/2, Putrajaya, Putrajaya Malaysia	
	Lat / Long		28.55677778 / 77.17361111	
	Tower / Roof Top		Roof Top	
	Building Height AGL	(m)	16	
	Antenna Height AGL	(m)	22	
TECHNICAL PARAMETERS	System Type (GSM/CDMA/UMTS)		GSM 900	
	Frequency of Operator	(MHz)	943.2	Normally D/L freq
	Carriers / Sector (Worst Case)		4	If 2 sectors has 3 carriers, and 3rd sector has 4, then worst case 4 carriers shall be used.
	Make and Model of Antenna		Andrew 858DG65VTASY	
	Antenna Gain	(dBi)	17.6	
	Total Tilt	(Deg)	3	Electrical Tilt + Mechanical Tilt + Beam Tilt
	Vertical Beamwidth	(Deg)	8.5	
	Side Lobe Attenuation	(db)	17	If required, Exact value of A_{sl} needs to be computed from vertical radiation pattern of Antenna and its corresponding value of side lobe suppression be chosen.
	Transmission Power	(dBm)	43	
	Combiner Loss	(db)	3	
	Feeder and Cable Loss	(db)	1	
	Other Loss	(db)	0	
	EIRP (Total)	(W)	1828.4	

EIRP / $EIRP_{th}$ CALCULATION

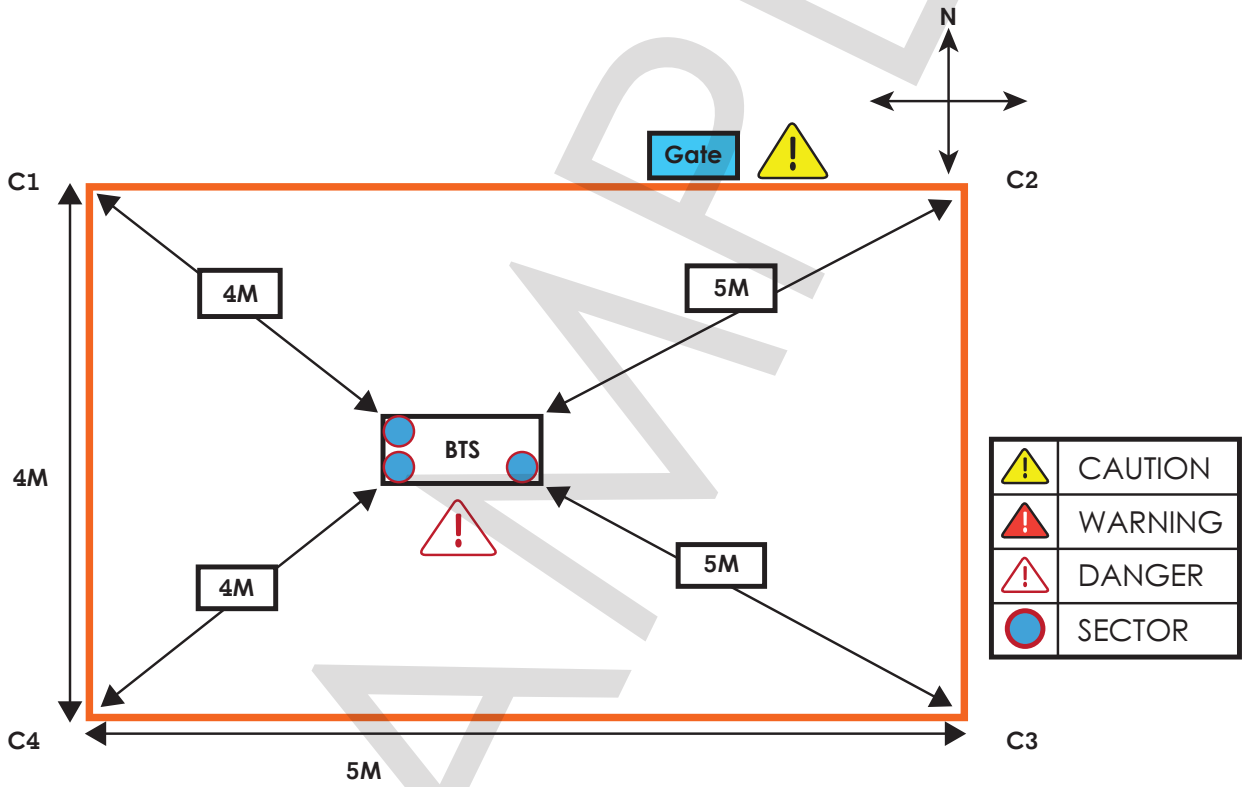
Computation of EIRP / $EIRP_{th}$ at adjacent buildings / conspicuous locations within 50 meters radius.

Building 0 (B0)				EIRPth at the Building Roof Top Corners and other points on the periphery of exclusion zone						
Lat / Long				Building Top Corners						Remark
28.55677778 / 77.17361111				C1	C2	C3	C4			
Distance from BTS				4.00	5.00	5.00	4.00			
$EIRP_{th}$				125426.74	110464.60	110464.60	125426.74			
Overall EIRP / $EIRP_{th}$				0.0145771	0.0165515	0.0165515	0.0145771			
NORMALLY COMPLIANT (YES/NO)				YES	YES	YES	YES			
Building 1 (B1)				$EIRP_{th}$ at various floors of the building						
Azimuth	70	Distance from BTS	8	I	II	III	IV	n-1	n (roof)	Remark
Lat / Long		28.55658/77.17341								
Height of B1 (m)				NA	NA	NA	NA	NA	12.00	n=4
$EIRP_{th}$				NA	NA	NA	NA	NA	296868.03	
Overall EIRP / $EIRP_{th}$				NA	NA	NA	NA	NA	0.0061588	
NORMALLY COMPLIANT (YES/NO)				NA	NA	NA	NA	NA	YES	
Building 2 (B2)				$EIRP_{th}$ at various floors of the building						
Azimuth	270	Distance from BTS	10	I	II	III	IV	n-1	n (roof)	Remark
Lat / Long		28.55682/77.17349								
Height of B2 (m)				NA	NA	NA	NA	NA	10.00	n=3
$EIRP_{th}$				NA	NA	NA	NA	NA	296868.03	
Overall EIRP / $EIRP_{th}$				NA	NA	NA	NA	NA	0.0061588	
NORMALLY COMPLIANT (YES/NO)				NA	NA	NA	NA	NA	YES	

EIRP / $EIRP_{th}$ CALCULATION

Computation of EIRP / EIRPth at adjacent buildings / conspicuous locations within 50 meters radius.									
Building 3 (B3)				EIRPth at various floors of the building						
Azimuth	NA	Distance from BTS	NA	I	II	III	IV	n-1	n (roof)	Remark
Lat / Long		NA								
Height of B3 (m)				NA	NA	NA	NA	NA	NA	B4 not within 50 mtrs
$EIRP_{th}$				NA	NA	NA	NA	NA	#VALUE!	
Overall EIRP / $EIRP_{th}$				NA	NA	NA	NA	NA	#VALUE!	
NORMALLY COMPLIANT (YES/NO)				NA	NA	NA	NA	NA	#VALUE!	
Building 4 (B4)				EIRPth at various floors of the building						
Azimuth	NA	Distance from BTS	NA	I	II	III	IV	n-1	n (roof)	Remark
Lat / Long		NA								
Height of B4 (m)				NA	NA	NA	NA	NA	NA	B4 not within 50 mtrs
$EIRP_{th}$				NA	NA	NA	NA	NA	#VALUE!	
Overall EIRP / $EIRP_{th}$				NA	NA	NA	NA	NA	#VALUE!	
NORMALLY COMPLIANT (YES/NO)				NA	NA	NA	NA	NA	#VALUE!	
Ground Level (AGL=0m)				EIRPth at various distance from the BTS						
Distance from tower				Worst case						
EIRPth at Ground				124666.7541						
Overall EIRP / $EIRP_{th}$				0.014665921						
NORMALLY COMPLIANT (YES/NO)				YES						
OVERALL COMPLIANT (YES/NO)				YES (Manual Check)						

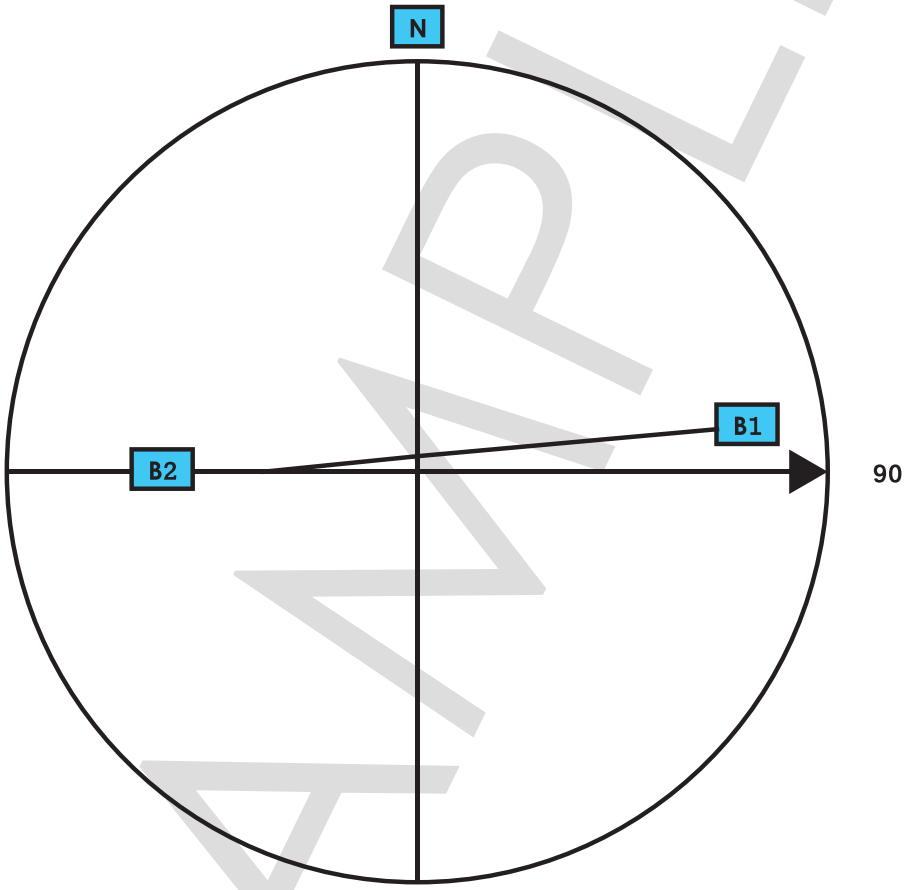
Operator	sample
Site ID	sample
Name	sample
Address	sample
Lat / Long	sample
RTT / GBT	RTT
Antenna Height AGL (m)	22



Distance From Tower Base (m)	C1	C2	C3	C4
	4	5	5	4
Height Above Ground Level	16	16	16	16

Format for collecting adjacent building / General public access area data

Site Name	sample
Name of Operator	sample
Operator ID	sample
Latitude	sample
Longitude	sample
Building Height	16



Adjacent Building	Latitude / Longitude	Height (m)	No. of Floor	Azimuth from the Tower	Distance from Tower	Accessibility Category
B1	2855658/77.17341	12	4	70	8	Cat 3
B2	2855682/77.17349	10	3	270	10	Cat 3
B3	NA	NA	NA	NA	NA	NA
B4	NA	NA	NA	NA	NA	NA

APPENDIX V:

UNCERTAINTY ESTIMATION OF RAY TRACING COMPUTATION

Table 6 – Sample template for estimating the expanded uncertainty of a ray tracing RF field strength computation

Source of uncertainty	Unit	Prob. distrib. type	Uncertainty or semi span *a*	Divisor *d*	Sens. couff. *c*	Standard uncertainty *u=a/d*	Corr. fact *t*	c^2u^2
System								
Variation in the power of the RF transmitter from its nominal level	dB	rect.			1			
Cable/connector lossess	dB	normal			1			
Mismatch between antenna and its feed	dB	U			1			
Antenna radiation pattern data (NOTE 2)	dB	normal			1			
Antenna positioning, mounting & support structure	dB	rect.			1			
Technique Uncertainties								
Inherent uncertainties associated with the approximate numerical model used to represent the antenna	dB				1			
Null–filling of antenna patterns (if applied)	dB	Depends on algorithm			1			
Environmental Uncertainties								
Scattering from nearby objects and the ground	dB	rect.			1			
Uncertainty in using electric field strength evaluations to estimate magnetic field strength or vice versa	dB	rect.			1			
Combined correction factor, $t_c = \sum_{i=1}^{N} t_i$								N/A
Combined standard factor, $u_c = \sqrt{\sum_{i=1}^{N} (c_i^2 u_i^2)}$								
Expanded uncertainty, $U=k \times u_c$								

NOTE 1 The value of divisor d for normal probability distribution is for 95% confidence, see Annex 0.2.

NOTE 2 The normalized radiation pattern uncertainty can be different inside the 'HPBW (very small); outside the main beam (larger); and in the side lobes.

APPENDIX VI:

SIMULATION REPORT FORMAT

EMF SIMULATION REPORT

RF Owner Logo

STRUCTURE ID	SAMPLE123 (REFER TO STRUCTURE ID IN RCI CIMS)
SITE NAME	(REFER TO SITE NAME IN RCI CIMS / RF owner address
SITE ADDRESS	SITE ADDRESS (REFER TO STRUCTURE ADDRESS REPORTED IN RCI CIMS)
STRUCTURE CATEGORY	STRUCTURE CATEGORY
SIMULATION DATE	SIMULATION DATE
EMF COMPLIANCE STATUS	EMF COMPLIANCE STATUS
RF OWNER	XXX (operator assigned by structure owner to produce)
	*Refer to RCI (Radio Communication Infrastructure) information reported in CIMS
PREPARED BY :	Person Name & Company (Simulator Vendor)
SOFTWARE :	Software Name Software Version

TABLE OF CONTENTS :

INTRODUCTION

In this report maximum cumulative radio-frequency (RF) exposure calculations are presented for the above mentioned cellular base station site. Results are shown 2m above ground level and/or roof top level, unless specified otherwise, and expressed in terms of the ICNIRP guidelines. The actual RF exposure levels will generally be significantly less than the simulated values, due to automatic power control used by cellular base stations as well as reduction in exposure levels due to environmental factors such as the presence of buildings, trees and other objects. The simulated values are aimed towards the analytic worst case scenario for the peak traffic conditions.

EXPOSURE STANDARDS

Results are expressed in terms of the ICNIRP'98 general public guidelines. These guidelines are reviewed on a regular basis by ICNIRP and specify the limits for continuous exposure of the general public to RF transmissions at frequencies used by cellular phone base stations.

REPORT FORMAT

The report in this document is as per MCMC standard "Commission Determination on the Mandatory Standard for Electromagnet Field Emission from Radiocommunication Infrastructure - Determination No. 1 of 2010". Electromagnetic mapping of BTS site and nearby clutter is done, based on ray tracing computational method as per "ITU-T K.52 Guidance on complying with limits for human exposure to Electromagnetic fields" and "ITU-T K.61 Guidance to measurement and numerical prediction of Electromagnetic fields for compliance with human exposure limits for telecommunication installations" documents. This report is published in the form prescribed in MCMC Standard document.

GLOSSARY OF TERMS USED

Exclusion Zone : Area around an antenna or antennas where the RF field values emanating from the antennas exceed the ICNIRP public guidelines (public exclusion zone) or the ICNIRP occupational guidelines (occupational exclusion zone). Red zone indicates no access without following appropriate shut-down, power-down or pass through procedures. Yellow zone indicates access only allowed for RF trained personnel. No access for general staff, maintenance personnel or the public, whereas white zone is free to everybody.

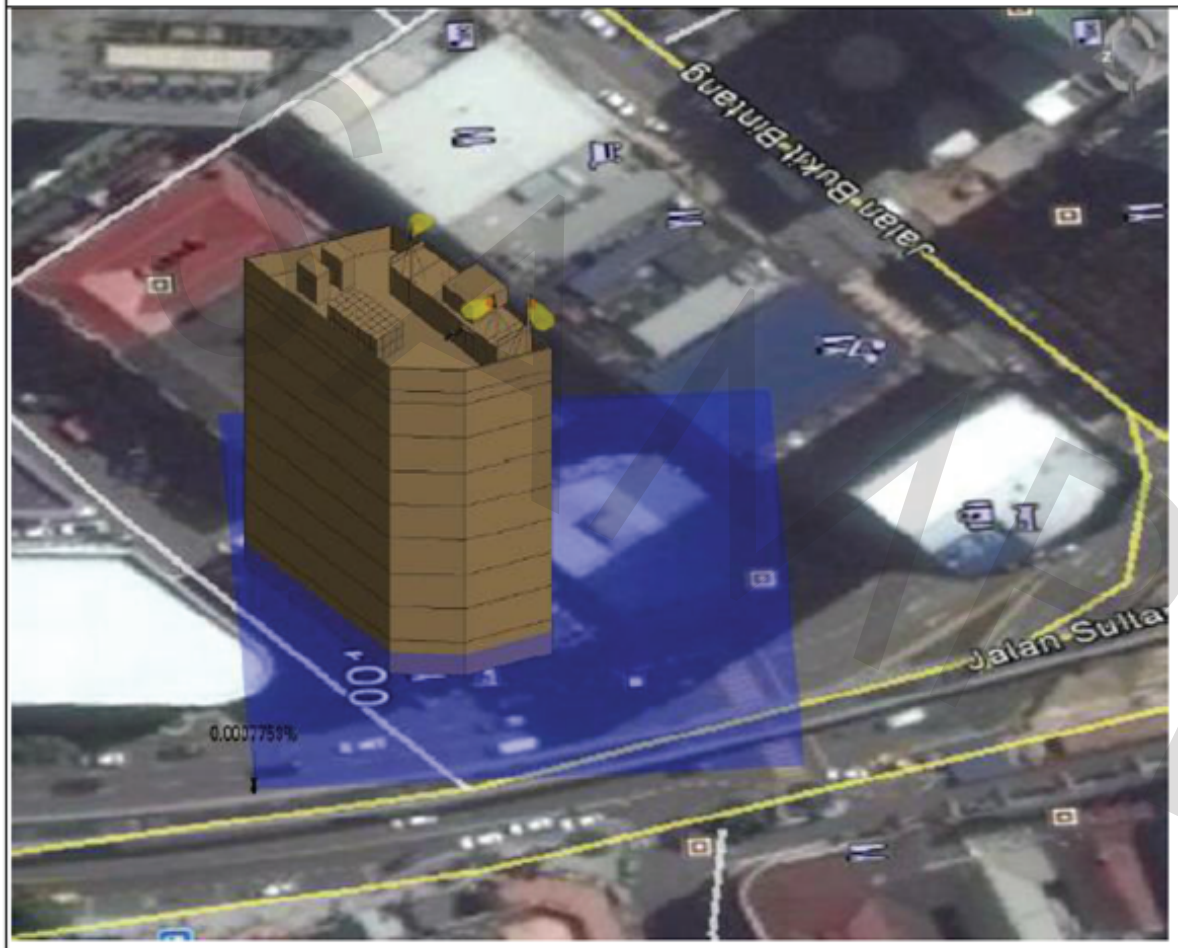
Orthoslice : Colour representation on form of power density values calculated in a plane of interest, expressed as a percentage of ICNIRP general public reference level with logarithmic legend. The standard dimension/area of Orthoslice of 60mX60m is used in the report as per Malaysian Standard document.

SITE DATA & TECHNICAL PARAMETERS

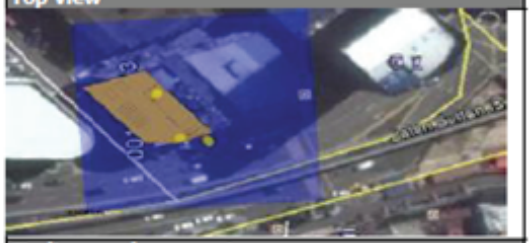
STRUCTURE ID : (STRUCTURE ID IN CIMS)

	Item	Units	Operator	1	XXX	Operator	1	XXX	Operator	1	XXX
SITE DATA	Site ID			Sample123			Sample123			Sample123	
	Name (refer to Telco's stn address)			SITE_Name			SITE_Name			SITE_Name	
	Date of Commisioning										
	Address (refer to Telco's stn address)										
	Building Height AGL										
	Tower Height (GBT) AGL	(m)									
	Lat (Y)										
	Lat (X)										
	RTT / GBT										
	Antenna Height AGL	(m)									
TECHNICAL PARAMETERS	System Type										
	Frequency Band	(MHz)									
	Make and Model of Antenna	Ant1									
		Ant2									
		Ant3									
	Antenna Gain	(dBi)									
	Electrical Tilt	(Deg)									
	Mechanical Tilt	(Deg)									
			SECTOR 1	SECTOR 2	SECTOR 3	SECTOR 1	SECTOR 2	SECTOR 3	SECTOR 1	SECTOR 2	SECTOR 3
	Azimuth	(Deg)									
	Tx Power	(Watts)									

ORTHOSLICE AT GROUND LEVEL
POWER DENSITY AT 2 M ABOVE THE GROUND LEVEL



Top View



Findings and comments

The Higher Reading Point of interest on this Site Electromagnetic. Field for Public area are measured by simulations with value of : -

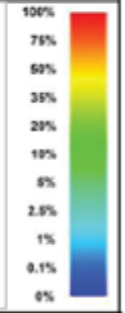
Value **0.001%**

This Site are safe for Public at 2 Meter Above Ground.This site is **comply** to MCMC Guideline

Conclusion (% of ICNIRP public)

This simulation reports reflect that the area are safe at Point of interest on Electromagnetic Field for Public are less than 2.5%.

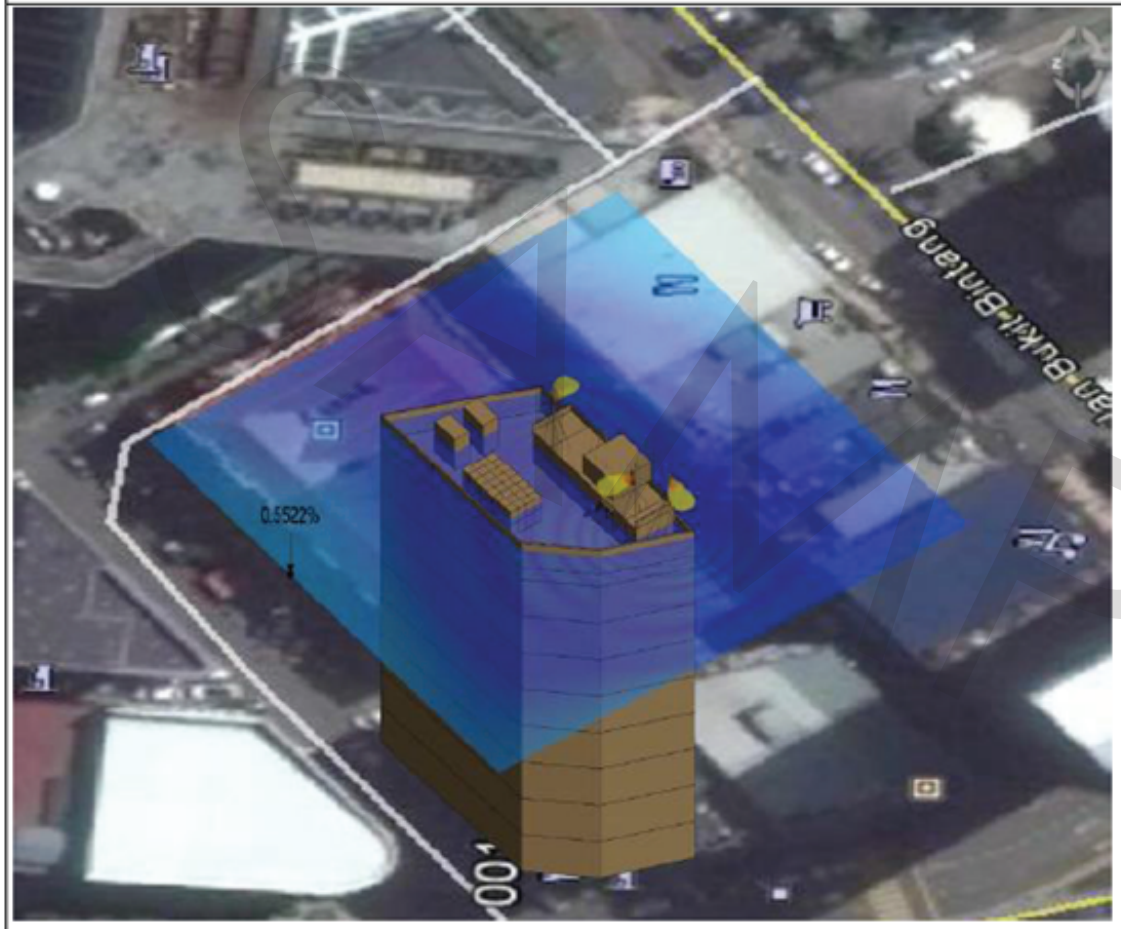
This Site are safe for Public at 2 Meter Above Ground.This site is comply to MCMC Guideline
The colour legend in logarithmic scale ranges from 2M above ground blue depicting values less than 2.5%, or twenty times below public guideline, to red depicting values more than 80% of the public guideline.



FINDINGS: The figure on this page show the calculated exposure levels in the vicinity of the base station site. The colour legend in logarithmic scale ranges from blue depicting values less than 2.5%, or twenty times below public guideline, to red depicting values more than 80% of the public guideline. 100% or more dark red would represent values above the guidelines.

Structure ID	**Sample123 (RF Owner/CIMS)**
Site Name	Site_Name
No. of Antennas	12

ORTHOSLICE AT ROOF TOP LEVEL
POWER DENSITY AT 2 M ABOVE ROOF TOP LEVEL



Findings and comments

The Higher Reading Point of interest on this Site Electromagnetic. Field for Public area are measured by simulations with value of : -

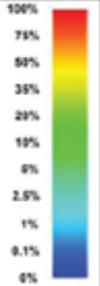
Value **0.552%**

This Site are safe for Public at 2 Meter Above Rooftop. This site is comply to MCMC Guideline

Conclusion (% of ICNIRP public)

This simulation reports reflect that the area are safe at Point of interest on Electromagnetic Field for Public are less than 2.5%

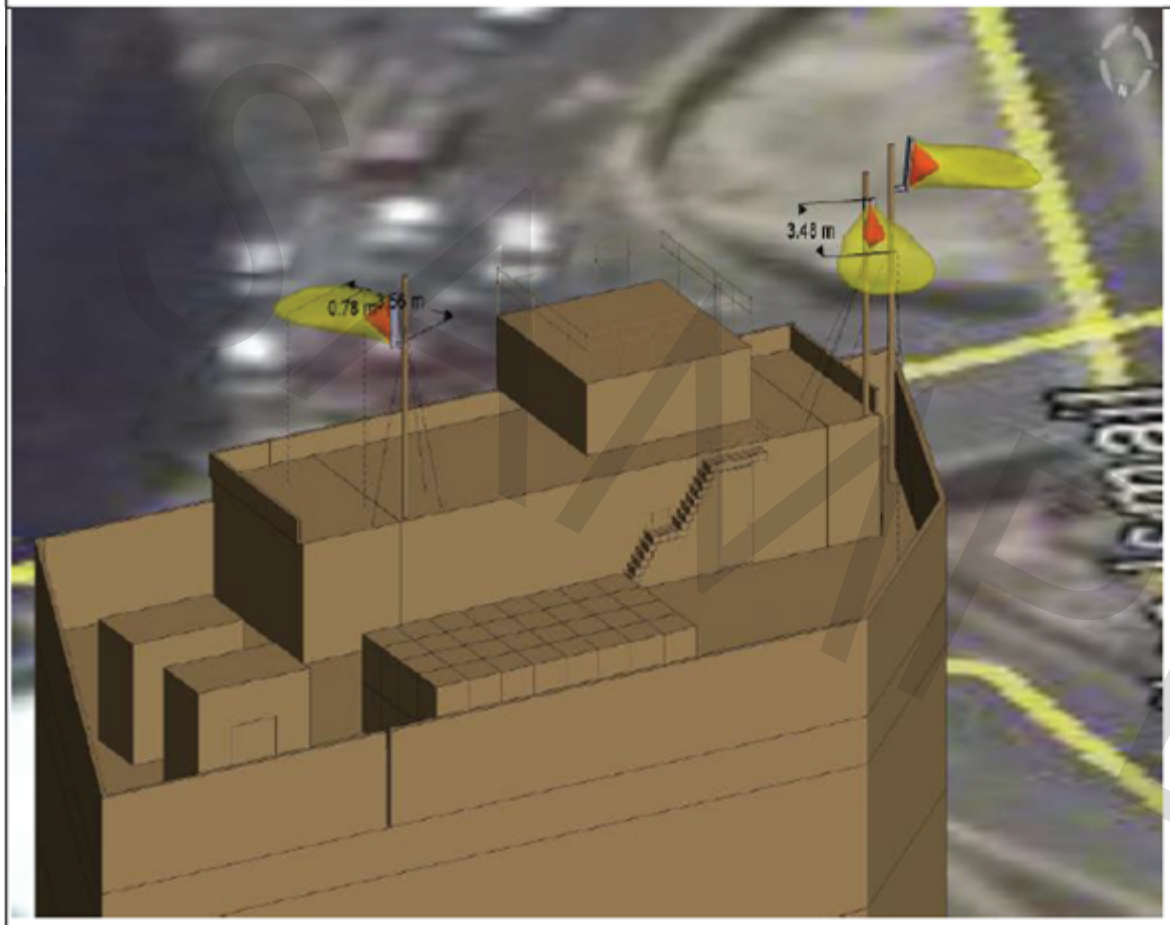
This Site are safe for Public at 2 Meter Above Ground.This site is comply to MCMC Guideline
The colour legend in logarithmic scale ranges from 2M above ground blue depicting values less than 2.5%, or twenty times below public guideline, to red depicting values more than 80% of the public guideline.



FINDINGS: The figure on this page show the calculated exposure levels in the vicinity of the base station site. The colour legend in logarithmic scale ranges from blue depicting values less than 2.5%, or twenty times below public guideline, to red depicting values more than 80% of the public guideline. 100% or more dark red would represent values above the guidelines.

Structure ID	**Sample123 (RF Owner/CIMS)**
Site Name	Site_Name
No. of Antennas	12

EXCLUSION ZONE CROSSOVER WITH ADJACENT BUILDING
TOP VIEW AND 3D VIEW



Top View

Findings and comments

This simulation reports reflect that the area exclusion zone 7m distance from the Antenna, No crossover with adjacent buildings at these area or Public access Area.

Comments and Recommendations

This site is comply to MCMC Guideline.

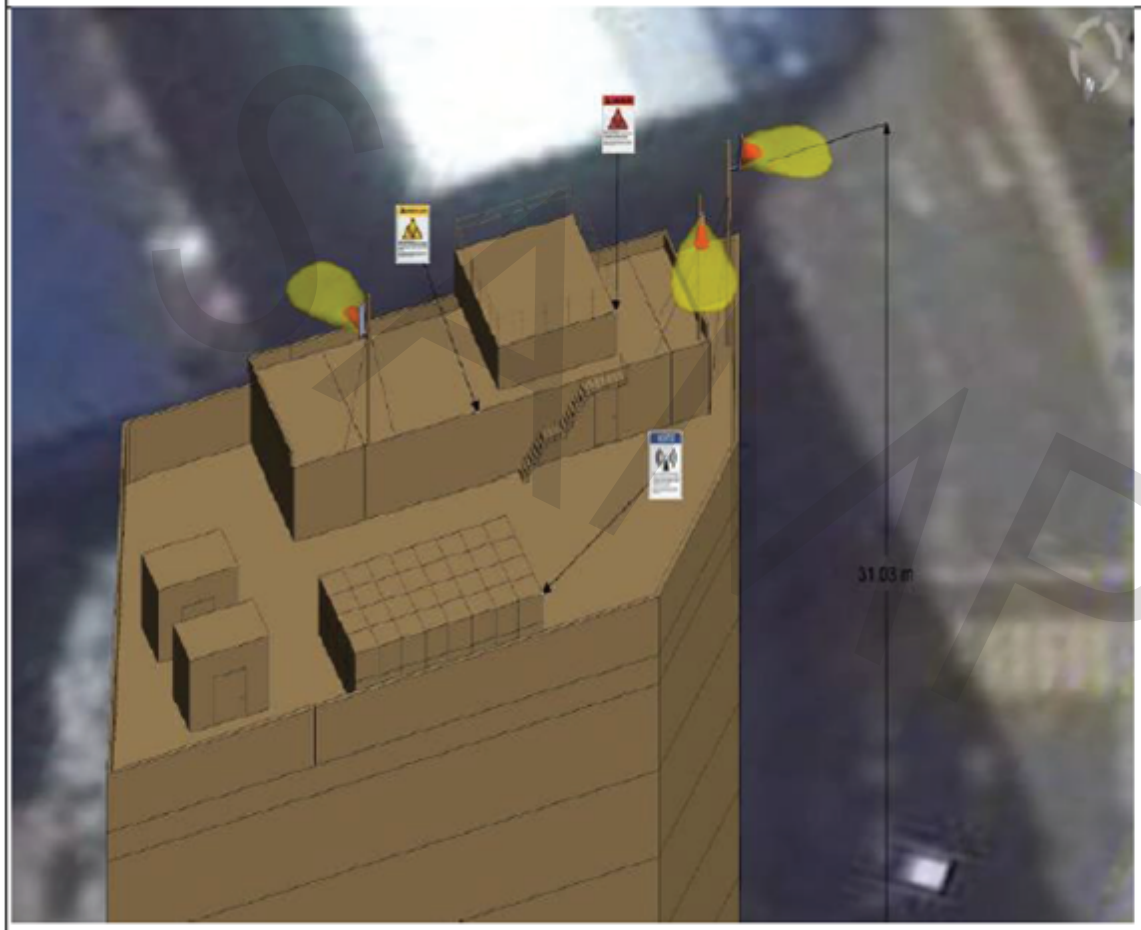
This simulation reports reflect that the area exclusion zone to determine Crossover. The distance of exclusion zone from the Antenna are within 3M and no crossover with adjacent buildings at these area or Public access Area.

The colour legend in Yellow are areas above public limits and Red is where the area that above occupational limits.

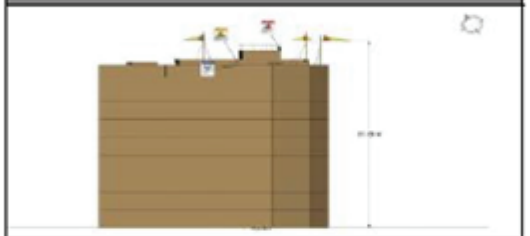
COMMENT: It is clear from the results that the exclusion zones are very small in length and hence are very less likely to have a cross with adjacent buildings. The exclusion zone crossover with adjacent buildings is manually verified with panaromic pictures. There was no nearby building observed in the pananoramic pictures within the range of exclusion zone. An aerial/google picture is overlaid with 3D geometry of the BTS site (if available) and the computed results of exclusion zone to determine crossover with adjacent buildings.

Structure ID	**Sample123 (RF Owner/CIMS)**
Site Name	Site_Name
No. of Antennas	12

SIGNAGE IMPLEMENTATION
EXCLUSION ZONE HEIGHT AND SIGNAGE IMPLEMENTATION



Side View



Signage requirements

The warning signs shall be placed at locations which are readily visible. Electrical and electronic equipment that has potential to emit RF and microwave radiate on above public limits but below the occupational limit shall display a label

Findings and Comments

This simulation reports determining the RF exposure emanating from the site, at positions where the public normally resides and ensuring that this exposure is below the public ICNIRP guidelines, it is also important that adequate control measures be in place to ensure that no person enters into the exclusion zones. Such control measures could include RF hazard signage and/or physical access control at this site.

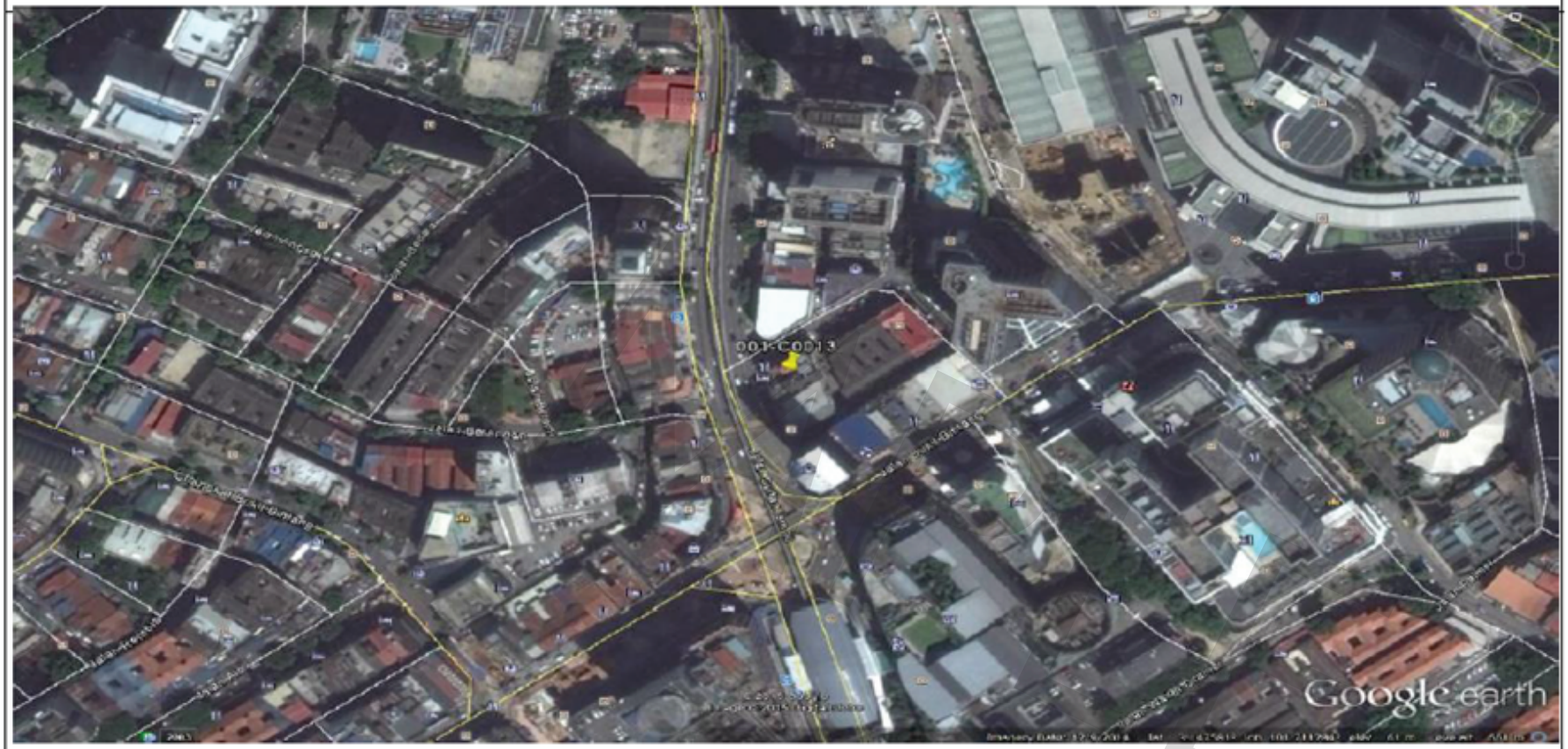
Signage Danger (BAHAYA) should be place at 1meter near to the Antenna. Whithin 7 Meter is where the Caution signage (BERHATI HATI) need to be place.

Radius of 12 Meter whithin the Antenna is Where the Warning (NOTIS) need to be place

FINDINGS: The figure on this page show the calculated exposure levels in the vicinity of the base station site. The colour legend in logarithmic scale ranges from blue depicting values less than 2.5%, or twenty times below public guideline, to red depicting values more than 80% of the public guideline. 100% or more dark red would represent values above the guidelines.

Structure ID	**Sample123 (RF Owner/CIMS)**
Site Name	Site_Name
No. of Antennas	12

AERIAL VIEW
EYE ALT VIEW AROUND 200m FROM GROUND LEVEL



Structure ID	MCMC	**Location**
Site Name	SITE_Name	Sample Address, 43900, Sepang, Selangor
No. of Antennas		

APPENDIX VII:

VERIFICATION OF COMPLIANCE
(MEASUREMENT REPORT FORMAT)

(Reference number)

ELECTROMAGNETIC FIELD (EMF)
REPORT ON RADIOFREQUENCY RADIATION MEASUREMENTS
AT (location)

Prepared by

For

MALAYSIAN COMMUNICATION AND MULTIMEDIA COMMISSION (MCMC)

MONTH YEAR

ELECTROMAGNETIC FIELD (EMF)
REPORT ON RADIOFREQUENCY RADIATION MEASUREMENTS
AT (location)

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EXECUTIVE SUMMARY

ELECTROMAGNETIC FIELD (EMF)
REPORT ON RADIOFREQUENCY RADIATION MEASUREMENTS
AT __(location)__

1. INTRODUCTION

2. OBJECTIVE

3. SCOPE OF THE MEASUREMENT

4. DESCRIPTION OF SURVEY SITE AND RADIATION SOURCE

5. SAFETY GUIDELINES AND EXPOSURE LIMITS

An overview of the telecommunications structure at/on _____(location)_____.

6. STANDARD MEASUREMENT EQUIPMENT

Broadband frequency measured by using __(equipment model and frequency)__. For details spectrum analysis of radiations involved, measurements were made using equipment model and frequency. Types of probe and instrument use in the measurement are given in Table 1.

In order to maintain the reliability and accuracy of the measurement, probes and instrument were calibrated at the recognized standard laboratory for every three years. A copy of calibration certificate is attached as Appendix 1.

Probe Type and Antenna	Frequency Range	Calibration Date

Table 1: Type of probes and instrument use in the measurement.

7. METHOD OF MEASUREMENTS

Layout of the measurement locations around the concern area.

8. RESULTS AND DISCUSSION

Detail results of the measurement carried out around the building using different equipment are given in Attachment A of Tables A1 to A2. The plots of Figure 4 and Figure 5 indicate the absolute radiation levels at measurement location. The unit of measurements for all selected locations are given in power density (μWatts/cm^2) and electric fields strength (V/m).

Field Strength / Probe	Electric Field (V/m)		Power Density (μW/cm^2)		Comparison with Exposure Limit (%)
	Min	Max	Min	Max	

Table 2: Summary of electric fields radiation level

	Power Density (μW/cm^2)			Field Strength (V/m)		
Location / Signal						
TV						
Radio						
Telco 1						
Telco 2						
Telco 3						
TOTAL						

Table 3: Results of total radiofrequency and microwave radiation measurements (electric fields)

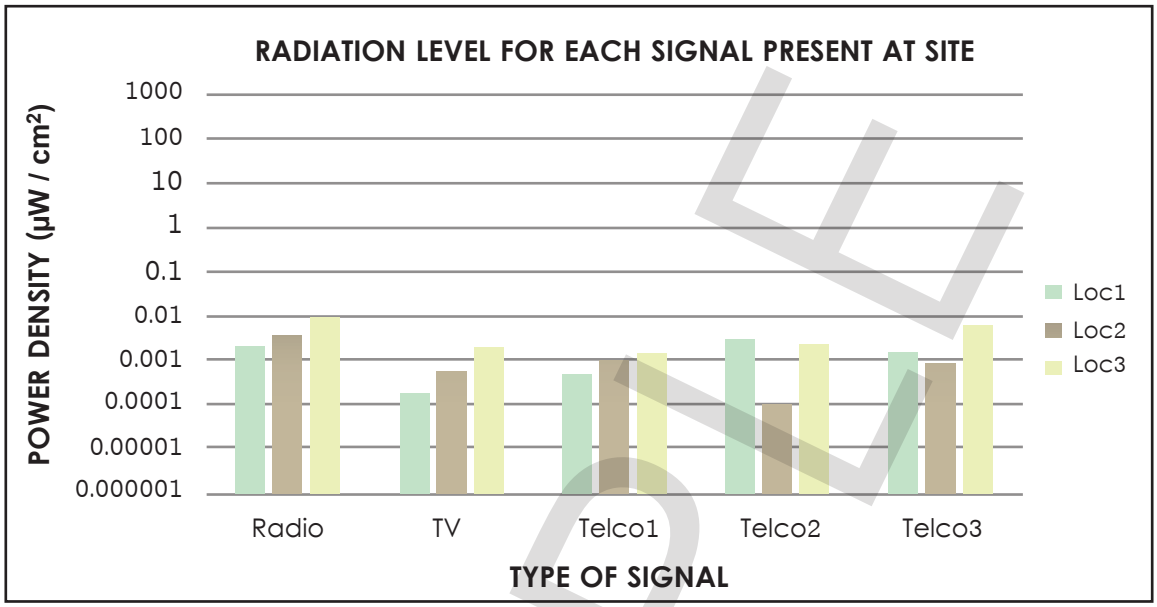


Figure above shows a plot of total radiation levels in microwatts per unit area (µW/cm²) for each signals present at three selected point around the area concern (and their comparison with MCMC exposure limit for public).

The contribution of specific radiation involved and its comparison with the total radiation measured around the site are shown in Table 3. As an example, the result at ___(location)___ on the ground indicates the total average radiation measured at the site was only _____V/m or _____µWatts/cm². This level corresponds to about _____% power density of the exposure limit as stated in MCMC Mandatory Standard.

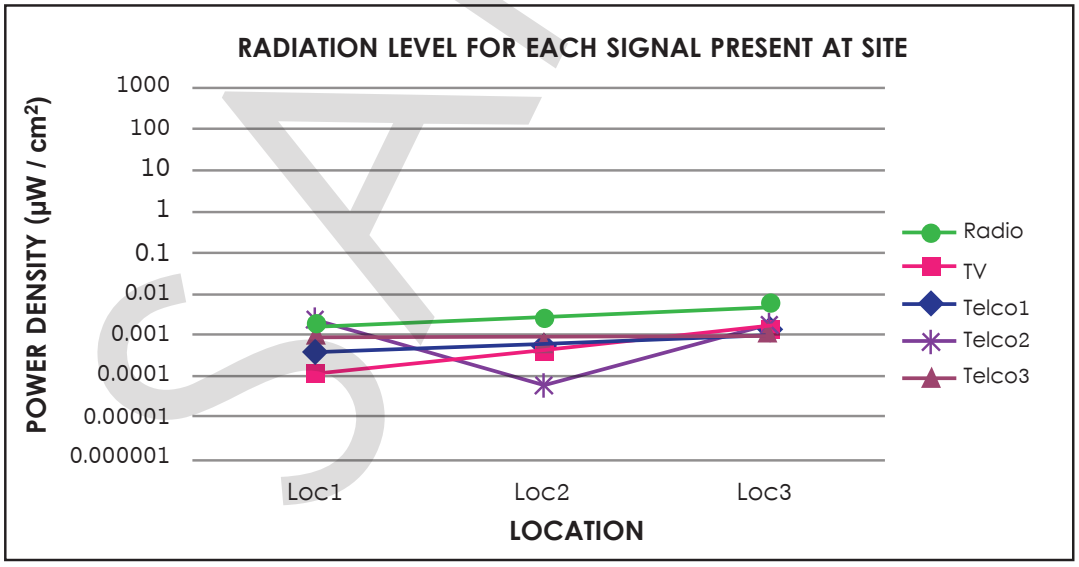


Figure above shows a plot of radiation levels in microwatts per unit area (µW/cm²) against location of measurement (and their comparison with MCMC exposure limit for public).

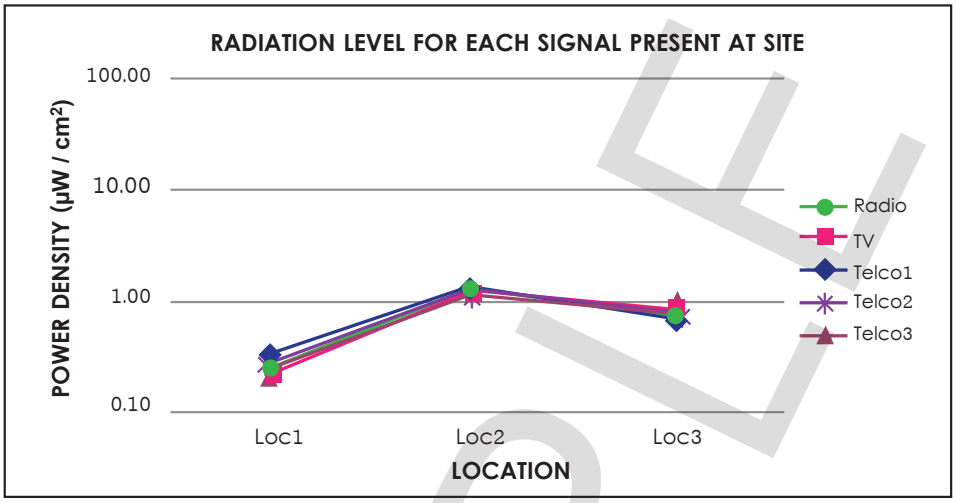


Figure above shows a plot of radiation levels in V/m against location of measurement (and their comparison with MCMC exposure limit for public).

9. CONCLUSIONS

ATTACHMENT A

Location	Distance from the source	Electric Field (V/m)				Power Density ($\mu W/cm^2$)				Remark
		Min	Max	Ave	Stdev	Min	Max	Ave	Stdev	
Loc1										
Loc2										
Loc3										

Table A1: Results of radiofrequency and microwave radiation measurements (electric fields) taken at the building using equipment model 1

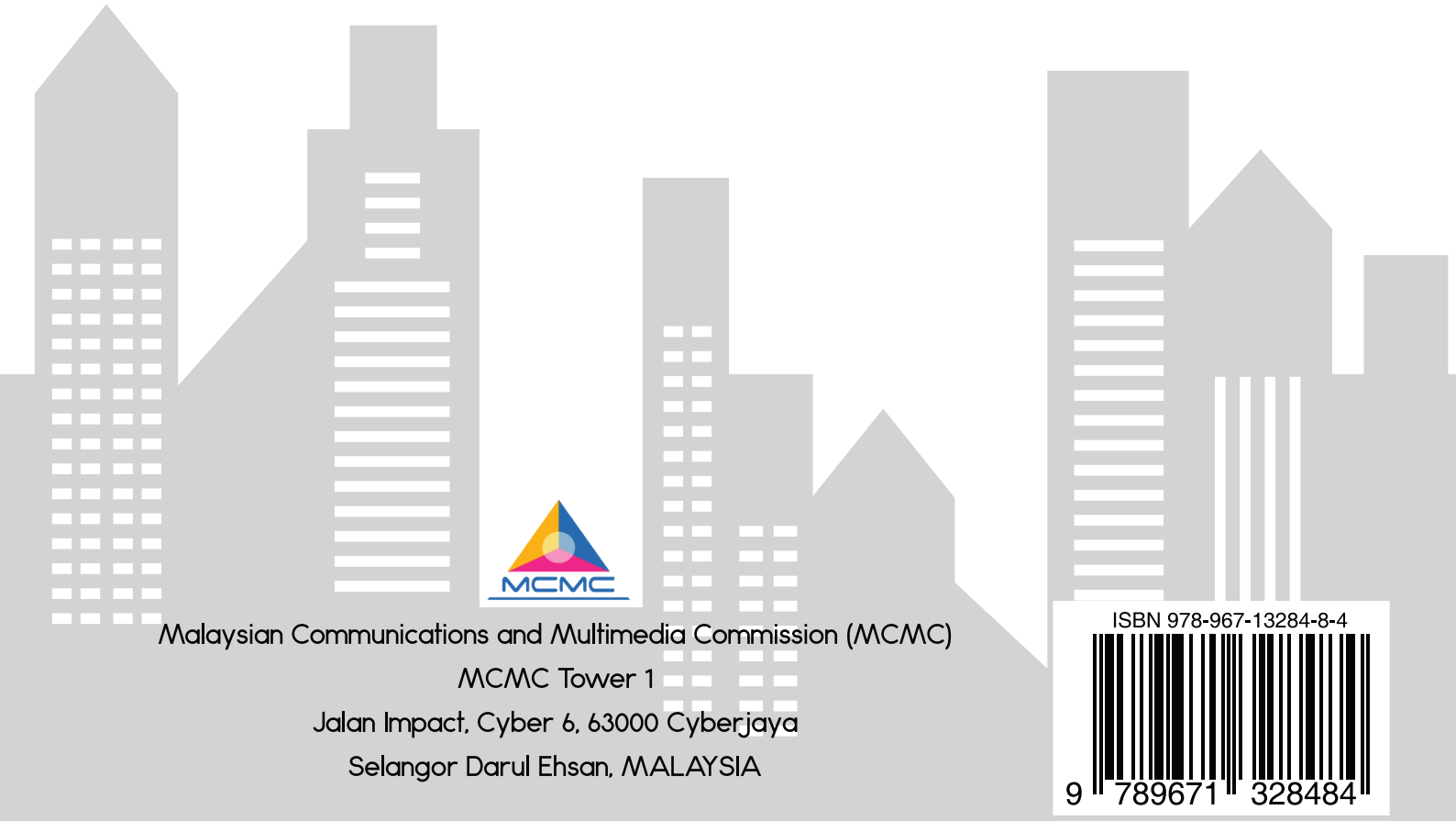
Location	Distance from the source (m)	Electric Field (V/m)				Power Density ($\mu W/cm^2$)				Remark
		Min	Max	Ave	Stdev	Min	Max	Ave	Stdev	
Loc1										
Loc2										
Loc3										

Table A2: Results of radiofrequency and microwave radiation measurements (electric fields) taken at the area concern using equipment 2

COUNTRY / ORGANIZATION	Radiofrequency and Microwaves			
	Frequency	Electric Field (V/m)	Magnetic Field (A/m)	Power Density ($\mu W/cm^2$)
IRPA/ ICNIRP	10 MHz–400 MHz 400 MHz–2 GHz 2 GHz–300 GHz	28 $1.375f^{0.5}$ 61	0.073 $0.0037f^{0.5}$ 0.16	200 f/2 1000
USA/ANSI /IEEE	30 MHz–100 MHz 100 MHz–300 MHz 300 MHz–3 GHz 3 GHz–15 GHz 15 GHz–300 GHz	27.5 27.5 NAP NAP NAP	$158.3/f^{1.668}$ 0.0729 NAP NAP NAP	200 200 f/1.5 f/1.5 10,000
MALAYSIA (MCMC)	10 MHz–400 MHz 400 MHz–2 GHz 2 GHz–300 GHz	28 $1.375f^{0.5}$ 61	0.073 $0.0037f^{0.5}$ 0.16	200 f/2 1000

Table A3: Radiofrequency and microwave radiation exposure limits for members of the public as recommended by MCMC and ICNIRP (For the purpose of comparison and easy reference, the exposure limits adopted by other countries are also included).

Note: Frequency (f) in MHz



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ISBN 978-967-13284-8-4