



ICNIRP compliance of and typical exposure from African base stations

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First West African Conference On EMF Exposure and Health:

"HARMONIZING EMF RISK COMMUNICATION AND EMF POLICY IN WEST AFRICA"

Lagos, Nigeria, 27-28 June 2012



EMSS Overview

- Based in Stellenbosch, South Africa
- Focus on electromagnetics
- Products and services in the field of EMF Safety
 - Ixus – EMF Compliance Software
 - fieldSENSE – personal safety meter
 - Site assessment and certification
 - EMF Measurements
 - RF awareness training










Content

- Background
- Safety guidelines and application (BTS focus)
- EMF measurements
- Conclusion



Radio Frequency Fields in Our Environment

RF Sources?



TV



Microwave Ovens



Comms in Vehicles



Base Stations



Cellphones



Radio




WiFi

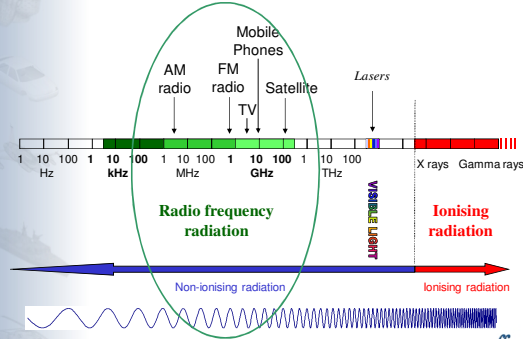


Content


- Background
 - EMSS Overview
 - RF fields in our environment
- Safety guidelines and application (BTS focus)
- EMF measurements
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Radio Frequency Fields in Our Environment



The diagram shows the electromagnetic spectrum from 1 Hz to 100 THz. A green oval highlights the 'Radio frequency radiation' range from approximately 100 kHz to 100 GHz, which is categorized as 'Non-ionising radiation'. Within this range, specific frequencies are labeled: AM radio, FM radio, TV, and Satellite. Above 100 GHz, the spectrum is categorized as 'Ionising radiation', including 'Visible Light', 'Lasers', 'X rays', and 'Gamma rays'.



Radio Frequency Fields in Our Environment

The diagram illustrates various sources of Radio Frequency (RF) exposure in our environment. On the left, a tall communication tower is shown with a red arrow pointing towards a person, labeled 'RF Exposure'. In the center, there is a television set and a mobile phone, both with red arrows pointing towards a person, also labeled 'RF Exposure'. On the right, a 'Base Station' antenna is shown with red arrows pointing towards a person, labeled 'RF Exposure'. The background features a blue sky with a white cloud and a blue water surface with ripples.

Guidelines for Safe Exposure

ICNIRP
International Commission on Non-Ionizing Radiation Protection

- De facto standard for RF safety
- Endorsed by World Health Organization (WHO) and numerous other international health bodies
- Thousands of Research Studies (since 1950s)
- Intense periods of research: 1970s (Microwave Oven), 1990s (Mobiles)

Radio Frequency Fields in Our Environment

- Cellular communications

The diagram shows a cellular communication tower on the right with yellow curved arrows representing radio waves emanating from it. On the left, a mobile phone is shown with yellow curved arrows pointing towards it. In the center, a person is standing next to a small building, with yellow curved arrows pointing towards them. The background is a light blue sky with a white cloud.

Guidelines for Safe Exposure

- Basic restrictions – Protect against known health effect (Heating)
- Two Tiers
 - Occupational, Safety factor of 10, RF trained
 - General public, Safety factor of 50

Category	SAR (W/kg) Limit
Excessive Heating	4.0
Occupational Limit	0.4
General Public Limit	0.08

Content

- Background
- Safety guidelines and application (BTS focus)
 - ICNIRP Guidelines
 - Typical exclusion zones
 - Controls to avoid overexposure
- EMF measurements
- Conclusion

Guidelines for Safe Exposure

- At mobile frequencies:
 - Basic restrictions (W/kg)
 - Not easily measured in field

The images show a person's face on the left, a laboratory setup with a computer monitor and a person in the center, and a yellow mannequin head on the right. The laboratory setup includes a person sitting at a desk with a computer monitor, and another person standing next to a piece of equipment.

Guidelines for Safe Exposure

- **At mobile frequencies:**
 - Thus “reference levels” (V/m or W/m²) derived from basic restrictions
 - Measurements in terms of the “reference levels”


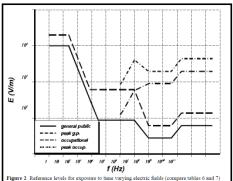


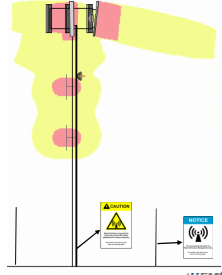




Figure 2 Reference levels for exposure to time-varying electric fields (compared with 1 volt/m)



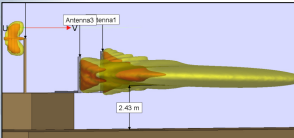


Controls to avoid overexposure

- **Zones known => Administrative controls**
 - Access control
 - RF warning signage


Typical exclusion zones

- **Determine location and size of EMF Exclusion zones**
 - Numerical (Computer) simulation

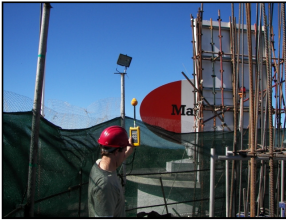

Content

- **Background**
- **Safety guidelines and application (BTS focus)**
- **EMF measurements**
 - Why EMF measurements?
 - Equipment
 - Methodology
 - Reporting
 - African results
- **Conclusion**




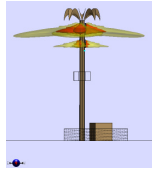

Typical exclusion zones

- **Determine location and size of EMF Exclusion zones**
 - Measurements



Why EMF Measurements?

- **Measure at publicly accessible areas around cellular base stations**
 - Public concern
- **Cellular exclusion zone determination**
 - Measurements normally not required or used to determine compliance boundary



Why EMF Measurements?

- **Example site: Photographs**

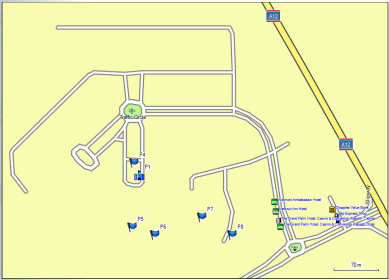

Why EMF Measurements?

- **Determine compliance boundary**
- **Radar, TV, etc installations**
- **Not covered in this talk**


Why EMF Measurements?

- **Example site: Map**

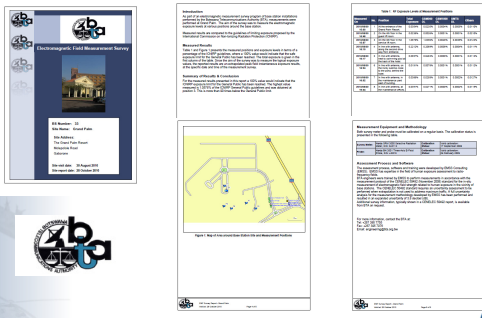
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Why EMF Measurements?

- **Example site: Report**





Site No.	Frequency	Power	Intensity	Time	Area
1	900	100	100	100	100
2	900	100	100	100	100
3	900	100	100	100	100
4	900	100	100	100	100
5	900	100	100	100	100
6	900	100	100	100	100
7	900	100	100	100	100
8	900	100	100	100	100
9	900	100	100	100	100
10	900	100	100	100	100
11	900	100	100	100	100
12	900	100	100	100	100
13	900	100	100	100	100
14	900	100	100	100	100
15	900	100	100	100	100
16	900	100	100	100	100
17	900	100	100	100	100
18	900	100	100	100	100
19	900	100	100	100	100
20	900	100	100	100	100
21	900	100	100	100	100
22	900	100	100	100	100
23	900	100	100	100	100
24	900	100	100	100	100
25	900	100	100	100	100
26	900	100	100	100	100
27	900	100	100	100	100
28	900	100	100	100	100
29	900	100	100	100	100
30	900	100	100	100	100
31	900	100	100	100	100
32	900	100	100	100	100
33	900	100	100	100	100
34	900	100	100	100	100
35	900	100	100	100	100
36	900	100	100	100	100
37	900	100	100	100	100
38	900	100	100	100	100
39	900	100	100	100	100
40	900	100	100	100	100
41	900	100	100	100	100
42	900	100	100	100	100
43	900	100	100	100	100
44	900	100	100	100	100
45	900	100	100	100	100
46	900	100	100	100	100
47	900	100	100	100	100
48	900	100	100	100	100
49	900	100	100	100	100
50	900	100	100	100	100



Measurement Equipment

- **Use spectrum analyser with isotropic antenna**
 - Frequency selective – differentiate sources
 - Isotropic – receives signals from all directions

Measurement Equipment

- Mostly use 27 MHz to 3GHz probe

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Measurement Equipment

- Want to allocate service or operators to spectrum parts

Measurement Methodology

- **Choosing measurement positions**
 - Publicly accessible positions
 - Points of local maximum exposure
 - Points of specific interest
 - Typically 6-10 points per site

Measurement Equipment

- **BTA Spectrum allocation used**

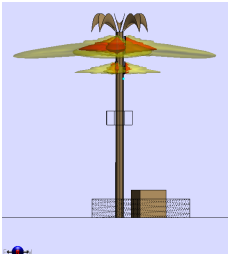
Lower Frequency	Upper Frequency	Name
27 MHz	58MHz	Below FM
88 MHz	108 MHz	FM Radio
108 MHz	117.975 MHz	Aeronautical Radionavigation
117.975 MHz	135.00 MHz	Aeronautical Mobile (B)
138.00 MHz	143.7 MHz	Alarms
146.00 MHz	174.00 MHz	Land Mobile
380.00 MHz	395.00 MHz	TETRA
410.4 MHz	424.2 MHz	Public Trucking
880 MHz	915 MHz	GSM900A
915.2 MHz	943.2 MHz	GSM900D_Mascom
943.2 MHz	951.4 MHz	GSM900D_Orange
951.4 MHz	955.6 MHz	GSM900D_BTC
1.71 GHz	1.785 GHz	DCS1800_U
1.8052 GHz	1.8154 GHz	DCS1800D_Mascom
1.8154 GHz	1.8258 GHz	DCS1800D_Orange
1.8258 GHz	1.8298 GHz	DCS1800_DL BTC
1.920 GHz	1.980 GHz	UMTS_U
2.120 GHz	2.14 GHz	UMTS_DL_Orange
2.14 GHz	2.155 GHz	UMTS_DL BTC
2.155 GHz	2.17 GHz	UMTS_DL Mascom
2.995MHz	3.000MHz	3GHz Band


Measurement Methodology

- **Sectorized site example**

Measurement Methodology

- **Choosing measurement positions**
 - Publicly accessible positions
 - Normally well outside exclusion zones





Measurement Methodology

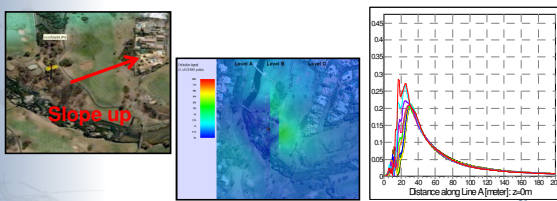
- **Example positions**






Measurement Methodology


- **Choosing measurement positions**
 - Points of local maximum exposure
 - In sector lines, where mainlobe hits the ground






Measurement Methodology

- **Example positions**





Measurement Methodology


- **Example positions**






Measurement Methodology



- **Example positions**





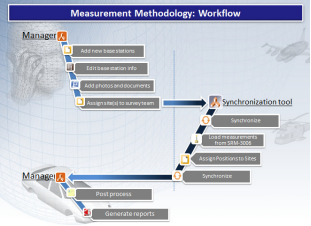


Measurement Methodology

- Example positions

Reporting

- Procedure automated in software (Ixus)
 - Improve accuracy & efficiency
 - Data stored on central database






Measurement Methodology

- Follow IEC 62232
 - “Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure”
 - International guideline
 - Details of techniques to determine human exposure from base stations




Reporting

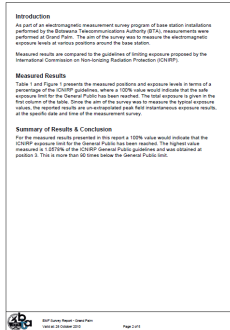



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Reporting




Reporting


Assessment No.	Position	Local Exposure (V/m)	CEM100 (µW/cm²)	CEM100 (µW/cm²)	CEM100 (µW/cm²)	Others
20100001	1	0.0000	0.0000	0.0000	0.0000	0.0000
20100002	2	0.0000	0.0000	0.0000	0.0000	0.0000
20100003	3	0.0000	0.0000	0.0000	0.0000	0.0000
20100004	4	0.0000	0.0000	0.0000	0.0000	0.0000
20100005	5	0.0000	0.0000	0.0000	0.0000	0.0000
20100006	6	0.0000	0.0000	0.0000	0.0000	0.0000
20100007	7	0.0000	0.0000	0.0000	0.0000	0.0000
20100008	8	0.0000	0.0000	0.0000	0.0000	0.0000
20100009	9	0.0000	0.0000	0.0000	0.0000	0.0000
20100010	10	0.0000	0.0000	0.0000	0.0000	0.0000

RF Exposure Levels (Table 1)
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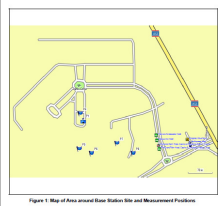



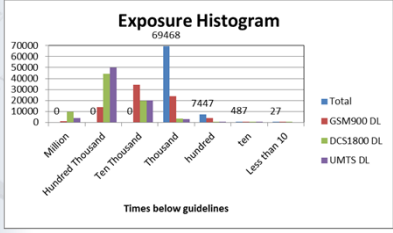
Figure 1: Map of Area around Base Station Site and Measurement Positions

RF Exposure Levels (Table 1)
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African results

- More than 77 000 measurements



Exposure Histogram

69468


70000
60000
50000
40000
30000
20000
10000
0

Million
Hundred Thousand
Ten Thousand
Thousand
Hundred
Ten
Less than 10

Times below guidelines

■ Total
■ GSM900 DL
■ DCS1800 DL
■ UMTS DL

7447
487
27



Reporting

Measurement Equipment and Methodology
Both surveying and probe must be calibrated on a regular basis. The calibration status is presented in the following table:


Survey Meter	Model	Serial No.	Calibration	Calibration Date
EMF550	EMF550	12345678	Calibrated	15 November 2011
Probe	EMF550	87654321	Calibrated	15 November 2011

Assessment Process and Software
The assessment process, software and reporting were developed by EMSS Consulting (EMSS). EMSS has expertise in the field of human exposure assessment to radio-frequency fields.

RF engineers were trained by EMSS to perform measurements in accordance with the assessment protocol using the EMSS EMF550 equipment. EMSS provides the on-site or base station. The EMSS EMF550 standard requires an uncertainty assessment to be performed at all measurement points. The EMSS EMF550 standard requires an uncertainty assessment to be performed at all measurement points. The EMSS EMF550 standard requires an uncertainty assessment to be performed at all measurement points. The EMSS EMF550 standard requires an uncertainty assessment to be performed at all measurement points.


For more information, contact the BTA at:
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Fax: +27 105 150 1515
Email: engineers@emss.org.za

RF Exposure Levels (Table 1)
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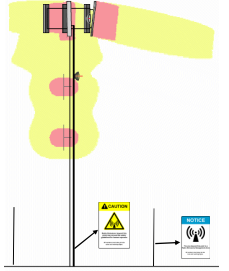
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Safety guidelines

- ICNIRP guidelines
- Identify exclusion zones
- Implement controls



THANK YOU



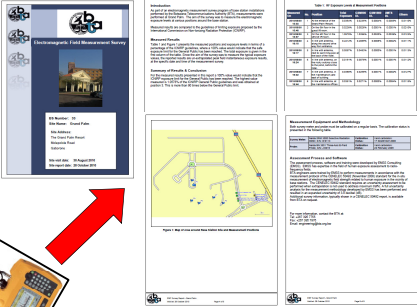
mvanwyk@emss.co.za


Further reading:
www.who.int/emf
www.emfexplained.info
www.itu.int





Measurements



Measurement Demonstration

- **Demonstration later today**
 - Spectrum measurement
 - GSM power control
 - Tabled results - Safety table



